ASSESSMENT OF DAIRY CATTLE PRODUCTION PRACTICES, TRADITIONAL MILK PROCESSING, CONSUMPTION AND MARKETING IN MIRAB BADEWACHO DISTRICT OF HADIYYA ZONE, SOUTHERN ETHIOPIA.

MSC THESIS

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Assessment of Dairy Cattle Production Practices, Traditional Milk Processing, Consumption and Marketing in Mirab Badewacho District of Hadiyya Zone, Southern Ethiopia.

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DEDICATION

I dedicate this thesis manuscript to my beloved wife Asnakech Fante and my staff members who inspired and encouraged me in all aspects during my research work.

STATEMENT OF THE AUTHOR

I declare that this thesis is my bona fide work and all sources of materials used for this thesis have been duly acknowledged. I cheerfully declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma or certificate.

Name:…….. ……Signature:…….……

Place: College of Agriculture, Hawassa University

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Table of Contents Pages

LISTS OF TABLES

LIST OF FIGURE

LIST OF TABLES IN THE APPENDIX

LIST OF FIGURE IN THE APPENDIX

LIST OFABBREVIATIONS AND ACRONYMS

AIBP	Agro Industrial by Products
ANOVA	Analysis of Variance
ARD	Agriculture and Rural Development
ATVET	Agricultural Technical Vocational Educational and Training
AFC	Age at First Calving
CACC	Climate and Clean Air Coalition
CI	Calving Interval
CSA	Central Statistic Authority
DA	Development Agent
DO	Days Open
DPL	Dry Period Length
EARO	Ethiopian Agricultural Research Organization
EDDP	Ethiopia Dairy Development Project
EPTD	Environment and Production Technology Division
ESAP	Ethiopian Society of Animal Production
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
Ha	Hectare
HF	Holeistein Friesian
HHs	Households
IGAD	Intergovernmental Authority on Development
ILDP	Integrated Livestock Development Project
ILRI	International Livestock Research Institute

IPMS	Improving Productivity and Market Success
LAB	Lactic Acid Bacteria
LL	Lactation Length
LSIPT	Livestock sector investment and policy toolkit
Masl	Meter above sea level
MBARDO	Mirab Badewacho Agriculture and Rural Development Organization
MOA	Ministry of Agriculture
NGO	Non-Governmental Organizations
RMA	Rapid Marketing Appraisal
SE	Standard Error
SNNRS	Southern Nations and Nationalities People Region
SPSS	Statistical Package for Social Sciences
TLU	Tropical Livestock Unit

Assessment of Dairy Cattle Production Practices, Traditional Milk Processing, Consumption and Marketing in Mirab Badewacho District of Hadiyya Zone, Southern Ethiopia.

By

Addise Desta

Advisor: Sintayehu Yigrem (PhD), Co-advisor: Mohammed Beyan (PhD)

ABSTRACT

A study was conducted in Mirab Badewacho District of Hadiyya Zone, to assess the dairy cattle production practices, traditional milk processing, consumption and marketing systems in the area. This study was conducted from May2019 up to June, 2020. Five kebeles were selected from the district, two from highland and three from mid-altitude. A total of 138 dairy producers were randomly selected using multi-stage sampling techniques. Formal survey was conducted using structured questionnaire to collect both quantitative and qualitative data on data sets that explore dairy cattle production practices, traditional milk processing, consumption and marketing systems. The major milk production system practiced in the study area was crop livestock mixed production system. The effect of agro-ecology and genotype of dairy cows were used to evaluate milk production and reproductive performances variations. In the study district, an appreciable number of crossbred cows notably Jersey crosses (40.6%), still with (51.4%) local and (8%) HF crossbred cows were raised by dairy cattle milk producers. The cattle herd size of households was within the range 1-4 heads. *In farm households who keep mainly local cattle breeds, lactating cows (0.75±0.036) and oxen (0.95±0.055) mainly dominate the herd composition while in case of cross breed (0.57±0.093) and (0.37±0.029) lactating cow and heifer were dominant, respectively. The composition of livestock was higher in midland than highland agro ecology which accounts 4.95TLU compared to 4.66 TLU. The overall mean milk yield obtained were (1.90±0.08) and (5.16±0.12) litres from local and Jersey cross cattle breed, respectively. The average milk off-take of 1.71 and 4.64litres, from local and Jersey cross breed, respectively. The overall average lactation length was 8.71±0.18 months for local cows, while it was 9.7±0.13 months for Jersey crossbreed cows. Overall mean for CI was 19.02±0.24 months for local cows and 15.97±0.17 months for Jersey crossbreed cows. Mean AFC for a local cow was4.57±0.07 years, while Jersey crosses breed cows had 2.98±0.05years. The typical dairy products in the study area were "Hadaro" in local name (culturally made from first two up to three week milked and fermented milk after calving) and "Shiffa" in local name (made culturally from partially churning sour milk. An informal dairy marketing system was the only marketing system in the study district. In general, the market share of whole milk/fermented milk was almost negligible in rural areas of the district, while butter and cheese was comparatively the most marketable commodity in the study area. Lack of improved forage, low milk yield of local cows, and high price of concentrate feed were mentioned by farmers as major constraints of milk production. In general, this study showed that despite the available cattle population and conducive agro-climate for dairy development, the performance of milk production in the study district was low and milk marketing system was undeveloped due to many constraints such as marketing channel, transport access, poor quality of milk and institutional related constraints. Therefore, dairy cattle milk production can be improved by solving constraints such as low milk yield of local cattle's, feed shortage, health care, general husbandry and milk processing facilities, AI and extension services and developing efficient marketing systems.*

Keywords: Agro-ecology, Consumption, Marketing, Milk production and processing

1. INTRODUCTION

Ethiopia is known for its huge cattle population which is estimated to be about 65.35million (CSA, 2020).Out of the total cattle population, the female cattle constitute about 55.90 percent and the remaining 44.10 percent are male cattle. On the other hand, the results obtained indicated that 97.76percent of the total cattle in the country are indigenous breeds. The remaining are hybrid and exotic breeds that accounted for about 1.91 percent and 0.32 percent, respectively. (CSA, 2019).

The direct contribution of livestock to GDP is estimated by LSIPT at ETB 150.7 billion per year, which amounts to 19% of GDP and 39% of the agricultural GDP. This rises to about 21% of the national GDP and 49% of the agricultural GDP, if the contribution of processing and marketing (35.6 billion) is taken into account. If the indirect contribution in organic fertilizer and traction (37.8 billion) is taken into account, the contribution of livestock to the GDP will rise to 25.3% (ILRI, 2017). The value of the animal draught power input into arable production is about a quarter (26.4%) of the value of annual crop production, and if the value of draught power services is included, the sector contributes up to 45% of agricultural GDP (Azage *et al.,* 2013).

Cattle have the largest contribution to the total national annual milk output (81.2%), followed by goats (7.9%), camels (6.3%) and sheep (4.6%) in Ethiopia (CSA, 2009). This is more else similar in most highland of the country.

Despite its potential for dairy development, productivity of indigenous livestock genetic resources in general is low, and the direct contribution it makes to the national economy is limited. A recent report by CSA, (2019) indicated that the total production of cow milk is about 3.89 billion litres, and this translates to an average daily milk production/cow of 1.48litres/day.

The national per capita consumption of milk and milk products is estimated at 17 kg (Mebrate *et al.,* 2019).

Dairy products are manufactured and consumed in many parts of the country. Fresh whole milk, butter, Arrera in local name (butter milk), whole sour milk (Ergo in local name), and Ayib in local name (a traditional cottage cheese) are the major dairy products produced and consumed in many parts of Ethiopia (Kassa *et al.,* 2016). Many of these products are produced using artisanal technologies at on-farm level and the types and processing steps of these dairy products can vary considerably from one area to the other. The milk products in Ethiopia are channelled to consumers through both formal and informal milk marketing systems. The informal market involves direct delivery of fresh milk by producers to consumers in the immediate neighbourhood and sale to itinerant traders or individuals in nearby towns (Mohamed *et al.,* 2004).

Dairy production is constrained by multifaceted factors, though the nature and magnitude of the problems vary between production systems and agro-ecologies. Some are cross-cutting that can have influence on dairy production regardless of dairy production system and agro-ecologies; others are system specific (Azage *et al,* 2013). In many countries there exist several traditional milk products whose processing techniques and technologies are handled down from generation to generation through demonstration and experience. However, most of these products have a comparatively short shelf life and loss of valuable milk nutrients often occurs particularly during periods of high milk production (Halloway *et al.,* 2000).

Milk production is an integral part of the farming system in Hadiyya Zone. The area has potential for production of milk and milk products. Mirab Badewacho is one of district of Hadiyya Zone which have milk production potential and its indicators of potential includes large

number of dairy cattle especially Jersey cross breed is widely owned by most dairy cattle milk producers, proximity to market centre and availability of veterinary services and processing of milk into products like traditional cottage cheese and butter which are practiced in many of the farming communities in this area. Milk production and marketing is very important source of food, income and creates job opportunity for many people in the study area. However, information on the current cattle husbandry practices, milk production, handling, processing and marketing system is lacking in the district. Such information is critically important for designing appropriate dairy development strategies, market orientations and providing base line information for further research and development. Thus, this research attempted to address issues identified as gaps such as untouched factors that limit and affect milk production practices, processing, consumption and marketing systems and to identify the major constraints and opportunities of dairy production in the study area.

The specific objectives of this study, therefore, were:-

- To assess dairy cattle milk management practices unique to the area.
- To assess traditional processing and consumption of dairy products.
- To assess milk and milk products marketing system.
- To identify the major constraints and opportunities of dairy cattle milk production practices in the study area

2. LITERATURE REVIEW

2.1. Overview of Dairy Production in Ethiopia

Dairy production is an important component of livestock production in Ethiopia. It is an important source of food, income and creates job opportunity for many people in urban and rural settings. However, despite its huge number, the performance of subsector in general is low compared to its potential, and the direct contribution it makes to the national economy is limited (Sintayehu *et al.,* 2008).

Despite its potential for dairy development, productivity of indigenous livestock genetic resources in general is low, and the direct contribution it makes to the national economy is limited. A recent report by CSA, (2019) indicated that the total production of cow milk is about 3.89 billion litres, and this translates to an average daily milk production/cow of 1.48litres/day. The national per capita consumption of milk and milk products is estimated at 17 kg (Mebrate *et al., 2019).*

According to the report of the Central Statistical Agency (CSA, 2019) indicated that 97.76 percent of the total cattle in the country are indigenous breeds. The remaining are hybrid and exotic breeds that accounted for about 1.91 percent and 0.32 percent, respectively. Despite its large livestock resource base and an ecological setting suitable for dairy production, it is not yet self sufficient in milk production. Despite its potential for dairy development, productivity of indigenous livestock genetic resources in general is low, and the direct contribution it makes to the national economy is limited. A recent report by CSA, (2020) indicated that the total production of cow milk is about 3.89 billion litres, and this translates to an average daily milk production/cow of 1.48litres/day. The national per capita consumption of milk and milk products is estimated at 17 kg (Mebrate *et al.,* 2019).

The indigenous zebu breeds produces about 400-680 kg of milk/cow per lactation period compared to grade animals that have the potential to produce 1,120-2,500 litres over 279-days of lactation (Mohamed *et al.,* 2004). On the other hand, the estimated daily milk yield and lactation length for local zebu cows, respectively, reported include: 1.0 kg/day/cow and 285 lactation days for Arsi zebu breed (Lemma *et al.,* 2005), 2.1 kg/day/cow and 264 lactation days for Sheko breed in Bench Maji zone (Stein et al., 2006), 2.2 kg/day/cow and 249 days for Boran breed in Borana Zone (Adugna and Aster, 2007) and 1.2 kg/day/cow and 219 days for local zebu breed at Meiso district (Kedija, 2007).

2.2. Milk Production Systems in Ethiopia

2.2.1. Rural milk production system

The traditional smallholder system represents the rural milk production system and accounts for about 97 percent of the total national milk production and 75 percent of the commercialized milk. This sector is largely dependent on the indigenous zebu breeds of low productivity, which produce about 400–680liters of milk/cow per lactation period (Zelalem *et al.,* 2011). Rural dairy system is part of the subsistence farming system that contribute up to 98% of the total milk production in Ethiopia, and includes pastoralists, agro-pastoralists, and mixed crop–livestock producers (O'Lakes, 2010).

Milking cows in the traditional sector have an average lactation length of 190 days and an average milk yield of 1.9 litres/day. Although this sector is mostly based on local breeds of low-producing native cattle, some progressive small-scale farmers in the various milk sheds are now maintaining cross-bred cows that are competent of producing 800 to 1200 litres of

milk/cow/lactation and sell milk to co-operative societies and commercial milk collectors (Getenet, 2009).

The average lactation milk yield (LMY) of Begait breed cows was found to be 605.85 ± 20.793 litres. This result is significantly higher than the LMY of local cows (457. 887 ± 86.4 liters) under farmers' level management in and around Mekelle city (Niraj *et al.,* 2014). The LMY of Begait breed cows in the present study are lower than the LMY of Boran breed cows (947±42.3 liters) and 1201 ±37.9 litres in Horro breeds in Ethiopia (18) and 645 litres in Begait breed (Rege *et al.,* 2006). Studies showed that, variation in LMY is mainly due to differences in genetic group, herd size, season of calving and parity (Niraj *et al.,* 2014).

The average cattle herd size is 5.34/household, which is larger than cattle herd sizes in both urban and peri-urban areas. Out of this herd size, 1.87 consists of local cows and the rest 5 represent other categories of cattle such as oxen, heifers, bulls and calves. Very few crossbred cows are kept in the rural dairy system. The rural dairy system focuses on butter production rather than fluid milk. Animals are kept in open kraals during the night and left on open grazing fields (Girma, 2008).

Natural pasture, crop residues, stubble grazing were listed as major feed resources, with minimal role of improved forage and local beverage by-products (Diqi or atela with local name) (Kassahun *et al*., 2015). Green grass and concentrates such as Nug-cake and wheat bran are provided as supplements to lactating cows, fattening animals, ploughing oxen and to donkeys when they are at work. Breeding takes place through natural mating using local bulls. About 6% fresh milk is sold to neighbour hoods and the remaining 94% is either home consumed or processed into butter, local cheese (ayib) and whey of which 20% is sold (Girma, 2008). This

indicates that fresh milk and butter sales contribution under rural dairy is not a priority; however, their nutritional contribution to households could be of considerable importance.

2.2.2. Peri-urban milk production system

This production system is now expanding in the highlands among mixed crop–livestock farmers, such as those found in Selale and Holeta, and serves as the major milk supplier to the urban market. This system is located around major cities and towns. It comprises of small sized to medium dairy farms which are also capable of keeping improved and local dairy stock. Cattle are housed in improved shelters made of locally available materials. The type of housing and facilities in the barn in urban and peri-urban dairy farms are, such that it prevents animals from hot conditions, theft and rain (Bekele *et al.,* 2015). The farmers have small size of grazing land; they use semi-grazing systems and also practice under stall feeding conditions for improved animals (Yitaye *et al.,* 2009).

The peri-urban dairy is characterized as a semi-intensive crop–livestock farming system. Farmers keep crossbred cows indoors with supplementary concentrate feeding. All farmers own farming land and hence the roughage such as crop residues are domestically produced. As compared to the rural dairy system, peri-urban dairy systems are mostly located along roads within reasonable distance to urban centres and involved in fluid milk market (Nigatu *et al*., 2012).

All small-holder in the urban areas and the mixed small scale dairy production systems are labour oriented, where milking is done by hand, and often done twice a day. Production on most smallholder farms relies heavily on family labour. The milk production levels also vary between different dairy breeds (Zewdu, 2004; Adebabay, 2009).

2.2.3. Urban milk production system

Urban dairy production system is market oriented like most urban dairying of Ethiopia and other East African countries, is characterized by market orientation. The types of feed commonly used in this production system include purchased concentrates and roughages of conventional and non-conventional sources locally called attela (traditionally brewed by product). In addition to these, a different fruit, wastes and road side grazing was also used (Asrat *et al.,* 2016).

As farmers have limited access to farming or grazing land, they are often based exclusively on livestock under stall feeding conditions (Yitaye *et al.,* 2009).The main feed resources are agro-industrial by-products and purchased roughage. The primary objective of milk production is generating additional cash income (Belete *et al.,* 2010). This production system serves as the main milk supplier to the urban market (Ahmed *et al.,* 2004; Yitaye *et al.,* 2009). Milk is either sold to dairy cooperatives, on the local informal market or directly to consumers from the farmer's gates (Azage *et al.,* 2007).

2.3. Productivity of Dairy Cattle

Performance of dairy animal is judged from the milk it produces during a specified period of lactation. Variations were observed in lactation milk yield from lactation to lactation in the same animal. The main reason of variation attributed to the physiology of lactation is the given set of genes and their reaction with non-genetic factors. The lactation performance of dairy cattle is usually measured by determining total milk yield per lactation or per year, average daily milk yield, lactation length (Zewdu *et al.,* 2013). The livestock subsector in Ethiopia is less productive in general, and compared to its potential, the direct contribution to the national economy is limited. The poor genetic potential for productive traits, in combination with the

substandard feeding, health care and management practices to which animals are exposed are the main contributors to the low productivity (Zegeye, 2003).

Most of the interviewed small scale dairy producers in the study area produce on average 10.5 and 2.6 litres of milk/ day/ cow from cross breed and local cow respectively (Girma and Verschuur, 2014).Productivity of the dairy herd is low with average milk yield of 1.3liters – 1.54liters/day for an average lactation period of 180-210 days. Cross-bred cattle have a higher level of production estimated at an average of 10 litre/head/day (EDDP) (Dairy Value Chains, 2010). According to Girma and Verschuur (2014) findings revealed that average lactation length of cross breed and local cows in the study area to be 240 and 255 days respectively. Because of this fact some of dairy farmers reported that they have milked their cow even during the whole pregnancy period.

On average, crossbreed cows produces 8 litres per day per cow and the indigenous one produces 2 litres per day per cow (Zewdu, 2004; Adebabay, 2009). Another study conducted in North Showa zone indicated that 50% crossbreeds produced more amount of milk (1511.5liters) than local breeds (457.89liters) per lactation (Belay *et al.,* 2012). Mulugeta and Belayneh (2013) reported that, mean milk production per lactation between Horro and Holstein Friesian was 2333.63 litres. This could be due to complementary effect to the achievable environment. A number of production constraints are seriously affecting smallholder dairy production.

In addition to already highlighted lack of capital to acquire the crossbreeds, many farmers face difficulties in getting full information on the breeds they are going to buy. Other factor hampering milk production include inadequate feed base, high cost of bought-in feeds, shortage of cash to buy concentrate feeds (Zewdu, 2004). Milk yield performance of cows as reported by

farmers varies across the different dairy production systems in the study area, mainly due to differences in breed and management (Azage et al., 2013).

2.4. Traditional Milking and Milk Handling Practices

2.4.1. Traditional milking practice

The majority of rural household milking of cows done twice per day in the morning and evening. The dams suckled by the calves for a few minutes before milking and allowed for sometimes to stay with dam there after (Alganesh, 2002) the cows are milked in the shade grazing field in front of the home stage none of which clean environment for milking (FAO, 2010).

Hand milking is performed by massaging and pulling down on the teats of the cow. Milking animals are kept with the rest of stock in the shade or enclosure during the night. Milking is done in the shade of grain feed in front of the homestead or under a tree, however, as this area is not kept clean except for dung removal milking cows usually become solid with dung urine and other. Good hand milking practice increase milk yield in dairy farm. These are, in the milking environment milking must be carried out in shade or roofed milking place which is clean and dry (Lemma, 2004).

2.4.2. Traditional milk handling practices

Milk and milk products play an important role in human nutrition throughout the world. Milk is also highly perishable and can easily be adulterated whilst the quality of the milk is highly dependent on farm management. Strict and comprehensive dairy regulations are therefore customary and necessary (Banda, 2010), the safety of dairy products with respect to food-borne diseases is a great concern around the world. This is especially true in developing countries

where production of milk and various dairy products take place under rather unsanitary conditions and poor production practices (Zelalem and Faye, 2006). Equipment used for milking, processing and storage determine the quality of milk and milk products. The use of plastic and traditional containers can be a potential source for the contamination of milk by bacteria, because this allows the multiplication of bacteria on milk to contact surfaces during the interval between milking (Abebe *et al.,* 2012).

Type of materials used for milking and methods employed in cleaning practices were common in the study with minor differences. Smoking of milk utensils prior to milking and churning is a common traditional practice in most parts of the country. Some of the plant species used in different parts of the country include *Achynthesaspera, Eucalyptus* globules, *Rutacymbopogon* and *Ocimumhardiense* in Wolaita areas, *Acacianilotica*, Cordial *glarfa*, C. *ovalis* or *Combertummolle* in the pastoral areas of Borena *Deinbollokilimandshorica*, *Syzygiumguinecnse*, *Herniareticulala* and *Oliaafricana* in Eastern Wollega; and, J. *procera* and *Ocimumhardiense* in East Shoa (Sintayehu et al., 2008).

2.5. Traditional Milk Processing

Small holder dairy producer are follow traditional milk processing systems. Different studies from Bahir Dar Zuria and Mecha study area show that they prefer processed milk products to raw milk because processed products diversify their diets and generate income, while in Jimma study areas result revealed that, majority (72%) of the milk is processed during fasting periods and extend shelf-life of milk by converting to milk products. So based on the study 46.3% of the respondents' process milk to dairy products. Dawa-Chefa study area also showed a trend similar to Jimma and Bahir Dar, Mecha study areas (Eyassu and Asaminew, 2014; Kefyalew *et al.,* 2016).

Milk processing thus refers to the act of traditionally converting milk into milk products at home or by catering service providers to derive other milk products. Accordingly, milk is processed into regularly consumed products such as plain hot milk, a mix of coffee and milk, fermented whole milk, butter, traditional ghee, buttermilk and cottage cheese.

Dairy farmers and catering service providers are the main actors who process milk into these milk derivatives. At household levels, milk processing activities are carried out using traditional processing methods and inputs (Reddy and Kanna, 2016).

The traditional milk processing materials and methods used are time consuming, laborious and inefficient in terms of fat recovery (Belay and Janssens, 2014). Small holder producers, however, lack the required technological, organizational as well as institutional capacities. They are less organized and distant from market outlet, lack economies of scale and institutions for risk management and face higher transaction costs. Urban and peri-urban small holder producers are the main suppliers of raw milk to milk processors of different scales. One of the major commercial processors (Sebata Agro Industry) has its own dairy farm but depends on outside sources for 99 percent of its raw milk intake (O'Lakes, 2010).

Milk storage and processing materials were all traditional. Milk processing is based on naturally fermented/sour milk. The sour milk is processed into butter using traditional materials such as plastic container (80%), bottle gourd (12%), clay pot (4%) and electric churner (4%) (Belay and Janssen's, 2014).

2.5.1. Ergo (Sour Milk)

Ergo is an Ethiopian traditional naturally fermented milk product with more or less the same characteristics to yogurt. It is normally smooth and with consistence or uniform appearance and

normally has a white colour if prepared carefully. The naturally fermented milk product with more or less similar with the quality and safety of a fermented product entirely the same characteristics to yogurt. It is normally smooth and thick with consistence or uniform appearance and normally has a white colour if prepared carefully. This fermented product is usually semi-solid state with pleasant odour, aroma and taste. It generally constitutes a sour milk product from which other products may be further produced. Depending on the storage temperature, it can be stored for 15- 20 days and it has been reported that *Lactococcus garvieae* and *Lactococcus* lactic subsp*lactic* were dominant (Esayas *et al.,* 2008). As it is well known, production of ergo is normally carried out by natural fermentation process, as the result different species of microorganisms involved and contribute a lot to basic final characteristics of ergo. The quality and safety of a fermented product entirely depend on the spices and spices composition of LAB that are involved in the fermentation process (Anteneh *et al.,* 2011).

2.5.2. Traditional butter (Locally Kibe)

Traditionally small holder butter making is based on sour milk. Milk for churning is accumulated over several days by adding fresh milk to the milk already accumulated. Since butter is always made from fermented milk there is no tradition of using cream. These traditional selling of butter by women is common in every community of the country. In traditional butter making milk is collected over period of 3-4 days in clay pot or other materials. The churn is then stopped with a plug, pieces of skin or leather or other similar materials stretched over the opening and securely tied. Then after the churn is vigorously agitated or churned in such a way that air is incorporated in the liquid (Berg JCT, Van den, 1990). Although different materials can serve as a churn for butter making, clay pot and bottle gourd are the most commonly used. The brake point that is the point when butter starts to form can be detected by a change in the sound

of the milk up on agitation. After butter granules have coalesced in to large grains, the churn is rotated on its base. This collect the grain in the centre and forms lumps for butter, the butter is then skimmed off. Kneaded in cold water and washed to remove visible residual butter milk (FAO, 2005).

2.5.3. Ghee making

Ghee is made by melting butter on a frying pan on an open fire. Butter is placed in a clay pot and put on an open fire to melt. Heating and stirring continue until foam is formed and a clear liquid is obtained. Along heating the butter, spices are added to impart good aroma and taste to the butter. Then the pot is removed from the fire and allowed to cool. Finally, the liquid fat is filtered through sieve or a clean cloth into a container. Different spices are used during ghee making which varies from household to household (Eyassu and Asaminew, 2014).

2.5.4. Butter milk (Arrera)

Butter milk is a semi liquid product that remains after butter making. Arrera is a local name for butter milk in Ethiopia. It has a thin consistency and basically contains the casein protein of milk. Its test and odour are similar to those of ergo. It is either consumed in that form or cooked to produce cottage cheeses. In contrast to other traditional dairy product Arrera comprises 91.5% moisture, 3.1% protein, 1.4% fat, 3.4% carbohydrate and 0.6% ash. A hundred gram of Arrera gives 95 milligram calcium, 84 milligram phosphorus, 1 milligram iron 0.03 milligram of thiamine, 0.21 milligram riboflavin and 0.10 milligram niacin (Henery, 2006).

2.5.5. Cottage cheese making

According to Tesfaye (2007), the butter milk remaining after the butter has been separated from the whole milk is used to produce a cottage-type cheese (ayib in local name) by heating the buttermilk. Arrera (defatted sour milk), which is a by-product of the butter making process, is the raw material used for cottage cheese making. The Arrera is placed on a clay pot and heated on slow fire at approximately 40^0 C to 50^0 C for about 30 minutes. After cooling, the whey is drained off (Eyassu and Asaminew, 2014).

2.6. Consumption of Dairy Products

Milk and milk products are part of the diet of many Ethiopians. However, the importance of milk in the diet of the people in the country is different according to the farming systems and the socio-cultural setups. In the lowlands, especially where livestock keeping is the main occupation, milk is consumed by all groups of the society. In the highlands, the rural people are sedentary farmers raising both livestock and crops, with their diet consisting mainly of cereals. Moreover, the consumption pattern of milk and milk products produced at home varies depending up on the amount of milk produced per house hold, dairy production system and market access, season of the year and fasting period (particularly for the followers of orthodox Christian). Fresh milk, ergo, whey, Ethiopian cottage cheese (ayib) and traditional butter are the most common milk products produced and consumed by different part of the country (Azage *et al.,* 2013).

Ethiopia has a low level of milk consumption compared to other countries in the region (Kenya = 90 lt/cap; Uganda = 50 lt/cap). Even though Ethiopia has the largest inventory of milk producing animals, (cattle, sheep, goats and camels), per capita consumption of milk is low compared to Kenya and Sudan with fewer livestock. The national per capita consumption of milk and milk products is estimated at 17 kg. Per capita income levels in Ethiopia place it in the

range with Tanzania and Rwanda with annual per capita consumption of milk at less than 20 kg. Average expenditures by households on milk and milk products is only 4% of the total household food budget (Mebrate *et.al.* 2019).

In lowland pastoralist dairy production system herds are large and milk production is low and seasonal. Milk produced in this system is a valuable component in the family diet. Milk surplus is rarely sold, except by households living close to main roads and urban centers where there is demand for fresh and fermented milk and butter. In this system frequency and amount of dairy products traded depend on herd size and distance to the market and women from households with large herds trading more often. (Holden et al., 1992)

2.7. Dairy Marketing System

Marketing includes all activities performed in moving commodities from the producer to the consumer (Woldemichael, 2008). It also includes all the exchange activities of buying and selling; all the physical activities performed to give the commodity increased utility; and all the auxiliary activities such as financing, risk bearing and disseminating information to participants in the marketing process. It involves the transfer of ownership of products through buying, selling, pricing, and renting and physical movement as well as transformation of the commodity into more usable forms through transportation, handling, storage, processing and packaging. Therefore, marketing involves sales, locations, sellers, buyers and transactions (Sintayehu *et al.,* 2008).

2.7.1. Formal versus informal milk marketing systems

Milk marketing is an incentive for farmers to improve production. It stimulates production, raise milk farmers' income and living standards and create employment in rural areas (Asaminew,

2007). Provision of improved and sustainable milk marketing arrangements in villages is therefore important in the aspiration for advancement of the sector. The Ethiopian milk marketing system is not well developed. This can be reflected from the fact that only 5% of milk produced in rural areas is marketed as liquid milk. This has resulted in difficulties of marketing of fresh milk where infrastructure especially transportation facilities are extremely limited and market channels have not been developed. In the absence of an organized rural fresh milk market, marketing in any volume is restricted to the urban and per-urban areas (Getachew, 2003).

2.7.2. Dairy marketing channels and outlets

Marketing outlet is the final market place to deliver the milk product, where it may pass through various channels. A network (combination) of market channels gives rise to the market chain. Marketing survey in Hawassa, Shashemane and Yirgalem depicted that milk producers sold milk through different principal marketing channels (Woldemichael, 2008).

These included:

• Producer-consumer (P-C) channel- involves direct sales to individual consumers accounting for 21%, 4.7% and 23.7% of total milk marketed per day in Hawassa, Shashemane and Yergalem, respectively.

• Producer → Retailer → Consumer: The channel represents average of 43% of milk marketed per day in the milk shed. This channel represents for 16%, 38%and 76.6% of total milk marketed per day in Hawassa, Shashemane and Yergalem, respectively.

• Producer → Semi-whole seller → Retailer →Consumer: This channel was identified to be operational only in Hawassa where milk semi-whole sellers undertake both retailing and whole selling activities.

• Producer → Cooperative →Consumer: This channel was exceptional for Shashemane and Hawassa where milk cooperatives are found and accounts for 0.81% and 10.67% of total milk marketed per day in Hawassa and Shashemane, respectively.

2.8. Dairy Production Constraints

Dairy production is constrained by multifaceted factors, though the nature and magnitude of the problems vary between production systems and agro-ecologies. Some are cross-cutting that can have influence on dairy production regardless of dairy production system and agro-ecologies; others are system specific (Azage *et al.,* 2013).

The primary constraints to increased milk production under all dairy production systems are inadequate feed resources, poor pasture development and the ever-increasing feed prices. Farmers tend to keep cattle at stocking rates that far exceed the carrying capacity of their grazing lands. This has resulted in degraded pastures and eroded soils. In the dominating crop/livestock production system, producers supplement the feeding of their dairy cows with crop residues and farm by-products from their farms. In some cases, during the dry season, these feedstuffs can be the only feeds available to the animals (Getachew and Tadele, 2015). In the same way, dairy producers in the Shashemene–Dilla area, South Ethiopia, prioritized the major problems and constraints as: availability and costs of feeds, limitations of land for sustainable dairy development, problems related to waste disposal (for urban producers), discouraging seasonal marketing systems, shortage of supply of genetically superior dairy animals, poor animal health

services, poor extension services (especially to urban producers), knowledge gap regarding improved dairying and labour problems for urban producers. The extent and significance of the problems and constraints differed between and within the different production systems and/or studied area (Sintayehu *et al.,* 2008).

The major constraints facing dairy farmer was lack of land as reported by 45 % of the respondents. The result from the present study is in agreement with reports in Jimma zone (Belay et al. 2012). Moreover, feed shortage (41%), inefficient artificial insemination (AI) service (11%) and water shortage (0.8%) was the constraint in the area. Unavailability feed probably limit the milk production potential of cows with good milk producing ability more than any other single factor and is the most serious constraint to improve dairying (Derese , 2008)

3. MATERIALS AND METHODS

3.1. Description of the Study Area

This study was conducted in Mirab Badewacho district, which is located in Hadiya Zone, South Nations Nationalities and Peoples Regional States (SNNPRS). It is part of triangle shaoed exclave of the Hadiyya one. Mirab Badewecho district is located at a distance of 352km away from south west of Addis Ababa (capital city of Ethiopia) and about 127km far from SNNP Regional city Hawassa and about 78km far from Zonal town-Hossana. Geographically, the absolute location of the district is between 07°69'00″N to 07°91'91″N latitude and 37°95'00″E to 38°10'00″E longitude (Figure 1). The relative location of the district, it bounded by KambataTambaro Zone on the North and Northeast, Misrak Badawacho on the east, Wolaita Zone on the south and Kacha bira district on the Northwest. There are13 district and 4 city in the Hadiyya Zone and the total population of the Zone is estimated to be 1,611,759 according to 2017 population projection (CSA, 2017). The total population of the district is 106,263 and total households 21,686 projected in same year, of which 98% is rural population, while the remaining 2% is urban. Among the total population male constitutes 52600 (49.5 %) and female constitutes 53,663 (50.5 %). It has totally 21 rural and 1 urban kebeles (small administrative units of the country (CSA, 2017). Agro-ecologically, the District is stratified into two agro ecology of highland and mid-altitude. Totally, there are 22 kebeles within Mirab Badawacho district, of which, the mid land contains 14 kebeles (64%) and the remaining 8 kebeles (36%)lying in the highland (MBARDO, 2015).

The altitude of the district ranges between 1750 and 2550 masl., mean annual rainfall between 800 and 1200 mm, and mean annual temperature of 11 -27^{0}C (MBARDO, 2015).

Agriculture is the main occupation of the people of study area. It is mainly rain-fed, although it is supplemented by small scale irrigation. The major crops grown in most of the area are Teff, Barley, Maize, Wheat, Haricot beans, Enset and Banana. Coffee and Chat are also grown as Cash crops (MBARDO, 2015).

Hadiyya Zone is known by large number of livestock population which is estimated to be about 950,388 cattle, 206,732 Sheep, 218,039 Goats, 171,007 Donkey and 724,972 poultry (CSA, 2020). It is important to indicate livestock population in the study district which is estimated to be about 120,836 cattle, 20,663 Sheep, 12,295 Goats, 16,529 equine and 160,060 poultry (MBARDO, 2020). These are important to decide on number of households in each kebele and in each agro ecology.

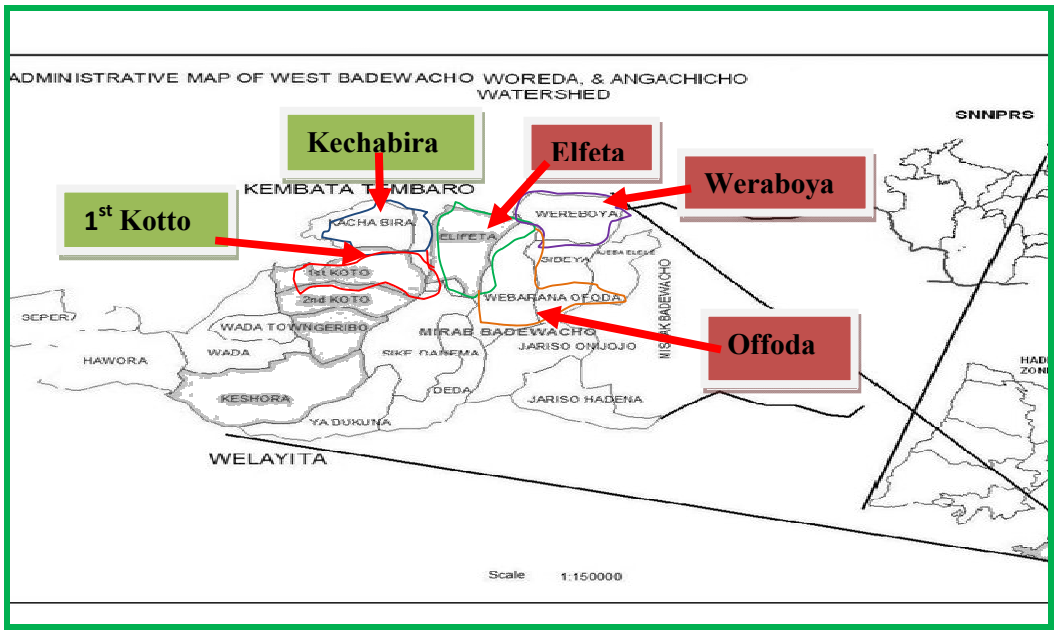

Figure 1: Map of study area

3.2. Sampling Procedure and Sample Size

A multi-stage sampling technique was used to select sample respondents in the study area. In the first stage the study district was purposively selected based on the herd size, breed and long term

practices dairy cattle for milk production. Then the district agro ecology was stratified into ***highland*** which includes 8 kebeles and ***midaltittude*** which includes 14 kebeles. From these 2 and 3 kebeles were selected randomly from highland and midaltitude respectively. Finally, from the selected kebeles, households which possess at least one dairy cow were purposively selected. The target sampling population was defined as all households in the study area who have dairy cattle and produce milk for home consumption or for market.

From the selected households, 138 farmers were selected by stratified random sampling by using the simplified formula provided by Cochran (1977) in order to determine the required sample size at 95% confidence level, degree of variability is 0.05 and with the level of precision of 5% is,

$$\mathrm{n} = \frac{Z^2\,(PQ)}{D^2}$$

Where n is the sample size; Z is 1.96 at 95% confidence level; P is the population proportion i.e. the proportion of dairy producers in the study area that was found to be 90%. While d is the margin of error (acceptable error) which was assumed to be 0.05 and Q is a weighting variable computed as (1-P) by using the above formula, we have

$$\mathrm{n} = \frac{(1.96)^2\,(0.90x0.10)}{(0.05)^2}$$

$$\mathrm{n} = 138$$

The sample sizes were proportionately disaggregated as shown in Table 1 for the five kebeles, based on the proportion of dairy cattle milk producers in each kebeles. The target households of the study area were obtained from office of the district ARD.

Table 1: Proportional sample size from study kebeles

Kebele	Agro ecology	Target HHs	Sample HHs	Total sample
Kechabira	Highland	952	29	
1st Kotto	Highland	910	28	57
Elfeta	Midland	961	29	
Weraboya	Midland	1008	31	81
Offoda	Midland	686	21	

3.3. Data Source and Methods of Data Collection

3.3.1 Survey and data type collected

Both primary and secondary data were used in this study to achieve the intended objectives. For data collection, enumerators were used and given appropriate orientation on how to collect the data from different source with a close supervision of the researcher. Before the actual survey, questionnaires were pre-tested. The primary data were collected from sample respondents through semi-structured questionnaires such as household characteristics, cattle husbandry and management, productive (lactation yield and length and dry period length and reproductive performances (age at first calving, days open and calving interval), major farming systems and milk handling practices. Secondary data were collected from district office of agriculture and previous research findings (livestock population data, human population, agro ecological data like temperature and annual rainfall); office of marketing, reports of Ministry of Agriculture and other government offices and non-governmental organization were used. Relevant information was also gathered from research reports, books, internet sources, government publications, journals etc.

3.3.2. Data collected for dairy products marketing system

Data for marketing parameters including access of transportation to marketing place, dairy products marketed in the area, selling price of milk and milk products in birr per litre/kilogram in different seasons/months of the year, the place where selling and purchasing milk and milk products taking place, volume of purchase and sale, amount of milk delivered to market, mode of payment, factors affect price as well as challenges in buying and selling of the milk products and types of buyers/consumers were collected.

In order to characterize the marketing system of milk and milk products, RMA technique was employed. Before administering RMA, the dairy product actors in the study area were identified and interviewed at farm-gate, and market places of the surveyed areas. Rapid Marketing Appraisal is an iterative and interactive research methodology, which is used to better understand complex market systems in a short time (Young, 1994). It is a process for determining market opportunities and how to capture them through focus on an entire value chain.

3.4. Methods of Data Analysis

All the collected data were properly managed and entered into SPSS (statistical package for social science) software, version 20. The quantitative data were analysed with descriptive statistics (mean and standard error). The independent sample t-test was used to separate the means difference across agro-ecologies at $P \leq 0.05$. The qualitative data were analysed by cross tabulation with Pearson chi-square and the frequencies and percentages differences across agro-ecologies were separated by using the Pearson chi-square value at $P \leq 0.05$. For parameters like household characteristics, cattle husbandry and management, major farming systems and milk

handling practices independent samples t-test at $P \leq 0.05$ was used to compare the means and percentages difference across agro- ecologies by using the following model.

Model 1: the appropriate model used for this study was as follows:

$Yij = \mu + \alpha i + \varepsilon ij$

Where;

Yij = measurement or observation due to i^t factor

μ = the overall mean

αi =the effect of factor i^{th} (agro-ecology)

εij =random error with mean zero (0) and variance σ^2.

For the analysis of productive (lactation yield and length and dry period length and reproductive performances (age at first calving, days open and calving interval), the following mathematical General Linear Model was utilized. The model analyzes the effect of agro-ecology and genotype on performance of cow.

Model 2: $Y_{ijkno}=\mu+Gi+L_j+ (G*L)\ k +e_{ijlo}$

Where,

Y_{ijlo} = the value of o^{th} individual under i^{th} genotype and j^{th} (agro ecology).

μ = the population mean.

G_i = the effect of i^{th} genotype (i=1, 2) 1=Local cattle, 2=Jersey cross cattle

L_j = the effect of j^{th} agro ecology (j=1, 2) 1=Highland, 2=Midland

G*L= the interaction effect of genotype and agro ecology

e_{ijklo} =the random error associated with individual which is randomly and independently distributed with mean zero and variance $\alpha 2$.

3.5. Index Calculation

Index analysis were done for ranking purpose of keeping cattle, consumption of dairy products, ways of increasing milk production, milk production and market constraints of milk and milk products according to the method suggested by Kosgey (2004). The ranking were expressed as an Index = the sum of (4 times first order + 3 times second order +2 times third order + 1 times fourth order) given for an individual variables divided by the sum of (4 times first order + 3 times second order +2 times third order + 1 times fourth order) for all variables.

4. RESULTS AND DISCUSSION

4.1. Demographic Characteristics of Households

4.1.1. Household size and Age group

The family size and age group of respondents in the study area are shown in Table 2. The average age of household was 42.05±0.79 years. The average age of households in each agro ecology was 41.29±1.40 and 42.16±0.96 years in highland and midland agro ecology, respectively. The overall average family size in the study area was 5.46±0.14.Most percentage of family size per households was 3-5 which covers (48.6%) and 6-9 which covers (44.2%) in both agro ecologies in averages. The average family size reported in this study was lower than that of Belay et al. (2012) who stated that the average family size of 6.02±2.52 persons. The average age of households (42 years of age) was lower than that of Belay *et al*., (2012) who stated that the average age of 51.26±10.99 but higher than that of Teshome and Tesfaye, (2017) who reported that the average age of 38.47±1.31 years.

This study indicates that family members in the productive age group were higher than that of the non-productive age groups (dependents) and this in return implies that households have good sources of labour to perform for different farm activities.

4.1.2. Educational level and gender of respondents

The educational level and gender of respondents are showed in Table 2. The survey also revealed that the majority of the households in the study area were headed by males which accounted 79.7% and the remaining proportion (20.3%) of the households was headed by females. Female headed household in this particular study would indicate either the husband has died or they are divorce. From this finding it could be observed that in both agro-ecologies males take greater responsibilities than females. The findings of the present study were similar

with (Mitiku *et. al.,* 2019) which showed that male (92.7%) as they were head of the family. Similarly Kassa and Dekamo, (2016) reported that in southern Ethiopia out of the total interviewed respondents (N=140), 95% were male and the rest (5%) were female household members of different age and educational status.

The overall proportion of illiterate 30.1%, grade 1-8 35.8%, grade 9-12 28.5%and greater than grade 12 was 5.6%. Percent of illiteracy in the current study area was higher than reported values in other studies with 22.5% illiteracy as indicated in the report of Getu *et al.,* (2016) in Amhara region, Ethiopia, 27.78% illiteracy reported in Bench-Maji Zone of Southwest Ethiopia Weldegebriel, (2015) and 10% illiteracy indicated in the report in AletaChukko district of Southern Ethiopia by (Beriso *et al*., 2015).

Education is an important entry point for empowerment of rural communities and an instrument to sustain development. It indicate the perception level of farmers for new technologies in milk production practices such as milk handling activities, milk processing activities, and type of milk utensils used and improving dairying market orientation.

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 obvious in affecting household income, adopting technologies, demography, health, and as a whole the socio-economic status of the family as well (Kerealem, 2005). In this finding, family member at elementary school level of education exceeds the proportion of those at higher educational level (Table 2). This shows the growing of educational coverage which provides better opportunity to implement improved agricultural practices and wise use of scarce agricultural resources in the study area.

Table 2: General demographic characteristics of respondents in the study Area

	Agro-ecology			
	Highland(N=57)	Midland(N=81)	Overall	
Variables	%	%	%	P-value
Sex of HH head				
Male	84.2	76.5	79.7	0.27
Female	15.8	23.5	20.3	
Household size				
Below 2	7.0	0.0	2.9	0.113
3-5	47.4	49.4	48.6	
6-9	42.1	45.7	44.2	
Above 9	3.5	4.9	4.3	
EDU status				
Illiterate	63.1	55	30.1	0.014
Grade 1-8	57	56.3	35.8	0.764
Grade 9-12	42.1	44.15	28.5	0.646
Grade > 12	21.05	28.15	5.6	0.021
	Mean± SE	Mean ±SE	Mean ±SE	
Age of HH head	41.89±1.40	42.16±0.96	42.05±0.79	0.869

HH=Household, EDU=Educational Status, N=Number

4.2. Socio-economic Characteristics of households

4.2.1. Land holdings of households

The land holding per household in the study area are shown in Table 3. The mean value of total land holding per household in highland and midland were 1.2±0.277 and 1.1±0.062ha respectively with the overall mean value of 1.13±0.043ha. It was significantly larger in highland than midland agro ecology ($P<0.05$). This might be due to the agro ecological variation on the

distribution of human population in both agro ecologies of the study area. The land holding in study area was not comparable with the land holding in Borana area as reported by Tollossa *et al*. (2014) who reported that the average means landholding of 2.91ha per household. Out of the total available land used on average 0.71±0.03 and 0.53±0.02ha in highland and midland agro ecologies respectively, was allocated for crop production with the overall mean value of 0.60±0.02ha and it was significantly larger in highland agro ecology ($P<0.05$). This might be due to the expansion of crop land in highland as result of the greater distribution of human population in this area. In the study area some of the farmers practice additional land renting from other farmers to increase the amount of crop land.

The overall 0.18±0.015ha was allocated for livestock grazing. The land allocated for livestock grazing was significantly different ($P<0.05$). In the study areas land allocated for livestock grazing and forage was limited this might be due to the expansion of crop land in this area and the reverse was true for the land allocated for forest tree production and this might be due to that some of the forest trees are used as livestock feed like Delphinium (Tudda in local name) in mixed crop livestock production system. Overall at kebele level in the study area the amount of land used for communal grazing was 0.48±0.17 and 0.36±0.14ha per kebele in highland and midland respectively with the overall mean value of 0.47±0.15ha. This might be due to the expansion of crop agriculture (provided for employee youths from 2013 to 2020) which caused the reduction of land used for livestock grazing from time to time. The present study was contrasted with the result of (Gezu *et al*., 2014) who reported the mean grazing land per household of the respondent shows in Lemo (0.15±0.013ha) and in Soro agro ecology (0.29±0.017, 0.11±0.012 and 0.13±0.021ha in dega woena, dega and kolla, respectively) revealing that little land was given to grazing of livestock.

Table 3: Land holdings per sampled households in the study area

	Agro-ecology			
	Highland (N=57)	Midland (N=81)	Overall (N=138)	
Parameters	Mean±SE	Mean±SE	Mean±SE	P-value
Crop land owned (ha)	0.71±0.03	0.53±0.020	0.60±0.02	0.000
Crop land rented (ha)	0.22±0.009	0.25±0.015	0.24±0.01	0.117
Grazing & forage owned (ha)	0.14±0.013	0.21±0.025	0.18±0.015	0.026
Tree and forest land (ha)	0.16±0.016	0.11±0.010	0.13±0.009	0.007
	1.2±0.277	**1.1±0.062**	**1.13±0.043**	

4.2.2. Feed resources and problem associated with feeding in the study areas

Animal feeds represent the major input in any dairy business. The major sources of feed for cattle in the study area are shown in (Figure 2).The common feed resources in the studied areas varied between agro ecologies. The major available feed resources in the study area included natural pasture, crop residues (barely, teff, wheat and haricot bean straws and maize stover), others (such as Enset (*Ensete ventricosum*) leaf, pseudo stems and root, banana stem and leaf, sugar cane tops, improved forages (Desho grass, Elephant grass, Phalaris, Guatemala and Sesbania species), supplements of industrial by products (wheat bran, noug cake and concentrate mix), and some indigenous fodder trees (Grawa (*Veronia amygdalina*), Korch (*Erythrina brucei*), Wanza (*Cordia Africana*), Avacodo (*Perseaamericana*)), Common Bamboo (*Bambus vulgaris)* and Dagusa Gulban. Almost all of the households practices cut and carry feeding systems in the study area and some indigenous fodder trees were provided for cattle's most of the time during shortage of feeds in dry season. This finding was in line with the report of

(Kassahun *et. al.,* 2015) who reported the major basal feed resources for cattle in the Horro and Guduru district of Oromiya region western Ethiopia.

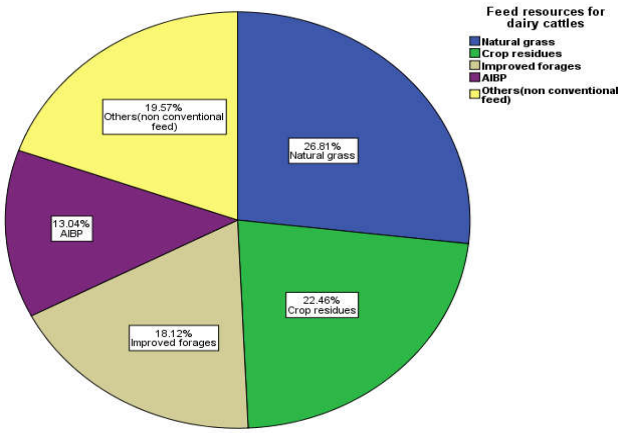

Figure 2: The major sources of feed for cattle in the study area

The major animal feed resource in the study area were natural pasture 26.8%, crop residue 22.5%, improved forage 18.1%, AIBP13.0% and 19.6% non-conventional feed resources (Atella by product of natural alcohol or brewed by product), Sweet potato, Banana and Enset leaf (*Enset ventricosum)*, indigenous fodder trees (Grawa (*Veronia amygdalina*), Korch (*Erythrina brucei*), Wanza (*Cordia Africana*), Avacodo (*Perseaamericana*)), Common Bamboo (*Bambus vulgaris)* and Dagusa Gulban. The feed resources used in both agro ecology was not significantly different ($p>0.05$).These feed resources are generally poor in quality and productivity and supply is seasonal, particularly when there is critical problem during the dry season. The current study agrees with the report of Tolera *et al.,* (2012) who reported that natural pasture and crop residue was the major feed resources for highlands of Ethiopia. The current result was also in line with Gezu *et al.,* (2015) who reported the major feed in Lemo woreda were grazing (36.3%), crop residues (28.2%), conserved feed (19.0%), agro-industrial products (13.3%) and local beverage by product atella and brint (3.1%).

4.2.3. Livestock holding per households in the study area

The type and number of livestock holding is shown Table 4.The livestock species kept in the area including cattle, poultry, small ruminants and equine. Among the animal species, farmers commonly keep cattle, small ruminants and some equine groups. However; some of the farmers also keep poultry and honey bees. The dominant livestock species kept by farmers were cattle (mostly local breeds), followed by small ruminants, particularly sheep and from equine groups donkey is most common.

The cattle herd size of households was within the range 1-4 heads, but it varied significantly ($P<0.05$) among the two agro ecologies. In farm households who keep mainly local cattle breeds, lactating cows 0.75±0.036 and oxen 0.95±0.055TLU mainly dominate the herd composition while in case of Jersey cross breed 0.57±0.093 and 0.37±0.029TLU lactating cow and heifer was dominant, respectively. The mean value of total local cattle breeds holding in study area was 3.22±0.36TLU and 2.97±0.31TLU per household in highland and midland respectively with the overall mean value of 3.05±0.24TLU. The overall mean values of local and crossbred cattle in the study area were 3.05±0.24 and 1.76±0.32TLU per household, respectively. In the current finding the overall mean of local and cross breed cattle is not similar with report of Kassu (2016) who reported the overall mean values of local and crossbred cattle in his findings were 4.14 and 2.96TLU per household, respectively in Bona Zuria district of Sidama Zone, Southern Ethiopia. There was the significant difference between Jersey cross breed lactating cows holding between agro ecology this due to no access of getting cross breeds cattle's in highland agro ecology ($p<0.05$). The current study indicated that the average number of local lactating cows per household 0.57±0.093 observed is lower to the one reported by Asrat et al., (2013) which is 1.1 in and around Boditti, South Ethiopia.

Table 4: Mean total livestock holdings in TLU

	Agro-ecology			
	Highland N=57	Midland N=81	Overall N=138	
Livestock type	Mean±SE	Mean±SE	Mean±SE	P-value
Local Cattle				
Male calves (<1years)	0.137±0.134	0.131±0.103	0.15±0.0079	0.055
Female calves (<1years)	0.168±0.120	0.138±0.104	0.133±0.0083	0.725
Heifers	0.37±0.043	0.35±0.035	0.36±0.027	0.684
Bulls	0.46±0.073	0.40±0.059	0.42±0.042	0.578
Oxen	0.89±0.079	1.00±0.075	0.95±0.055	0.308
Dry cows	0.13±0.053	0.11±0.037	0.11±0.030	0.794
Pregnant cows	0.19±0.051	0.18±0.041	0.18±0.032	0.836
Lactating cows	0.89±0.045	0.66±0.050	0.75±0.036	0.001
Local Cattle total	**3.22±0.36**	**2.97 ±0.31**	**3.05±0.24**	
Crosses with exotic breeds				
Male calves	0.098±0.02	0.14±0.02	0.12±0.016	0.491
Female calves	0.14±0.030	0.16 ±0.01	0.15±0.018	0.154
Heifers	0.35±0.047	0.38±0.038	0.37±0.029	0.525
Bulls	0.036±0.036	0.079±0.045	0.061±0.030	0.489
Oxen/Steer	0.035±0.035	0.067±0.047	0.052±0.029	0.595
Dry cows	0.16±0.069	0.17±0.064	0.17±0.046	0.860
Pregnant cows	0.21±0.082	0.32±0.084	0.27±0.059	0.362
Lactating cows	0.42±0.14	0.67±0.12	0.57±0.093	0.200
Cb Cattle total	**1.44±0.45**	**1.98±0.42**	**1.76±0.32**	

TLU=Total Livestock Unit, Cb=Cross breed

The current study indicated that the average number of cross breed lactating cows and heifers per household 0.57±0.093 and 0.37±0.029 observed respectively were higher than to the one reported by Tariku ,(2020) 0.21±0.47 and 0.015±0.36 in Hadiyya Zone, Southern Ethiopia.

The composition of livestock was higher in midland than highland agro ecology which accounts 4.95TLU compared to 4.66 TLU. The cattle population in study area was significantly larger in midland agro ecology ($P<0.05$) than the highland. This might be due to the agro ecological and seasonal variation on feed availability, water, disease and other factors that influence livestock keeping.

In the current study the number of cross breed heifers and cross breed bulls indicated that the average TLU of cross breed heifers(0.37±0.029) is greater than the average TLU of cross breed bulls (0.061±0.030). This result showed that cross breed heifers are highly preferred over cross breed bulls in the study area.

4.2.3. Breed preference in the study area

In the study area, local cattle were highly preferred over crossbred cattle. The reasons for the preference of local cattle breed by the respondents were that local cattle can be purchased by few capitals and lack of capital to buy improved breeds, need small amount of feed and can resist feed shortage during dry season, easy for management and need minimal care and resistance of disease and parasites. In appendix (Table 2), showed that cross breed blood level<50% and between 50%- 75% were the two major blood groups reported in the study area. In case of cross bred cattle the overall, 40.6% of the respondents preferred to own Jersey cross dairy cattle breed. With this regard, 8% of the respondents residing in both agro ecology of the study area preferred first to have a Holstein Friesian cross dairy cattle breeds. As it is actually true for many other tropical developing countries, the cattle genotypes of Ethiopia have evolved largely because of natural selection for the traits such as adaptability, heat tolerance and tolerance for diseases and seasonal shortage of feed (Debir, 2016).

4.2.4. Farming activity of the respondent households in the study area

Almost all of the respondents (94.9%) of the study area involved mixed crop livestock production system for milk production which is indicated Table 5. The current finding was similar with finding of (Amistu *et al*., 2016) who reported that all of the respondents in the study area undertake mixed farming system for milk production. In similar way, crop-livestock and livestock production systems are common farming systems in Burji woreda of Segen Zuria Zone (Seid and Berhan, 2014). Similarly, 91.1% of respondent households in central Zone of Tigray, northern Ethiopia practiced mixed type of production, 6.7% livestock production and 2.2% crop production (Gebremichael *et al.,* 2015).

The primary sources of livelihood of the farmers in the study area are given in Table 5. The majority of farmers (57.2%) reported crop production as the most important source for their livelihood followed by milk and milk products (20.3%), off-farm activities (12.3)% and live animal sale (10.1%). The current study was no agreed with reported by Kassu (2016) which are 74% sources of income is both crop and livestock production in rural areas of Bona district Sidama zone southern Ethiopia. In the study area the socio economic benefit of dairy production reported to fulfil household necessity (43.5%) followed by all-purpose like to get additional income, for children school fee and to purchase dairy inputs (34.8 %).The socio economic benefit of dairy production in both agro ecology was significantly different this is due to access of crossbreed cattle in midland agro ecology enables the households to use income obtained from selling of dairy products for multipurpose activities ($p<0.05$).

Table 5: The major farming system, income source and socio economic benefits of dairy production.

	Agro-ecology			
	Highland	Midland	Overall	
Parameters	N=(57)	N=(81)	N=(138)	P-value
Major farming system				
Livestock production	7	3.7	5.1	0.382
Mixed	93	96.3	94.5	
Major income source				
Cash crop	64.9	51.9	57.2	0.214
Live animal sale	5.3	13.6	10.1	
Milk & milk products sale	15.8	23.5	20.3	
Off-farm activity	14	11.1	12.3	
SE benefit of dairy prod				
To get additional income	5.3	11.1	8.7	0.018
School fee for children	8.8	6.2	7.2	
To fulfil household necessity	56.1	34.6	43.5	
To purchase dairy inputs	8.8	3.7	5.8	
All	21.1	44.4	34.8	

SE=Socio economic Benefit, N=Number

4.3. Cattle Management Practices

4.3.1. Purposes of keeping cattle

In both agro ecologies, 82.9% of study households ranked milk production as their first rank for keeping cattle (Table 6). In both study agro ecologies, cattle was primarily raised for milk production, asset, traction and manure production were ranked first, second, third and fourth, respectively. This result was agreed with the report of (Weldegebriel, 2015) in Bench-Maji Zone that keeps cattle primarily as source of milk and draft power. The current finding is in lined with Adebabey (2009), who reported that purpose of cattle keeping meets urgent financial need,

dietary requirements, draft power, transport, loan repayment, dowry and gift, fuel, fertilizer, as a buffer in the case of crop failure, and also for social and cultural functions in Bure District, Ethiopia.

Similarly, the primary purpose of cattle rearing in the Aleta Chukko district of Southern Ethiopia was for milk production but in opposite to this, cattle were not reared for the purpose of meat production and traction in Aleta Chukko district (Beriso *et al*., 2015). All farmers from study district (100%) indicated that they distribute manure on the crop land and door step grasses, but this is not to increase the fertility of the soil but it is to dispose the waste. They use manure for the source of fuel and fertilizer. Similarly, Farmers in Fogera woreda of Amhara region traditionally fatten oxen after the completion of tillage (Belete *et al*., 2010). Therefore, cattle in the current study district are produced mainly for milk and milk by-product production, asset, traction, manure production and meat production.

Table 6: Major purpose of keeping cattle

	Agro-ecology				
	High land(N=57)		Mid land(N=81)		
	Index	**Rank**	**Index**	**Rank**	**P-value**
Milk	0.384	1st	0.339	1st	0.072
Asset	0.231	2nd	0.273	2nd	0.734
Traction	0.205	3rd	0.253	3rd	0.146
Manure	0.178	4th	0.133	4th	0.014

* Index = [(4 for rank 1) + (3 for rank 2) + (2 for rank 3) + (1 for rank 4)] divided by sum of all weighted reasons mentioned by respondent.

4.3.2. Cattle housing practices

According to the survey result, about 79% of the households keep their dairy cattle within family house both in agro ecologies are shown in (Table 7). This study was contrasted with result of (Mitiku *et al.* 2019) which reported that 85.37% of the respondents keep their cattle in separate barns from family house and 14.63% keep inside family house. These study was similar with Abebe *et al.* (2012) reported that 90.8% of households share the same house with their animals, while 9.2% of the households used separate houses for the cows in Ezha District of Gurage Zone. This study was also contrasted with result of Kassa and Fiseha, (2016) who reported 49.6% of respondents in Kaffa and Sheka zones dairy cattle owners have no house for their animals and kept their animals open out of their own residence while 50.4% kept their cattle within their own residence compound with open barn/shed in Kaffa and Sheka Zones, Southern Ethiopia. The report from the households in the study area indicates that cattle dung is disposed from house in drainage system, labour and use of family members. In addition, in all cases of the study districts calves and small ruminants were housed together with cattle in the same house. The majority of the respondents were housed their cattle's together with family because of ease for cattle husbandry and management practices such as feeding systems, watering, milking and also protects their cattle from extreme environmental hazards and thieves that agree with report Asrat *et al.,* (2014).

Disposing manure reported from of respondents in the study district overall 68.1% (61.4%) and (72.8%) daily in both high land and midland, respectively. Zelalem (2010) reported similar result for smallholder farms in Central Highland of Ethiopia in which smallholder farmers clean barns on daily basis (87%), once or twice a week (9%) and did not clean at all (4%). Maintaining the sanitary condition of the milking area is an important prerequisite for clean wholesome milk

production, and hence daily removal of manure and cleaning of barn is recommended. The present study is also agreed with report of (Mitiku *et al.,* 2019) most of the respondents (78.05%) reported remove manure daily Haramaya District, Ethiopia.

4.3.3. Cattle waste management

All the interviewed dairy cattle producers in the study area used animal dung primarily as fertilizer. In addition, it is also used as household fuel. Manure from these animals play a very important role for farming of their food crops, particularly for coffee, enset, maize, root crops and fruits found in the garden of the farmer. Enset usually requires a large quantity of organic fertilizer and thus animal dung had special attention than the cereal crops.

Almost all the interviewed dairy cattle producers in the mixed crop–livestock system (91.3%) used animal dung primarily as fertilizer while only few (8.7%) households used as household fuel which was shown in (Table 7). This result was in agreement with the report of (Sintayehu *et al*., 2008), who reported that almost all the interviewed dairy cattle producers in the mixed crop–livestock system (97.4%) used animal dung primarily as fertilizer while only few (2.6%) households used primarily as household fuel. This result was in agreement with the report of Tesfaye (,2007), who reported that 83.2% the produced manure was used as manure fertilizer, while insignificant proportion was used as fuel (1.3%) or other purposes (2.6%). Thus, even among the users, 12% of the produced manure was wasted.

Manure is mainly disposed by distributing it in crop and forage land 52%, and storing in one 39.1%. Some respondents dispose manure by drainage systems 8% and 1.4% store it on backyards or disposed in roadsides (Table 7). Disposal system of dead animals is by simply

throwing it around roadsides and river areas to be eaten by hyena and dogs. However, some farmers disposed by burying.

The waste disposing materials used in the study area reported from the respondents showed that 68.8% of respondents used bamboo tree basket, 14.5% used sack and 16.7% used plastic materials for disposing waste (Table 7). The materials used to dispose cattle waste in both agro ecology was significantly different ($p<0.05$).

4.3.4. Calf rearing practices

The major calf raring systems practiced in the study area were restricted to partial suckling and bucket feeding as shown in (Table 10). Bucket feeding was practiced with households who own crossbred cows only; whereas partial suckling was mainly practiced with households who own local zebu cows. In average 52.2% of respondents do not let calves suckle partially before milking due to of farmers who have crossbreed cows. However, the remaining 47.8% of the respondents allow their calves to suckle partially before and after milking who own local zebu cows. This result was in contrasted with the reports of Asrat *et al.,* (2016) from in and around Wolaita Sodo Town (94.1%), the reports of Asrat *et al.,* (2015) from Humbo Woreda (80%) and Asaminew and Eyasu (2009) in Bahir Dar and Mecha areas (80.7%). Even if local cows not let providing of milk in the death of calf, the respondents used different techniques to get milk. Majority (73.2%) of respondents were provide feed for the cow at the time of milking, and few respondents (15.9%) exercises milking by tying artificial calf (doll) (Bahaa in local name) in front of cow to lick. This was in lined with the report of Adebabay (2009) who reported that about 28.8% of the respondents exercise milking when calves die by using salt and artificial dolls (by stuffing the skin of the calf with a straw and spraying salt over it) and very few (8.7%)

respondents exercises milking by washing udder and some (2.2%) households stop milking. In the current study area, almost all of respondents mix evening and morning milk.

4.3.5. Record keeping practice in the study district

About 87.7 and 82.7% of the high land and midland agro ecologies, respectively, did not have any record keeping systems (Table7). Only 13.3and 18.3% of the high land and midland agro ecologies, respectively, were found recording some reproduction parameters using informal sheets. Record keeping in modern dairying is a precondition for any decisions and manages over certain production and reproduction performance of dairy cattle in the farm and to measure the profit of any market-oriented farms. Despite this principle, record keeping in the area was not practiced as the owners do not have adequate experience and are not aware of the benefits. It is therefore essential to provide formal training on this useful practice to dairy owners in the study areas. The trend of record keeping is almost not familiar in traditional dairy farming systems in many parts of Ethiopia. This is in line with the result of Kiros *et al*., (2018) who reported that in peri-urban Assela, urban Assela, peri-urban Sululta, urban Sululta, urban Holeta, peri-urban Bishoftu and peri-urban Holetta, respectively many dairy owners stated that the reason for not practicing records was lack of awareness. The present study was contrasted with report of Asrat et al., (2016) (42.7%) (Town) and 27.8% (surroundings) of dairy producers were found to maintain breeding/AI and farm/reproduction records respectively, in and around Wolaita Sodo Town. However, 29.4% of dairy producers did not practiced record keeping did not know the importance of record keeping. Current result is in line with the result of Asrat *et al.,* (2013) reported 95% of respondents in and around Boditti town, Wolaita zone were not practiced record keeping. Lack of record keeping may have negative impact on productivity, decision making on progress and also may lead to inbreeding between closely related herds.

4.3.6. Dairy cattle culling practice in the study area

The reasons of culling cattle in the study areas are presented in Table 7. In the study area, respondents reported that most farmers (79%) do not have the experience of culling cattle if they don‘t perform well. In the study area, animals were culled mainly due to very low milk production and butter yield, infertility, low feed intake and frequently death of calves. The present study was agreed with report of (Chali, 2014) who reported that reason for culling include infertility of the cows and as such cows can lead to delay in conception hence such cows/heifers are better to be identified and culled. Farmers cull cows if their calf die frequently (traditional assumption), due to bad behaviours of cows (not docile/aggressive), if they have infertility problems, and weakness for traction power (especially male animals). This result was in agreement with the report of Ayantu *et al*., (2012), who reported that farmers in Horro district have developed culling mechanism for maintaining the desired quality of their animals. Culling is an essential farm practice which enables the respondents to select the best cattle across the herds (Endashaw, 2012). According to farmers in the study area, farmers use different methods to cull unproductive and low milk producing animals from their herd and in most cases they cull through selling and slaughtering. In the current study culling was also practiced after the end of the agriculture season, poor draft ability so is their fertility decreases as the animals' age progresses. This result was similar with reported by (Chali, 2014) who reported that reason for culling include poor draft ability, fertility and the end of the agriculture season for male cattle's.

Table 7: Housing, facilities in the house, culling and record keeping

	Agro-ecology			
	High land	Midland(N=81)	Overall(138)	
Variables	%	%	%	P-value
Ways of housing				
In the same house	84.2	75.3	79	0.206
Separate house	15.8	24.5	21	
No	77.2	80.2	79	0.665
Reasons for culling				
Infertility	21.3	26.2	23.6	0.805
Low milk yield	44.7	47.6	46.1	
Low butter yield	27.7	19	23.6	
Others	6.4	9.1	6.7	
HH keeping records				
No	87.7	82.7	85.5	0.536
Manure disposal system				
Storing in one place	45.6	34.6	39.1	0.072
Drainage system	10.5	6.2	8	
Scattering on CF land	40.4	59.3	51.4	
Others	3.5	0	1.4	
Waste disposing materials				
Bamboo tree basket	73.7	65.4	68.8	0.010
Sack	19.3	11.1	14.5	
Plastic	7	23.5	16.7	
Frequency of disposing manure				
Once per day	61.4	72.8	68.1	0.026
Twice a day	1.8	9.9	6.5	
Four times a week	33.3	14.8	22.5	
Others	3.5	2.5	2.9	
Cattle dung removal				
As fertilizer	93	90.1	91.3	0.0557
As fuel	7	9.9	7.7	

HH=Households, CF= Crop and Forage

4.4. Reproductive Performance of Local and Crossbreed Dairy Cows in the Study Area

4.4.1. Age at first calving

The average age at first calving of local and Jersey crossbred heifers was 4.57years (54.84 months) and 2.98years (35.76 months), respectively(Table 8).The analysis of variance showed that genotype ($P<0.05$) exerted highly significant effect on average age at first calving. The longer age at first calving in the study districts might be due to feed shortage and management status of dairy cows in the areas. The result is agreed with the study conducted in the rural community of Wolaita Zone for local cows has shown that agro ecology had no significant effect on age at first calving (Lijalem and Zereu, 2016). Local cows in the current study area had slightly greater overall mean age at first calving than 4.24 years (50.87 months) reported by Genzebu (2015). However, local heifers in the current study area have shorter AFC than 4.98 years (59.73 months) for Horro heifers in and around Horro-Guduru livestock production and research centre which was reported by (Demissu *et al.,* 2013) and 4.76 years (57.08 months) reported by (Amenu *et al.,* 2017) for local heifers in Gindeberet districts of West Shoa zone of Oromia regional state. In other way, the current finding of AFC for local heifers was comparable with the finding of Kassu (2016) with 53.98 months in Bona district, Sidama zone.

On the other hand, the age at first calving for Jersey crossbreeds found in the current study was slightly similar with 3.05 years reported by Belay and Yisehak (2012) in Jimma town. In the same way, it was longer than 2.46 years (29.52 months) and 2.68 years (32.1 months) reported by Sena *et al.,* (2014) in Debre Tabor town and Yifat *et al.* (2009) in Ziway for cross breed dairy cows respectively. As the result indicated, the time gap between the birth and age at first calving by smallholder farmers is very much longer. The prolonged age at first calving of heifers in

present study area was compared with previous studies in different parts of Ethiopia. The low performance of heifers in the present study area could be due to poor nutrition and management practices including poor heat detection. Housing system used for calves and heifers in the study district is also not according to their space requirement and calves are standing and feeding in the same stall with mature animals. Houses of most farmers construct for their cows are closed and have no ventilation system which predisposes calves to pneumonia and other respiratory diseases. This is another factor to reduce the growth rate of calves and prolonging age at first calving. According to the different studies in Ethiopia, heifers that were better managed and well-fed could grow faster, served earlier and resulted in more economic benefit in terms of sales of pregnant heifers and/or more milk and calves produced during the lifetime of the animal (Yifat *et al.,* 2009). Meaza (2017) also indicated that with good nutrition, heifers would exhibit fast growth and attain higher weights at relatively younger ages.

Table 8: Estimated reproductive performance parameters

		Agro-ecology			
Parameters	Breed type	High land (N=57) (Mean±SE)	Midland (N=81) (Mean±SE)	Overall (N=138)	P-value
AFC (Years)	Local	4.63±0.11	4.52±0.10	4.57±0.07	0.558
	Jersey Cross	2.89±0.08	3.07±0.06	2.98±0.05	0.365
	P -value	0.000	0.000	0.000	
DO (Days)	Local	194.09±5.26	205.45±5.26	198.54±3.58	0.141
	Jersey Cross	161.42±4.17	147.36±3.27	154.39±2.65	0.009
	P -value	0.000	0.000	0.000	
CI (Month)	Local	18.31±0.35	19.73±0.34	19.02±0.24	0.058
	Jersey Cross	16.11±0.27	15.83±0.22	15.97±0.17	0.268
	P -value	0.000	0.000	0.000	

Where, AFC=Age at First Calving, DO=Days Open, CI=Calving Interval

4.4.2. Days open

The overall means±SE of days open reported in the present study for local and Jersey crossbred cows were 198.54±3.58 days (range 110 to 330days) and 154.39±2.65 days (120 to 340) respectively. The overall mean of day‘s open of local cows was longer as compared with day‘s open of crossbreed cows (Table 8), and the difference of the means of two genetic groups was statistically significant (P<0.05). The results of the current study for DO for both local and crossbreed cows was much longer than the reported DO of 148.33± 38.44 days and 93.11±43.87 days for local and Jersey crossbreed cows respectively in Gonder (Niraj Kumar *et al,*. 2014). However, the current value for local cows was less with 222 days reported by Mebrahtom and Hailemichael (2016) in Endamehoni district of Tigray region.

On the other hand, the reports of Hunduma (2012), Sena *et al.* (2014) and Zenebe (2016) who have reported DO of 85.6, 93 and 164 days respectively for crossbreed dairy cows was much shorter than the finding of current study.

The DO period of Jersey cross breed cattle in the high land agro ecology (161.42±4.17) was higher than that of midland agro ecology (147.36±3.27). It was significantly different in DO period between agro ecologies (p<0.05). In the study area there is traditional thinking that lactating cows will dry off immediately if inseminated/mated due to their first choice from cows is milk rather than calf. Therefore, farmers do not allow cows to be inseminated, early weaning and oestrous is missed in early and mid-lactation stages due to deliberately to take the advantage of milk. This is why DO in the current study is very long as compared with literature. This variation might be attributed to lack of proper management and problem of proper heat detection in the study areas. Another problem in the study area that prolongs DO might be lack of follow up of cows in oestrous and awareness gap of the limited time of heat. Farmers in the study area

do not use visual heat detection of their cows regularly to detect whether they are on oestrous and due to that, oestrous is missed. Other causes for prolonging of DO in the study area might be low body condition score due to feed shortage and long calf suckling period for local cows. According to Mengistu *et al.* (2016) lower energy balance in cows delays the onset of postpartum heat this is due to negative energy balance affects follicular development in ovary. Similarly, Tadesse *et al.* (2010) have also reported that difference in DO in different literature is due to the differences in managements such as nutrition, health and heat detection by farmers.

4.4.3. Calving interval

Calving interval is the time gap between two consecutive calving. The current study revealed that the overall mean±SE calving interval (CI) was 19.02±0.24 (range 11 to 36 months) and 15.97±0.17 (range 14 to 38 months) for local and Jersey crossbred cows respectively. In both agro ecology genetic group had significant statistical effect on calving interval ($P<0.05$). Calving interval was more variable in Jersey crossbreed cows than local cows, due to widely use of crossbred cows for milk production rather than calf rearing and not widely use local cows for milk production due to very low milk yield during late lactation stage in study area. The calving interval of 19.91 months (1.66 years) was reported by Zereu and Lijalem (2016) for local cows in rural community of Wolaita zone which was in line with the finding of the current study. In other way, Tadele and Nibret (2014), and Bayou *et al.* (2015) have reported shorter calving interval of 1.23 years (14.58 months) and 1.45 years (17.40 months) respectively. But Adebabay (2009) has reported longer CI for local cows of 2.17 years (26.04 months). Overall calving interval found in this study for Jersey crossbred cows was longer than and 1.13years (412 days) reported by Meaza (2017), Belay et al. (2012), Yifat *et al.* (2009) respectively and 21.36 months

and 22.1 months by Belay *et al.* (2012) in Jimma town and Ike *et al.* (2005) in peri-urban at Awassa town for crossbreeds respectively.

Feed scarcity for long period, need of milk for two and above years, silent oestrus, lack of proper heat detection, and suckling of calves throughout the lactation and poor quality of semen that are prolonging DO finally prolong CI in the study area. Similarly, according to Bayou *et al.* (2015) scarcity and deterioration of available feeds, poor breeding management, disease and parasites load and prolonged suckling by calves under extensive management systems were factors prolonged CI in Sheko cattle.

4.5. Productive Performance of Local and Crossbreed Dairy Cows in the Study Area

4.5.1. Daily milk yield

Average daily milk yield of local and Jersey crossbreed cows in the study area are shown in Table 9. An average milk yield of local breed dairy cows per day in the current study areas were on an average of 3.02±0.06, 1.85±0.07 and 0.81±0.03liters for the early, mid and late lactations, respectively with an overall average of 1.90±0.08 litres. Average daily milk yields of Jersey crossbred cows were 7.19±0.15, 5.46±0.12 and 2.98±0.08 litres for the early, mid and late lactations, respectively with an overall average of 5.16±0.12litres. The reported average daily milk yield of local breed dairy cows of the present study was higher than the value reported by Asaminew (2007), which was 1.2 litres in Bahir Dar zuria and Mecha study areas. The current study was in line with Fikrineh *et al.,* (2012) reported that, the overall daily milk production per cow was 1.71litres, from local breed of cow in Mid-Rift valley. In the current study areas respondents reported based on agro ecology in that average daily milk yield of crossbreed cows in highland and midland were 5.05±0.19 and 5.27±0.15litres/day per cow respectively.

Table 9: Estimated productive performance parameters

Parameters	Breed type	Lactation stage	High land (N=57) Mean±SE	Mid land (N=81) Mean±SE	Overall (N=138) Mean±SE	P-value
DMY(L)	Local	Early	3.00±0.09	3.02±0.09	3.01±0.06	0.861
		Mid	1.93±0.10	1.74±0.09	1.85±0.07	0.280
		Late	0.80±0.04	0.83±0.04	0.81±0.03	0.734
		Overall	**1.91±0.12**	**1.88±0.15**	**1.90±0.08**	
	Jersey cross	Early	6.88±0.20	7.19±0.15	7.03±0.12	0.230
		Mid	5.45±0.19	5.47±0.15	5.46±0.12	0.947
		Late	2.82±0.13	3.13±0.10	2.98±0.08	0.075
		Overall	**5.05±0.19**	**5.27±0.15**	**5.16±0.12**	
LL(Month)	Local		8.63±0.27	8.79±0.26	8.71±0.18	0.685
	Jersey cross		9.54±0.21	10.00±0.16	9.77±0.13	0.097
	P- value		0.000	0.000	0.000	
DPL(Days)	Local		97.61±4.08	100.00 ±3.90	98.81±2.82	0.725
	Jersey cross		87.00±3.16	87.24±2.48	87.12±2.01	0.946
	P-value		0.001	0.001	0.001	

Where, DMY= Daily milk yield, LL=Lactation Length, DPL=Dry Period Length

Current study results were less from peri-urban and urban production system daily milk yield of cross breed cows who earlier study reported by Bekele *et al.,* (2015) was 5.77 and 6.0liters/day/cow respectively in Dangila towns. Also current study observation reported much lower than reported by Desalegn *et al*. (2016) milk yield was 14.3±5.4litres, 12.7±2.7litres and 7.9±2.5litres/day/cow for the first, second and third stage of lactations, in Bishoftu town respectively. The result of this study was slightly different with regard to performance of cross breed dairy cows, traits of daily milk yield from the others. This may be due to insufficient dairy cattle management conditions, low genetic traits of dairy cattle (level of exotic gene inheritance in the cross bred) and environmental effects especially temperature effects.

4.5.2. Lactation length

Lactation length in these study areas are shown on Table.9.The lactation length of dairy animals in the study area depended mostly on the management goal of the producer. The producer may prolong the lactation length for the sake of continuous milk supply or dry off the cow at early stage for breeding purpose. Average lactation length for local and Jersey crossbreed dairy in high land and midland were reported 8.71±.0.18 and 9.77±0.13 months respectively. In mid land agro ecologies lactation lengths of both breeds were slightly higher than high land. However there is significant difference between breed types statistically ($P<0.05$). Previous study reported the average lactation length for local and cross breeds by Asaminew (2007) in Bahir Dar and Mecha were 9.8 and 10.1months respectively. Average lactation lengths for local and cross breeds reported by Tsadkan (2012) in Enderta district were 7.27 and 9.55month's respectively. An average lactation length for local and cross breeds reported by Desalegn *et al.,* (2016), in Bishoftu and Akaki town were 9.22 and 9.36 months, respectively. The result of current study greater than previous reported by Kefyalew *et al.,* (2016) indicates that, an average lactation length for local breed cow was 8.37months in Dawa Chefa District, South Wollo zone, whereas current study was greater than with the result of Tsadkan (2012), who reported 7.27 months in the study areas of Enderta district, whereas less than reported by (Dessalegn *et al.,* 2016), who reported 278.65 days (9.1 months) in smallholders management system in Bishoftu and Akaki Towns. In general, the lower average daily milk yield per cow and the variation in lactation length in the present study may be attributed to feed and water shortage, diseases and external parasites and poor genetic potential of the sample population.

4.5.3. Dry period length

Average dry period length of local and crossbred cows in the study area is shown in Table 9. An average dry period length of local and Jersey cross breed dairy cows in current study areas were on an average of 98.81±2.82 and 87.12±2.01days respectively. Generally, 45 to 50 days is recommended. If less than 40 days, the milk yield in the next lactation will be decreased. According Atashi *et al.* (2013), cows with the standard DPL (dry period length) (51 to 60day) produced more 305-days milk, fat, and protein over the next lactation compared with those with shorter dry periods. Shorter dry periods (0 to 35day and 36 to 50day) were associated with lower initial milk yield, steeper inclining and declining slopes of the lactation curve, and higher milk persistency compared with dry period length of 51 to 60days. Peak lactation was achieved later in cows with 0- to 35days and 36- to 50day dry period length than in those with dry period length of 51 to 60days. The overall average means dry period length of both local and crossbreed cows observed in the current study were 92.96±2.41days. This result is greater as compared with the report of Atashi *et al.* (2013) who reported that mean dry period length was 67.3 (23.7%) in Iran. The result of current study dry period length was greater than the report of Sandra *et al.* (2014) only one farm (1.1%) had a regular dry period of more than 70 days dry period length in northern Germany. In the study area, there was longer dry period length in both agro ecologies and breed type due to maximize milk yield in the next lactation, very low milk yield during late lactation stage, high cost for feed and low milk yield and traditional perception of thinking for foetus in the oviduct. However, few respondents reported that they practice short dry period length. There is no significant difference in both breed type based on agro ecologies but, between genetic group there is significant difference ($P<0.05$).

4.6. Milking practices, handling, consumption and processing in the study area

4.6.1. Milking Practices in the study area

Milking practice in the study areas is shown in (Table10). In the study area all of the dairy producers practiced hand milking and calves were allowed to suckle their dams before milking or prior to as well as after milking. But in both agro ecology of the study district, some dairy producers did not allow calves to suckle their dams those who had cross breeds; instead they used bucket feeding practices. According to the study households, mothers were the major responsible persons of milking (81.2%) (Table10). Next to mothers, daughters (13.8%) and (5.1%) sons were responsible for milking cows. The result was agreed with the report of Abebe *et al.* (2013), in the rural Ethiopia milk processing and other household activities are almost always the responsibility of women. The currents findings were in line with the report of *Asrat et al.* (2013), in almost all cases in all production systems milking was predominantly handled by household wives or adult females in and around Boditti Wolaita Zone, Southern Ethiopia.

As Pearson chi-square test indicated that the responsibilities for milking in both agro ecologies was significantly varied ($P<0.05$) and this might be due to people in midland agro ecologies were more cross breed owners that encourage different family members milking cross breeds.

Water source for hand and utensils washing about (47.4%), (38.6) %, and (14%) of interviewed respondents were use piped/tap water, stream and hand dug well water respectively as source of water in high land whereas in midland (76.5%), (7.4%), and (16%) were use piped/tap water, stream and hand dug well water respectively and this indicates that there was significant variation ($P<0.05$) on accessibilities of water sources in highland and midland agro ecologies. This finding not agreed with the report of Teshome and Tesfaye (2017) who indicated that

majority of the respondents (50 and 75.6%) used river followed by hand dug well water in Debub and Shey Bench. This finding agreed with the report of Abebe *et al,* (2013) who reported that majority of the respondents used tape water (61%) in woina dega agro ecology of study areas. However; the qualities of both stream and hand dug well water used for washing hand and cleaning milk utensils may not meet the required standards thus may contribute to low qualities of milk and milk products in study area. Therefore, it is recommended to boil and treat the water from stream and hand dug well before using for cleaning purpose.

After washing their hands (42.1%) and (52.1%) in high land and midland, respectively were use towel due to they have crossbreed cows and got awareness from extension agents and the rest (57.9%) and (47.9%) use their own clothes due to have not got any idea from extension agents.

Majority (87%) of the households milked their cows thrice a day; at 6:30-7:30am in the morning, 3-4pm in the afternoon and 8-9pm in the evening. The present findings was contrasted with report of Teshome and Tesfaye (2017) who reported that all of the household milk producers at Mizan Aman and the majority of dairy cow producers at Debub Bench (97.8%) and Shey Bench (98.9%) milk their cows twice a day (morning and evening), while the cows are in the barn or under a tree shade. However, some of the respondents (2.2 and 1.1% of Debub Bench and Shey Bench, respectively) milk their cows once a day. This might be due to late stage of lactation.

This study indicated that (11.6%) of the respondents practice suckle before and after milking and which was followed by suckling before milking only (14.6), suckling after milking (21.7) and milking without suckling (52.2) in both agro ecologies as type of milking practices. There was a significant variation ($P<0.05$) on the type of milking practices used in different agro ecologies of study area this is due to the population of crossbred cattle in the midland is higher

as compared to highland areas. This finding was opposite of Kassu (2016), who reported 54.7% of the respondents practice suckling before milking, while 43.3% of them exercise suckling before and after milking in the rural production systems.

Table 10: Milking practices

	Agro-ecology			
	Highland (N=57)	Midland (N=81)	Overall (N=138)	
Variables	%	%	%	P-value
Milking person				
Women	91.2	74.1	81.2	0.019
Daughter	8.8	17.3	13.8	
Son	0.0	8.6	5.1	
Milking if calf dies				
By washing udder	8.8	8.6	8.7	
By providing artificial calf	26.	8.6	15.9	
By providing feed	61.4	81.5	73.2	0.027
Stop milking	3.5	1.2	2.2	
Drying materials			50.7	0.462
Own cloth	57.9	47.9	49.3	
Towel	42.1	52.1		
Water source			64.5	0.000
Piped/tap	47.4	76.5	20.3	
Stream	38.6	7.4	15.2	
Hand dug well	14	16		
Milking frequency				
Once	3.5	2.5	2.9	0.724
Twice	12.3	8.6	10.1	
Three	84.2	88.9	87	
Type of milking				
Milking without suckling	49.1	54.3	52.2	0.032
Few suckle before and after milking	21.1	4.9	11.6	
Suckling before milking	12.3	16	14.5	
Suckling after milking	17.5	24.7	21.7	
Practice of complete milking				
Yes	86	95.1	91.3	0.062
Fixed milking time				
Yes	70.2	91.4	82.6	0.001

This result is contrasted with the reports of Asrat *et al.,* (2015) from Humbo Woreda (80%) and Asaminew and Eyasu (2009) in Bahir Dar and Mecha areas (80.7%). The remaining households in the town that kept cross breeds and got high incomes from milk sale never allow partial suckling but for the first 15days gave milk freely. They provide milk for the calves by using different equipments.

Most of the respondents (91.3%) were practice complete milking and the rest of few respondents (8.7%) were not practice complete milking due to allowing of calf suckling for long days and this may influence the chemical composition of milk and milk products in study area. Milking time of most study households (82.6%) is fixed. According to the study households of both agro ecologies, evening and afternoon milking time are not fixed due to different activities in the family was performed by mother or females and lack of awareness on the effect of milking time variation in milk yield. Variation in milking time affects milk yield and composition. Farmers in two agro-ecologies were significantly different in milking time ($P<0.05$) meaning that milking time in both agro ecologies was mostly not fixed during afternoon but it is fixed during morning milking time.

4.6.2. Hygienic practice during milking time

Hygienic practices of the barn and the cow during milking time were indicated in (Table 2). Majority of (91.3%) the interviewed respondents reported that they do not have separate milking place for their cows and milk their cows in common barn together with other animals. The practice of cleaning milking areas (barn) varies among households. All of the interviewed respondents (100%) clean the barn of dairy cow but the frequency of barn cleaning was significantly varied ($P<0.05$) within and between agro ecologies. In both agro ecologies majority

of respondents (64.5%) clean dairy cow barn daily because of dairy cow is housed in the same barn with family that made a bad smell for family members and this is the major reason for cleaning of dairy cow barn daily and the rest few (26.8%), (7.2%) and (1.4%) were clean twice a day, three times a day and when necessary, respectively. The current finding was in lined with report of Mitiku *et al.,* (2019), who reported that most of the respondents (78.05%) reportedly remove manure daily. Zelalem (2010) reported similar result for smallholder farms in Central Highland of Ethiopia in which smallholder farmers clean barns on daily basis (87%), once or twice a week (9%) and did not clean at all (4%). Maintaining the sanitary condition of the milking area is an important prerequisite for clean wholesome milk production, and hence daily removal of manure and cleaning of barn is recommended.

Overall in the study area most of the respondents (76.1%) reported that they washed and dried the udder of cow before milking and the rest (23.9%) were washed udder merely at the time of udder and teats dirtied with their moisture dung's. However, the result was not agreed with the report of Abebe *et al.,* (2013), who reported that washing of cow udder was not practiced in Ezha district of the Gurage zone but the result is agreed with the report of Asrat *et al,.* (2016) who reported that all the dairy producers in the area wash the cows' udder before milking with clean water in and around Wolaita Soddo town of the Wolaita Zone. This finding is similar to the finding of (Yitaye *et al.,* 2009) that shows the udder was cleaned during milking (75.9%) found in North Western Ethiopian highlands and the remaining 26.1% of the respondents were not clean the udder during milking, this may due to lack of training in how to process and handle during milking.

The most common type of water used to wash udder is cold water (72.5%) and the rest respondents (27.5%) washed udder by hot water. This result was lower than Haile *et al*. (2012)

who reported that 85.6% of respondents were used hot water to clean milk handling equipment in Hawassa City. This is because Hawassa is an urban area the respondents have better awareness than the present study area. However, the present result was higher than the result reported by Tsegaye and Gebreegziabhar (2015) only 26.5% of respondents were used hot water in Wolaita Zone, respectively.

Table 11: Hygienic practices of the barn and the cow during milking time

	Agro-ecology			
	Highland (N=57)	Midland (N=81)	Overall	
Parameters	%	%	%	P-value
Having milking place				
No	96.5	87.7	91.3	0.07
Cleaning the barn				
Yes	100	100	100	
Frequency of cleaning barn				
Daily	73.7	58	64.5	0.036
Two times	15.8	34.6	26.8	
Three times	7	7.4	7.2	
Others	3.5	0	1.4	
Washing & drying udder				
Yes	73.7	77.8	76.1	0.579
No	26.3	22.2	23.9	
Time of washing cow udder				
Before milking	62.8	24.7	37.9	0.000
After milking	7.0	23.5	17.7	
Before & after milking	30.2	51.9	44.4	
Udder drying material				
Collective towel	33.3	41.3	38.1	0.319
Individual towel	42.9	46.0	44.8	
Just with hands	23.8	12.7	17.1	
Water for udder washing				
Cold water	84.2	64.2	72.5	0.010
Hot water	15.8	35.8	27.5	

Time of cow's udder washing in the present study indicated that (44.4%) of the respondents wash cow's udder before and after milking. The rest of respondents (37.9%) and (17.7%) washed their cows udder before and after milking only, respectively. This study is contrasted with report Teshome and Tesfaye (2017), who reported 83.3% in Shey Bench, 85.6% Debub Bebchand 60% in Mizan Aman did not Practice washing the udder and teats before milking in Bench Maji Zone, Southwest Ethiopia. This study is also contrasted with report Abebe *et al,* (2013) who indicated that washing of udder before milking is completely not practiced in Ezha district of the Gurage zone, Southern Ethiopia.

Overall in the study area most of the respondents used individual udder drying materials (44.8%) and (38.1%) used collective towel. The rest (17.1%) of the respondents do not used towel but dry just with hands. The current finding is contrasted with Ayalewu, (2017) who reported that in rural dairy production systems respondents did not used towel at all in study area.

4.6.3. Milking and milk storage tools and their hygienic practices

The type of utensils used for milking in the study area was found to be different (Table 12). Overall most of them used plastic buckets (60.9%), small clay pot (Humbulo in local name) (32.6%) and the rest (6.5%) used stainless steel (nickel). The type of utensils used for milking between agro-ecologies were significantly different ($P<0.05$) and this is due to most of respondents in midland agro ecology were cross breed owners this enables respondents to use plastic buckets/materials because of more milk is produced and sold from cross breed cattle's.

As indicated in Table 12, about (43.9% and 72.8%) respondents in highland and midland used plastic buckets for milking. Whereas, (45.6% and 23.5%) of respondents used small clay pot made containers for milking and collection in highland and midland. However, some percent (10.5% and 33.7% of highland and midland) of respondents adopted stainless steel (Nickel).

This is in line with the findings of Yitaye *et al*. (2009), Teklemichael (2012) and Teshome *et al.(*2014) who reported that 83% of the surveyed urban dairy farms in Bahir Dar and Gondar, 75% of the surveyed in Dire Dawa town and Shashemene town used plastic utensils. However, such practice may cause microbial contamination of the milk from the milkers' hand.

The interviewed households used different utensils for milk storage and processing. All respondents reported using clay pot (Ensira) for milk storage and churning (butter-making). As reported by the respondents 29.7%, 55.1%, 11.6% and 3.6%used clay pot, plastic, clay pot and plastic and aluminium source like nickel were used as milk storage utensils, respectively. The type of utensils for milk storage and processing were significantly different ($p<0.05$) and this was also due to more amount of milk was produced from cross breed cattle's in midland agro ecology. In both agro ecologies clay pot is also used for storage of milk until the needed amount is accumulated for processing. Abebe *et al.* (2012) revealed similar result where 88.3 and 96.7% in Dega and Woina dega agro ecology in Ezha district of the Gurage Zone, Southern Ethiopia was obtained. As indicated by respondents, clay pot keeps milk well at the prevailing high ambient temperature compared to plastic containers. This is agreed with the report of Asrat *et al.* (2015), who reported that about 45% of rural producers used clay pots, 45% used plastic utensils for milking in and around Boditti town of the Wolaita zone, and Gemechu and Amene (2017) who reported that most of the respondents (95.6%, 58.9% and 55.6% of Mizan Aman, Debub and Shey Bench districts, respectively.

Almost all (100%) of the interviewed respondents reported that they wash milking and milk storage equipment, and frequency of washing containers was (42.8%) before and after every use that followed before every use (40.6%) of milking and milk storage. The present study is contrasted with report of Mitiku *et al.* (2019) showed that 4.88% of respondents wash milking

and milking utensils before every use. The frequency of washing milking and milk storage containers was significantly different ($p<0.05$) this due to that most of the cross breed owners in the midland agro ecology were washed utensils more frequently.

The majority (76.8%) of the respondents in both agro ecologies usually clean their milking utensils before and after milking using different plant species and water and the rest clean milk utensils by water and detergent (5.8%) and by water only (17.4%), before milking and storage they kept it clean and dry by placing on Enset leaf up-side down after use. Most highland producers (82.5%) usually clean their milking utensils before and after milking by plants. With regard to cleaning milking utensils by using different plant species, highland producers were found better than midland farmers due to the existence of different plant species in the area.

The most common technique is washing the containers with warm water using leaf of different plants and finally it is rinsed with cold water. Moreover, the farmers reported that the milk utensils were washed with warm water first and then with cold water when the plant species are not available around their homestead. Minantofa (Achyntus aspera) is the most common plant species used to clean vessels used to store milk and milk products.

These plants are used to impart good flavour to the milk and milk products. Besides, it is claimed that they are known to extend the shelf life of milk. Thus, the effect of these plant species on the quality and safety of milk and milk products deserves further study. On the contrary, Olea africana is the most frequently used plant for smoking milk containers in other parts of the country (Beyene, 1994; Tola, 2002; Fita, 2004; Yilma and Faye, 2006).

Table 12: Milking and milk storage tools and their hygienic practices in the study area

	Agro ecology			
	Highland (N=57)	Midland (N=81)	Overall (N=138)	
Parameters	%	%	%	P-value
Type of milking utensils				
Plastic	43.9	72.8	60.9	0.002
Small clay pot	45.6	23.5	32.6	
Others	10.5	33.7	6.5	
Milk storage container				
Clay pot	26.3	32.1	29.7	0.004
Plastic	45.6	61.7	55.1	
Both	22.8	3.7	11.6	
Others	5.3	2.5	3.6	
Wash milk storage				
Yes	100	100	100	
Frequency of washing				
Before every use	56.1	29.6	40.6	0.007
After every use	10.5	21	16.7	
Before and after every use	33.3	49.4	42.8	
Methods of washing MSC				
By water only	14	19.8	17.4	0.385
By water & detergents	3.5	7.4	5.8	
By water & some plants	82.5	72.8	76.8	

Where, MSC=Milking and Storage Container

4.6.4. Milk storing and its hygienic practices

In the study area, total milk produced per households per day of most respondents was not sufficient for processing, due to that they mix the evening and morning milk and few respondents reported that they practice milk ekub/cooperative (wijjo in local name) (they give and take or turn by turn). This result was agreed with the report of Amistu *et al.* (2016) who reported that about 1.5 litres milk was processed in to butter and butter milk after 2 to 3 days reserving until sufficient for agitating.

All respondents in the study area practice milk collection. As the study result indicating that collected milk was used to process into other milk products which accounts 73.5% in highland and 80.2% in midland and there was no significant difference between highland and midland agro ecologies, but other respondents store milk because if milk is not enough for process 26.3% and 19.8% in highland and midland, respectively.

The study result indicated that majority of respondents in the highland store milk by placing in large clay neck (Batta in local name) (61.4%) while in midland (46.9%) of respondents practiced milk storage by cooling water by soaking milk containing utensils in water those have cross breed cows.

Milk is sterile at secretion in the udder but is spoiled by bacteria even before it leaves the udder. Further infection of the milk by microorganisms can take place during milking, handling, storage, and other pre- processing activities. Therefore, in the study area the farmers practice different shelf-life increment methods, from which majority (63.8%) of respondents use washing containers with half boiled water and plants, smoking of containers (11.6%) washing containers with detergents (21%) and (3.6%) used some freezing methods. but this finding not agreed with the report of Zegeye and Belay (2017) who reported that almost half of the producers in the Enderta district, northern Ethiopia did not use detergents to wash their milk vessels.

To increase the shelf-life of milk and its products, farmers smoke utensils by placing clay pot on fire and they place smoking plants and water in the pot, after that they boil all together. At the last they put-off from fire and rub the pot by fingers and plants very well to remove dirties and milk and milk products residue on the utensils. The current study indicated the respondent's response in the study area showed that milk producers smoke milking and milk storage materials for different purposes.

Overall 59.6% of the respondents smoke milking materials for increment of flavour, to increase shelf life and to improve texture of dairy products. Gemechu and Amene (2017) reported that smoking of milking and milk storage containers was done by using Kosarate (Ocimum haardiense), Tej sar (Cymbopogan martini), Tenadem (Ruta chalepensis) and wood splinters of Weyira‘ (Olea africana) in the areas. They reported that smoking was used to provide desirable flavour and aroma, increase shelf life of milk and activate fermentation. In addition to imparting pleasant flavour, it facilitates fermentation and increases shelf-life of milk and milk products. Smoking has antimicrobial activity, thus inhibits the growth of microorganisms in milk (Mogessie and Fekadu, 1993 and Teshome *et al.,* 2014 cited in Gemechu and Amene, 2017).

The Frequency of churning in week in study area were daily (40.6%), two-times (13%), three times (34.1%) and (12.1%) churn less than two times (Table 14).

In both agro ecologies (100%) in highland and (95.1%) farmers in midland use different plants for milking and milk storage equipments` cleaning and improve milk and milk products shelf life. Majority of interviewed respondents use Kosarat (*Ocimumhaardiense*) 6.5%, *Achynthes aspera* (locally Minantofa) 37.5%, Tenadem (*Rutachaepensis*) 12.5% and others like Kessie (locally Attada) (*Ocimum haardiense*), Bissana (*Croton macrostachyes* and damakessie (*Ocimumhardiense*) 13.5% were used by respondents for cleaning purpose. The purpose of smoking milking and milk storage utensils in the current study reported that majority of respondents smoke milking utensils for multipurpose such as to get good flavour, to increase shelf life to improve the texture and to maintain quality of the milk and milk products. This study is in lined with report of Endale, (2018) who reported different plant species for cleaning and smoking milking and milk storage utensils.

Table 13: Milk storing and its hygienic practices

	Agro-ecology			
	Highland (N=57)	Midland (N=81)	Overall (N=138)	
Parameters	%	%	%	P-value
Collecting milk				
Yes	100	100	100	
Purpose of collecting milk				
For processing	73.7	80.2	77.5	0.363
If milk is not enough to process	26.3	19.8	22.5	
Methods of milk storage				
Cooling by water	19.3	46.9	35.5	0.001
Placing on clay pot neck	61.4	33.3	44.9	
Others	19.3	19.8	19.6	
Increase SL of M &MP				
Smoking of containers	7	14.8	11.6	0.191
Washing containers with HW&SPl	73.7	56.8	63.8	
Washing containers with detergents	17.5	23.5	21	
Others	1.8	4.9	3.6	
Use smoking plants				
Yes	100	95.1	97.1	0.089
Purpose of smoking				
Good flavour	10.5	20.3	16.2	0.382
To increase SL	3.5	2.5	2.9	
To improve texture	19.3	22.8	21.3	
All purpose	66.7	54.4	59.6	
Plants to clean milk utensils				
Kosarat(*Ocimumhaardiense*)	26.3	44.3	36.8	0.078
Tenadem (*Rutachaepensis*)	10.5	13.9	12.5	
Minantofa(A*chynthesaspera*)	49.1	29.1	37.5	
Others	14.0	12.7	13.2	
Spices used TDPP				0.019
Tosign(*Thymus serrulatus*)	12.3	28.4	21.7	
Abish (*Trigonnellafoenumgraecum*)	12.3	11.1	11.6	
Kororima (*Aframommumkorerima)*	28.1	8.6	16.7	
Onion,(*O.kilimandscharicum Guerke*) & kosarat	43.9	46.9	45.7	
Others	3.5	4.9	4.3	

Where, SL=Shelf life, HW=Hot Water, SPL=Some Plants, TDPP=Traditional Dairy Product Processing

4.7. Traditional Processing of Dairy Products

Milk processing practices and the reason for milk processing is presented in Table 14. All of the interviewed respondents were processed raw milk into various milk products. The survey result indicated that before milk is processed into various products, it is stored in well prepared, cleaned and smoked equipment for at least two up to three days for making fermented milk. Fermented milk is the basis for production of different milk products. Ethiopian cottage cheese, butter, ghee, hadaro, shiffa, butter milk, yoghurt and whey were the most commonly traditionally processed milk products in the study area.

The survey result revealed that the frequency of processing milk was depend on the numbers of cow, amount of milk produced per day, breed types of cows, lactation stage, environmental temperature and milk handling equipments. However, (47.8%) of respondents was process milk every day those have cross breed milking or local breed early lactation stages, (45.7%) and (6.5%) respondents process every two day and every three day respectively. This result was contrasted with the report of Tsegay and Gebreegziabher (2015) who reported that frequencies of processing milk in the Wolaita Zone, Southern Ethiopia were about 82.7, 6.8, 8.3, 0.8, 0.8 and 0.8% of the respondents processed every day, every two day, every three day, every four day, triple per day and twice per day respectively. The result was not agreed with the report of Abebe *et al.* (2013) in Ezha district of the Gurage zone, Southern Ethiopia who reported that 70% and 30% of respondents process milk twice per week and once per week, respectively (in Woina Dega areas); while 53.4% of in Dega areas process their milk twice per week, whereas the remaining 38% and 8% of the respondents process once per week and once for nightly, respectively. The reason for processing frequency variation of milk in different study area might be due to effect of handling management, ambient temperature and relative humidity.

The milk products that were produced in the study district in both agro ecology were butter, cheese, yoghurt, whey, butter milk, Hadaro, (in first one to three weeks milked fermented by adding of spices) and shiffa (partially churned sour milk). In the study area, the major target of milk processing was to get butter followed by buttermilk and cheese. Very few respondents reported that there was other liquid milk type which prepared by mixing of water and butter milk (‘qoonnamma‘‘in local name). The only butter churning equipments was clay pot whose size depends on the amount of daily milk that to be processed.

The current survey reported that 45.7% of the respondents use *Ocimum kilimandscharicum Guerke* (locally Atti gemenja), red onion (*Allium cepa)* and kosarat (*Ocimum haardiense*), commonly especially for hadaro and buttermilk. Additionally (21.7%), (11.6%) and (16.7%) of the respondents used Tosign (*Thymusserrulatus*), Abish (*Trigonnellafoenumgraecum)* and kororima (*Aframommum korerima*) respectively for spicing butter in the study area. Only 4.3 % of the respondents used Basobila (*Ocimum urticifolium*) Garlic (*allium sativum*) that is described in (Table 13). Another study by Lemma *et al.* (2004) in east Shewa indicated that surplus butter produced during high production season was either sold at lower price or preserved and stored by mixing with spices for later use. According to Lemma *et al.* (2004), almost all the women in Adami Tulu and Arsi Negelle and 63.3% of the women in Lume district somehow used some form of preservatives to keep butter for longer period of time. The same study revealed that, according to the respondents, spiced butter can be kept for about 3 years if properly worked, kept clean and mixed with fresh butter from time to time. Another study in North-western Ethiopia also reported that smallholders practice spicing of butter for preservation purpose (Eyassu and Asaminew, 2014). A former report by Alganesh (2002) also revealed that spiced butter can be kept for 2.80 months in eastern Wollega zone. However, in North-western

Ethiopia, spiced butter can be kept for up to 11.40 months at an ambient temperature without deterioration (Eyassu and Asaminew, 2014).

4.7.1. Whole milk (Raw milk)

The survey results showed that milk producers used different techniques to preserve fresh milk (Ibbado in local name) without fermenting, such as cleaning of milking and milk storing utensils properly, smoking of the milk storing containers, placing in very cold area (in a big clay pot locally called baatta) and cooling of milk by cold water. In the study area, smoking was the usual practice practiced by majority (97.1%) of the respondents. Cooling by putting the container with milk into a cold water bath was practiced in the study area was reported (19.3%) and (46.3%) in highland and midland respectively. In highland most of the respondents (61.4%) practiced storing fresh milk by placing large clay pot until the fresh milk ferment and churning amount of milk collected. In both agro ecologies of the study area 19.6% of respondents placing fresh milk containing small clay pot underneath of the soil in cool place.

4.7.2. Hadaro (Local name for first three week fermented milk)

Hadaro is a distinctive traditional ergo type made culturally from first two up to three week milked and fermented milk after in each calving before beginning of any processing in the study area. The processing step was started after colostrums (locally Qenterra) milked first, fresh milk placed in a medium clay pot (locally called Harachcho) and mixed the fresh milk and fermented milk all together and stirred properly and stored until a distinct curd is formed by souring naturally from one week up to three weeks depending on the number of families and relatives. At the end of cooling, the curd and whey mixture was transferred into another smoked container and stored at room temperature. Subsequently, another fresh batch of milk was mixed following the same procedure and added into the previous batch after completely removing the whey from

the earlier batch. This procedure continues every day for up to 2 to 3 weeks until needed amount is collected and fermented for preparing hadaro. While adequate quantity of hadaro is attained, the clay pot containing the fermented mixture is enclosed with clean *Enset ventricosum* (locally weessi kobba) (false banana outer coverage). Following last days for serving fine grounded spice powder, red onion (*Allium cepa*), kosarat (*Ocimumhaardiense*) and tikur azmud (*Nigella sativa*) were added into the vessel and mixed with the curd. After adding these spices, the vessel is covered again for further removal of whey for another few days with constant change of the vessel cover each day. Fermentation of milk is where milk is allowed to ferment naturally without addition of starter culture. Milk is accumulated over a number of days in pot vessels of 10-15litres volumetric capacity and allowed to develop acidity up to 1% lactic acid. In cold weather, the container is kept near the fire to keep it warm. Soured milk (hadaro) is consumed as a side dish. The disadvantage of this type of milk is that since it is not boiled there is always danger of people contracting diseases like Tuberculosis (T.B). In the study area before any milk processing hadaro was consumed culturally.

4.7.3. Shiffa (Local name for partially churned sour milk)

Shiffa (the point when butter grains start to form especially at foam stage) is unique traditional processed dairy product in the study area made culturally from partially churning sour milk. The survey report showed that this processed dairy product “shiffa” is provided as medicinal purpose for emaciated and seriously coughing children because it contains all the contents of milk and highly palatable and accepted as medicine traditionally. Additionally shiffa is provided for guests and for circumcised male only.

4.7.4. Ergo (Ethiopian Naturally Fermented Milk)

Ergo (Ginna in local name) is rarely made from traditionally fermented milk products in the study area. In both agro ecologies ergo was made by fresh batches of milk added to the fermented product each day with or without previous removal of whey, until the container is full. Ergo is a traditional fermented milk product, which is made by natural fermentation of milk under ambient temperature, with no defined starter cultures used to initiate the fermentation processes (Assefa *et al.,* 2008). As a result, the microbial load of fermented milk samples, including Ergo, could vary from sample to sample based on the microbial load and types of microbes in the original raw milk (Abdulkadir *et al.,* 2011).

4.7.5. Butter

Traditional churning practice was the only method to obtain butter (Burro) in the study district. After milk is completely fermented for more than one day by mixing morning and afternoon firstly and secondly mixing evening and it is transferred in to churning clay pot, wearing the clay pot with old cloth to warm the milk and churned in forward and back ward movement by placed on a old cloth on the floor. During the churning, the churning clay pot vent (locally Tishita) is opened within three to five minutes intervals especially for the first 25 minutes to remove the gas. According to respondents 'report the breakpoint, i.e., the point when butter grains start to form is detected by removing small butter grains through a vent on the neck of the churner. Then it is checked weather butter granules are formed or not and if enough size of butter granules are formed then it is collected and washed using cold water and the resulting product is called butter. The procedure of butter making was the same with Eyasu and Asaminew (2014), Amistu *et al.* (2016) and Bekele *et al.* (2015) in Bahirdar zuria and Mecha, Alle and Dangila districts, respectively. On the other hand the result indicated that there is a variation between in churning

time of Jersey cross breed cattle milk in the study area ($p<0.05$) this is depends on environmental temperature and milk composition of the cross breed cattle in both agro ecology. The highest churning time (1.9) hours was observed in Huet Eju Enesie District, East Gojjam Zone, Ethiopia by (Sale *et al.,* 2018).

The amount of milk required for churning at a time in the study area that indicated in Table 18 from local cows was 2.72 and 2.92 litres in highland and midland, respectively. The amount of milk required for churning at a time in the study area from Jersey cross breed cows was 4.01 and 4.86 litres in highland and midland, respectively. The result was contrasted with reported by Eyasu and Asaminew (2014) who reported that 1.8 litres were required for churning at a time in Bahirdar Zuria and Mecha districts. However, Bekele *et al*. (2015) in Dangila district reported that 25.14 litres of milk was required for churning at a time in Dangla district. This might be due to high amount of milk was produced per day in the household than the present study area.

The overall average amount of butter obtained from one churning time in the study area was 0.17±0.007kg from 2.83±0.10 litres milk and 0.19±0.004 kg from 4.52±0.26 litres of milk from local and Jersey cross breed cow, respectively in (Table 18). The amount of butter obtained was significantly different in case of cross breed cattle between agro ecologies among in study area. This result was slightly lower butter yield (0.23±0.02) kg was observed in in Huet Eju Enesie District, East Gojjam Zone, Ethiopia by (Sale *et al.,* 2018), this might be due to the presence of more cross breed cattle which produce low fat content milk than local cattle. The difference might be due to breed, type of feed provided for the cow and the churning procedure.

4.7.6. Buttermilk (Arrera)

Defatted butter milk (Arrera) is a semi liquid product that remains after butter making. Arrera

(Locally Gimma) is a local name for defatted butter milk in Ethiopia. It has a thin consistency and basically contains the casein protein of milk. Its test and odour are similar to those of ergo. In the study district buttermilk consumed in that form (raw form after removing butter) or cooked to produce (Ethiopian traditional cottage cheese) ayib to generate income, to cook cultural foods after fermenting buttermilk with mixing of different spices. The consumption of defatted butter milk depends on the standard of living of the family. In contrast to other traditional dairy product Arrera comprises 91.5% moisture, 3.1% protein, 1.4% fat, 3.4% carbohydrate and 0.6% ash. A hundred gram of Arrera gives 95 milligram calcium, 84 milligram phosphorus, 1 milligram iron 0.03 milligram of thiamine, 0.21 milligram riboflavin and 0.10 milligram niacin (Hennery T. 2006).

4.7.7. Cheese (Traditional cottage cheese/ Ayib)

All the respondents in the study area reported that they make traditional cottage cheese from cows' milk. Buttermilk, which is a by-product of the butter making process, is the raw material used for cottage cheese making. The buttermilk is placed on a small clay pot and warmed on slow fire (ember) at approximately 40^0C to 50^0C for twenty to thirty minutes. After cooling, the whey is drained off. This procedure of traditional cottage cheese making is in line with the reports of other authors in Ethiopia Gonfa *et al.* (2001), Seifu and Tassew (2014), Aysheshim *et al.* (2015) and Shewangizaw *et al.* (2016) in the north western highlands of Amhara Region and in the central highlands of Ethiopia. Traditional cottage cheese made at household level in the study areas are used for home consumption (some time), for receiving of respected strange and marketed or sold. On the other hand, the whey obtained is either used for consumption by the family members or given to animals (such as lactating cow and calf).

In the current study, on the average 13.43±0.187litres of buttermilk was required to produce a kilogram of cottage cheese. This value is in agreement with the yield estimates for cottage cheese reported by O'Connor (1993). According to the respondents, cottage cheese can be kept unspoiled up to 3 days at ambient temperature.

This result was not similar with the yield estimates for cottage cheese reported by Yilma and Inger (2001) and disagrees with Gonfa *et al*. (2001), who reported that 8 litres of Arrera is required to produce one kilogram of ayib. The variation could be due to difference in the composition of the milk and the moisture content of the final product.

Figure 3: Traditionally made cottage cheese (ayib) in the study area

4.7.8. Whey ``Uggata`` in local name /Aguat)

Consumption of whey in the study area was reported by 62.3% of respondents and the rest 21.7% and 15.9% of respondents give whey for calf and as medium for making different traditional foods, respectively. However, majority of respondents (75.4%) and (53.1%) in highland and midland areas utilized whey for direct consumption indicated (Table 16). This might be due to the trend of the respondents as well as scarcity of other dairy products in the household. The result indicates good awareness of respondents about the importance of whey for human consumption. However, some farmers get rid of the whey because they perceive that it is

useless. The same to this result Eyasu and Asaminew (2015) and Melku (2016) indicated that whey was used for calf feed and human consumption in west Gojjam Zone. All of respondents (100%) practiced whey making in both agro ecologies of study.

Figure 4: Whey (Traditionally cheese making process by product) (locally ``Uggata``)

4.9.9. Ghee (Nitir kibe)

Ghee is prepared by melting butter. It is not marketed in the study area rather it was solely used for home consumption. Butter were placed into a clay pot and put on open fire to melt. Heating and stirring continue until foam was formed and a clear liquid was obtained. Along heating the butter, spices are added to impart good aroma and taste. Then the pot were removed from the fire and allowed to cool. Finally, the liquid was filtered through sieve or piece of cloth or burlap into a container. Similar procedures have also been reported by many authors in Ethiopia (Flavey and Chantalkhana, 1999; Alganesh, 2002; Lemma, 2004). Another practice noticed in the study area is that some respondents melt the butter as usual and then remove it from the fire and keep it overnight after adding water on top of it, believing that it clearly filters the melted butter (ghee) from the residue. After draining the residue again they put it on fire for a few minutes as usual along with spices for further removal of the residue.

Different spices are used during ghee making which varies from household to household. The different types of spices used in the study site are shown in Table 13. During the process, spices such as abish (*Trigonella foeniculum*), tikur asmud (*Nigella sativa)* garlic (*Allium sativum),* kororima

(Aframomum korarima) and *tosign (Thymus serrulatus)* and some plants such as kosorat and azmarino are added to improve its flavour. It is common in the study area that ghee is used during cooking wot, eating raw meat and mixed with coffee and drunk. It is also used by some households when eating cottage cheese.

Table 14: Processing, frequency &reasons of processing, processed milk products and equipments used for processing

	Agro-ecology			
	Highland (N=57)	Midland (N=81)	Overall (N=138)	
parameters	%	%	%	P-value
Processing milk	100	100	100	
Yes				
Frequency of processing				
Every day	35.1	56.8	47.8	0.007
Every two days	61.4	34.6	45.7	
Every three days	3.5	8.6	6.5	
Milk product processed				
Butter	15.8	21.0	18.8	0.471
Cheese	12.3	18.5	15.9	
Butter milk	8.8	7.4	8.0	
Hadaro (2-3 wk stored milk)	43.9	43.2	43.5	
Whey	14.0	4.9	8.7	
Others	5.3	4.9	5.1	
Frequency of churning in week				
Daily	29.8	48.1	40.6	0.029
Two times	12.3	13.6	13.0	
Three times	36.8	32.1	34.1	
Others	21.1	6.2	12.3	
Churning utensils				
Clay pot	100	100	100	
Cheese making				
Yes	100	100	100	
Milk for cheese making				
Butter milk	100	100	100	
Equipments for butter handling				
Small clay pot	49.1	37	42	0.243
Plastic	47.4	54.3	51.4	
Stainless steel	3.5	8.6	6.5	

The melted butter product ghee (Nitir kibe) can be stored for quite a long time at ambient temperature. Butter has additional functions besides its nutritional value. Women use butter as hair oil, which is assumed to have dual functions for hair dressing and to cure headaches. Ghee is added to variety traditional foods in the study area such as mucho (Enset product bula) and a variety of cereal, pulse and meat based sauces. Ghee is also consumed merely and with coffee and especially when important guests are received in a home and during major holidays (Yahoode Masqalla, Easter etc.). Ghee is the most important ingredient in food and it is rich source of dietary energy and contains high calorific value. Ghee is commonly used for culinary, social functions and therapeutic purposes.

4.8. Consumption and Utilization of Dairy Products

Milk and its product utilization pattern varies in the study areas as; used for calves, consumption for family and sold to purchase family commodities. Fresh whole milk, hadaro, shiffa, sour milk, butter, buttermilk, traditional cottage type cheese, whey and ergo are among the common dairy products produced and consumed in the study areas. In general, the consumption pattern of milk and milk products in the study area is characterized by considerable product diversity (Table 15). Most the respondents reported that milk is consumed after processing to various products. However, milk is also consumed in its raw state. 12.3% of the respondents in midland reported that they boil milk before use. Consumption of sour milk is rarely reported in the area because it is used for further processing in order to generate income from sale of products such as butter.

Traditional milk processing is a common practice of all smallholder farmers who own lactating cows in the study area as it is elsewhere in the country. Butter is used for cooking, for sale and cosmetic purposes (mainly by the female members of the household) (Table 16).

Table 15: Consumption and purpose of milk and milk products in study area

	Agro-ecology			
	Highland (N=57)	Midland (N=81)	Overall (N=138)	
Parameters	%	%	%	P-value
Purpose of butter prodⁿ				
Consumption	10.5	14.8	13.0	0.859
For market	7	4.9	5.8	
Ointment	7	7.4	7.2	
All	75.4	72.8	73.9	
Uses of butter milk				
Consumption	10.5	16.0	13.8	0.476
Cottage cheese making	3.5	6.2	5.1	
Consumptⁿ& C cheese making	86.0	77.8	81.2	
Uses of whey				
Consumption	75.4	53.1	62.3	0.028
Providing animals(calf)	14.0	27.2	21.7	
Others	10.5	19.8	15.9	
Major purpose of MP				
Home consumption	5.3	4.9	5.1	0.953
For market	8.8	7.4	8	
Consumption & market	86.0	87.7	87	
Freq. Of consuming MP				
Every day	19.3	19.8	19.6	0.172
Once a week	8.8	21.0	15.9	
Three times a week	42.1	40.7	41.3	
During special occasion	29.8	18.5	23.2	
Ways of consuming milk				
In its raw state	10.5	18.5	15.2	0.006
After souring	89.5	69.5	77.5	
After boiling	0.0	12.3	7.2	
Methods of butter consuming				
With coffee	19.3	12.3	15.2	0.646
With food	14.0	13.6	13.8	
With coffee and food	61.4	70.4	66.7	
Drinking fermented butter	5.3	3.7	4.3	
Commonly consume milk				
Children	47.4	40.7	43.5	0.205
Women	0	4.9	2.9	
Men	52.6	54.3	53.6	

All the respondents (81.2%) reported that buttermilk is used for consumption and cottage cheese production, in both agro ecologies of the district.

In the study area all the milk produced and consumed is obtained from dairy cows. Milk and milk products have other additional functions in the area besides their nutritional value. They use fresh whole milk to neutralize toxins and butter for hair ointment. This result agrees with the report of Zelalem and Ledin (2001a) in the central highlands of Ethiopia.

According to the respondents in the study area the milk and milk products were used for household consumption, market and both consumption and market. Majority of respondents (87%) in the study area produce milk and milk product for consumption and market.

The butter produced in the study area was used for different purposes. The survey report indicated that (73.9%) of the respondents used butter for all purpose in different forms or states. Only 13%, 5.8% and 7.2% of the respondents used butter for consumption, market and ointment respectively. In generally, milk and its products used for home consumption, sale/income generation. A report on the review of Ethiopian dairy sector (Zelalem *et al.,* 2011) revealed that use of butter as hair oil is assumed to have dual functions: for hair dressing and to cure headaches, butter is also used as ointment and for relief on wounds is agreed with the result of this study district. Fresh butter is also used by children of weaning age and the elderly (Yonad, 2009).

In the study area, cow milk is mainly consumed in its raw state with being subjected to some sort of processing treatment. In the study area there is a variety of ways of consuming milk: in its raw state (15.2%), after processing/souring (77.5%) and after boiling (7.2%). This observation is contrasted with that reported earlier by Kebede *et al.* (2019) who indicated that

milk is consumed by Borana pastoralists in different forms which include fresh raw milk soon after milking in Borana pastoralists in Southern Ethiopia. This finding was supported by the study of Lemma (2004) cited in Kebede *et al.* (2019) who reported that in most cases fresh milk and fermented milk were not consumed on the daily bases, as they were reserved for further processing in Borana pastoralists in Southern Ethiopia

In the study area milk was commonly consumed by men (53.6%) followed by children (43.5%). Only 2.9% of women commonly consume milk in the study area this is due of culture of community that as give priority for husband and milk was the most beneficial for children overall health.

In the study area the survey report showed that in (Table 15) the methods of butter consuming were different. Most of the respondents (66.7%) in the study area consume butter with coffee and food. Only 4.3% of the respondents reported that they were consuming by drinking fermented butter. The frequency of consuming milk products were 19.6%, 15.9%, 41.3% and 23.2 at every day, once a week, three times a week and during special holidays respectively.

The common dairy products that have to be consumed in the area were butter milk, fermented sour milk (ergo), butter, whey, hadaro, shiffa and cheese. This study is contrasted with Eyassu and Gezu, (2018) they revealed that fresh whole milk, ergo (naturally fermented sour milk), Arrera (defatted sour milk), butter, ghee, Ayib (a traditional cottage cheese), Metata Ayib (a traditional fermented cottage cheese) and Zure are the common dairy products produced and consumed in different part of Ethiopia. From these products, the four most prioritized milk and milk products consumed indicated in (Table 16) were whey, cottage cheese, butter milk and butter with their ascending ranking order $4^{th,}$ 3rd, 2^{nd} and $1^{st,}$, respectively in highland and midland of the study area. The naturally fermented sour milk, fresh whole milk and ghee were

used as rarely consumed in the area. The results of the current study are in contrast with the report of Tsedey (2018) who indicated that butter milk and butter which is ranked as 1st and 2nd product used for home consumption in Sidama zone particularly.

Table 16: Consumption of dairy products

	Agro-ecology				
	Highland N=57		Midland N=81		
Parameters	Index	Rank	Index	Rank	P-value
Butter milk	0.32	2nd	0.28	2nd	0.006
Cottage cheese	0.23	3rd	0.20	3rd	0.002
Butter	0.38	1st	0.34	1st	0.243
Whey	0.068	4th	0.16	4th	0.006

* Index = [(4 for rank 1) + (3 for rank 2) + (2 for rank 3) + (1 for rank 4)] divided by sum of all weighted parameters mentioned by respondent.

4.9. Marketing of Milk and Milk Products

4.9.1. Marketing systems

The survey result in the study area indicated that there were no formal marketing channels for milk and milk by products in the study area. Dairy farm owners as a result sell their milk products informally to local market or village consumers. Cheese and butter were the only marketable dairy products in the study area. This result was opposite with Belay and Jassen (2014), Tsegaye and Gebreegziabhar (2015) and Kassa and Dekamo (2016) who reported that milk and butter were the main marketable dairy product in Jimma town, Wolaita and Sheka and Keffa Zone, respectively. Report by Woldemichael (2014) was in agreement with this report and disagree with Adebabay (2009) and Negash (2012) studies that reported formal market was limited to urban and per-urban areas where collection of milk is possible. Zegeye (2003) and Lemma (2004) came with the same conclusion that both rural and urban milk is distributed from

producers to consumers through the informal (traditional) means. Unlike Sheka zone, the practice of milk sell at Kaffa is not common in Gimbo district due to inefficient milk production and cultural restrictions (taboos) toward selling fresh whole milk followed by lack of market are the most common reasons reported.

In the study area all of respondents collect dairy products especially cheese and butter before sell because of either to collect marketable amount or up to market day. The average storage length of butter, ghee and cheese is presented in (Table 18). The survey result indicated that ghee could be stored up 1.52 years depending on the quality of the processing procedure. The survey result indicated that aged ghee was used to cure different human diseases like chronic malaria, coughing and stomach upset. The result was the same with Adebabay (2009) who indicated that ghee is used to cure disease locally called Mitch in Burie district. The shelf life of butter in this study was higher than the report of Adebabay (2009) and Kefyalew *et al*. (2016) 21.7 days and six to seven months in Burie and Dawa Chefa district, respectively but shelf life of ghee is lower. The average shelf life of cheese in the study area was 2.30±0.098 months and it significantly varied ($P<0.005$).

Marketing practice of milk and reason for not selling milk means of transportation, factors affecting milk price and frequency of selling milk product in the study area is presented in (Table 17). All of respondents (100%) do not practiced milk marketing. In both agro ecologies of the study areas milk marketing was absent due to preference to process (41.3%), lack of demand (10.1%), and lack of market (9.4%), low milk yield (13.8%) and cultural taboos (25.4%). This study was In line with result of Abebe *et al.* (2013) and Amistu *et al.* (2016) reported that 100% of respondents do not sold milk in Ezha districts of Guragie Zone and Alle district of Segen Zone, respectively. This study disagreed with the report of Tesfaye (2007) that

the shortage of milk (49.8%) is the main problem of milk marketing; while other problems like lack of access to market (21.2%), cultural restriction (20.8%) and the desire to convert whole milk into other dairy products (8.2%) are the reasons for not selling whole milk.

As it is indicated in studies like Negash (2012) and Sintayehu *et al. (*2008), fasting season also the main determinant for milk marketing in the study areas. During religious and some cultural festivals in the study area, dairy products were highly demanded. Thus, the prices of dairy products especially butter increase highly. In the current study fasting season (64.5%) was the major factors affect milk product prices followed by income (30.4%) and weather condition (5.1%). Religious festivals of Ethiopian Christians such as 'Enkutatash' (Ethiopian New Year), 'Meskel' (Finding of the True Cross), 'Genna' (Ethiopian Christmas), and 'Fasika' (Ethiopian Easter) were the main ones when animal products are highly demanded that leads to high prices.

The means of milk product transportation depend on the distance that milk producers were located (Table 17). Majority of respondents transport milk products to market place by their own foot (63.8%) depending on the distance to market. The rest milk producers in the study area were transported by cart (15.9%) and car and motor bicycle (2.3%).

The quality factors for selling and consumption of milk products in the study revealed that (55.1%) of the respondents check quality of milk products by cleanliness, colour, freshness, flavour and aroma. The rest of respondents check quality of products by cleanliness (11.6%), colour (9.4%) freshness (12.3%) and flavour and aroma (11.6%).

The frequency of selling milk product in month was different in highland and midland agro ecology of the study area. In the current study 3.5%, 19.3%, 56.1% and 21.1% of respondents

sold milk products once, twice three times and more than three times in month in highland agro ecology.

Table 17: Preconditions for dairy products marketing in study area

	Agro-ecology			
	Highland (N=57)	Midland (N=81)	Overall (N=138)	P -value
Parameters	**%**	**%**	**%**	
Collect butter & cheese for sale				
Yes	100	100	100	
Milk selling practice				
No	100	100	100	
Reasons of not selling milk				
Preference to process	42.1	40.7	41.3	0.604
Lack of demand	10.5	9.9	10.1	
Lack of market	5.3	12.3	9.4	
Low milk yield	12.3	14.8	13.8	
Cultural taboos	29.8	22.2	25.4	
Means of transportation				
On foot	68.4	60.5	63.8	0.000
By cart	26.3	8.6	15.9	
Others	5.3	30.9	20.3	
Quality factors for S and C of MP				
Cleanliness	5.3	16.0	11.6	0.005
Colour	3.5	13.6	9.4	
Freshness	8.8	14.8	12.3	
Flavour and aroma	8.8	13.6	11.6	
All	73.7	42	55.1	
Factors affect MP price				
Fasting season	71.9	59.3	64.5	0.051
Income	28.1	32.1	30.4	
Weather condition	0.0	8.6	5.1	
Freq. of selling MP in month				
Once	3.5	4.9	4.3	0.000
Twice	19.3	54.3	39.9	
Three times	56.1	28.4	39.9	
Others	21.1	12.3	15.9	

S =Sale, C=Consumption, MP=Milk Products,

In the current study 4.9%, 54.3%, 28.4% and 12.3% of respondents sold milk products once, twice, three times and more than three times in month in midland agro ecology. There is significant variation in selling frequency of milk products between study areas ($p<0.05$).

4.9.2. Marketable dairy products and prices

The survey result of marketable dairy products in the study district is shown in Table 18. Data obtained from the Rapid marketing appraisal (RMA) showed that marketable dairy products in the study area include traditionally processed butter and cottage cheese. On average about 27.76±0.79 litres of milk was produced/household/week from local dairy cows, out of which about 22.64 litres was accumulated for further processing and the remaining 5.12 litres consumed on weekly basis. On average about 1.57 kg of butter was produced per household per week in both agro ecologies. Out of this total production of butter about 1.14 kg per week (73%) was marketed and the remaining is consumed at home. On average about 47.58±1.02 litres of milk was produced/household/week from Jersey cross breed, out of which about 40.76 litres was accumulated for further processing and the remaining 6.82 litres consumed on weekly basis.

Majority of respondents interviewed in study district process cottage cheese. Majority of respondents who use produced traditional cottage cheese both for home consumption and sale. On average about 2.14 kg of cheese was produced per household per week in both agro ecologies. Out of this total production about 1.21 kg per week (57%) was marketed and the remaining 0.95kg (43%) used at home. In the study area amount of butter produced and sold, cheese produced, consumed and sold was significantly varied among study areas ($p<0.05$).

Butter marketing practices in the present study is indicated in (Table 17). All of respondents in the study area were involved in butter marketing. The result was in line with Menal and Yilkal

(2015) who reported that 90.98% of respondents sold butter in Kutcha district but higher than Zewudie (2010) and Abebe *et al.* (2013) only 56% and 60% of respondents sold butter in and around Zeway town and Ezha district. Butter marketing in the present study was mostly performed in market places reported by 76.1% of respondents but 21% and 2.9% replied that butter was sold around homesteads for consumers (neighbours) and both around homestead and market place, respectively (Table 19). The current result is in lined with this report of Adebabay (2009) reported that 83.4% of respondents sold butter in market place. The kind of butter buyers in the present study was individual (consumers), retailers and whole sellers reported by 38.4%, 49.3% and 12.3% of respondents, respectively (Table 19). The result is significantly varied ($p<0.05$) among the study areas. In highland areas majority of respondents (61.4%) replied that butter was sold for retailers while in midland areas butter was sold for both individual and retailers reported by 40.7% and 40.7% of respondents, respectively. The lowest percentage of respondents in both agro ecology that sold butter for whole sellers might be they are liked by consumers because the butter is expected to be free from adulteration. This result was similar with Tsegaye and Gebreegziabhar (2015) who reported that 41.9%, 13.3%, 2.9% and 41% of respondents sold milk for consumers, retailers, cooperatives and both consumers and retailers, respectively in Wolaita Zone.

As indicated in Table 18, the overall average minimum and maximum price of butter in the present study was 178.4±1.41 and 224.2±1.67 ETB/kg respectively. The result is significantly varied in case of selling price of both butter and cheese ($p<0.05$) among the study areas. The result was higher than the report of Kassahun *et al.* (2014), Kassa and Dekamo (2016) and Amistu *et al.* (2016) 100, 93 and 110 ETB/kg in East Shoa Zone, Keffa and Sheka Zone and Alle districts of southern Ethiopia, respectively. This result was also higher than the finding of Menal and Yilkal (2015) and Tsegaye and Gebreegziabhar (2015) 130 and 134.5 ETB/kg in

Chencha district and Wolaita Zone. However, this result was not comparable to the result of Menal and Yilkal (2015) and Melku (2016) 125 and 123 ETB/kg in Kutcha district and West Gojjam Zone, respectively. This is due to the price of butter is varied according to season of the year (wet season is cheaper than dry season), holidays and in every year when the price of other economic activities is increased.

The main butter marketing channels observed in the study area is presented in (Figure 4). Producer to consumer through travelling traders was the most commonly practiced butter marketing channel in the district. Because these traders have no measuring balance, marketing was by volume of butter only in a lowest price than consumers and big traders and if they have measuring balance they were not properly used. Butter marketing through producer to big traders and consumers was arrived up to Durame, Shone, Shinshicho, Boditti and other market areas.

In general, as it was seen during field visit in different market places, majority of respondents sold butter without measuring balance. The result indicates marketing of butter was at a standstill very usual and selling butter through this method might reduce the farmer's profit. Butter marketing channels in this study was the same with the result reported by Adebabay (2009) and Azage *et al.* (2013) in Burie and Metema district.

The average price of cheese was 74.1±0.76 and 95.5±0.93 ETB per kg at minimum and maximum marketing price respectively in the study area. The price of cheese indicated significant variation among study areas ($p<0.05$). The mean prices of cottage cheese (ayib) and butter were 84.8 per kg and 201.3 per kg respectively. This result is higher when compared with results of Abebe *et al.* (2013) and lower than Shewangizaw and Adisu (2014).

Table 18: Dairy products consumption, storage length, amount of milk churned, required time for churning & amount of butter obtained

	Agro-ecology			
	Highland (N=57)	Midland (N=81)	Overall (=138)	
Parameters	Mean±SE	Mean±SE	Mean±SE	P-value
JCrBr cow milk produced/wk	44.18±1.53	49.86±1.30	47.58±1.02	0.006
JCrBr cow milk consumed/wk	6.43±0.257	7.08±0.248	6.82±0.18	0.080
Local cow milk produced/wk	26.50±1.41	28.92±0.75	27.76±0.79	0.130
Localcow milk consumed/wk	5.25±0.39	5.00±0.17	5.12±0.20	0.556
Amount of butter prod/wk	1.44±0.075	1.66±0.06	1.57±0.05	0.027
Amount of butter cons/wk	0.42±0.02	0.48±0.22	0.46±0.01	0.065
Amount of butter sold/wk	1.03±0.062	1.21±0.05	1.14±0.03	0.028
Amount of cheese prod/wk	1.92±0.095	2.23±0.084	2.14±0.064	0.004
Amount of cheese cons/wk	0.83±0.40	1.04 ±0.036	0.95±0.028	0.000
Amount of cheese sold/wk	1.09±0.065	1.29 ±0.061	1.21±0.046	0.034
Minimum butter price/kg	176.58±1.97	179.69±1.96	178.4±1.41	0.280
Minimum cheese price/kg	73.69±1.24	74.44±0.97	74.1±0.76	0.627
Maximum butter price/kg	215.61±3.01	230.2±1.62	224.2±1.67	0.000
Maximum cheese price/kg	91.67±1.01	98.27±1.34	95.5±0.93	0.000
Butter storage length (month)	2.82±0.097	2.62±0.138	2.70±0.090	0.261
Cheese storage length (month)	2.61±0.127	2.07±0.136	2.30±0.098	0.006
Ghee storage length(years)	1.61±0.065	1.46±0.056	1.52±0.043	0.069
AOFMClb at a time	2.72±0.15	2.92±0.14	2.83±0.10	0.373
Required time for churning	1.70±0.05	1.62±0.03	1.66±0.03	0.190
Amount of butter obtained	0.16±0.06	0.17±0.01	0.17±0.007	0.412
AOFMClb at a time	4.01±0.19	4.86±0.42	4.52±0.26	0.121
Required time for churning	1.74±0.03	1.60±0.02	1.66±0.02	0.001
Amount of butter obtained	0.17±0.005	0.20±0.006	0.19±0.004	0.005

Where, JCrBr=Jersey Cross breed, Prod=Produced, Wk=Week, Kg=Kilogram, L=litre, hh=household, AOFMC=amount of fermented milk churned at a time, lb=local breed, cb=cross breed.

4.9.3. Supply, demand and price factors of milk products

As far as market information concerns, farmers used different sources of information for existing market prices of dairy products. Overall 57.2%, 28.3%, 7.2% and 7.2% respondents get market information from traders, neighbours, and personnel visit and extension agents respectively.

The sources of market information indicated significant variation among study areas ($p<0.05$). Majority of the respondents milk products varieties with different selling price in the study district during none fasting and fasting days with 100% cash means of payment (Table 19). As it is common in Ethiopia, informal dairy marketing is the only marketing system in the study district; these involved direct delivery of cheese and butter by farmers to local market, neighbouring consumers, and others (individual consumers, restaurant in the immediate neighbourhood and sales to travelling traders and individuals) in nearby areas.

The survey result in the current study area indicated that butter and cheese was the most marketable milk product in the study area which accounts 63.8% butter and cheese commonly, only 20.3% and 15.9% sell cheese and butter separately.

Majority of the respondents sold their milk products for different customers in the study district. The result indicated that 49.3% of respondents sold for retailers 49.3%, for individuals 38.4% and 12.3% for whole sellers in average. There is a significant variation on selling milk products in the study area ($p<0.05$).

The major factors affecting the prices and demands of dairy products in the studied area included season (dry and wet seasons), access to market, fasting and non-fasting days (followers of the Orthodox Christian church), holidays and during the beginning of school (to purchase

exercise books, pens, pencil, clothes), quantity of dairy supply versus purchasing ability of the urban dwellers as well as quality versus origin of the product.

Table 19: Supply, demand and price factors of milk products

	Agro-ecology			
	Highland (N=57)	Midland (N=81)	Overall (N=138)	
Parameters	%	%	%	P-value
Source of market inform[n]				
Extension agent	3.5	9.9	7.2	0.042
Neighbours	28.1	28.4	28.3	
Personnel visit	14.0	2.5	7.2	
Traders	54.4	59.3	57.2	
Selling place of MP				
Local market	71.9	79.1	76.1	0.069
Neighbours	28.1	16.0	21.0	
Others	0.0	4.9	2.9	
Selling MP				
To individual	35.1	40.7	38.4	0.010
To retailers	61.4	40.7	49.3	
Whole sellers	3.5	18.5	12.3	
Type of MP sold				
Butter	26.3	16.0	20.3	0.087
Cheese	8.8	21.1	15.9	
Butter & cheese	64.9	63.0	63.8	
Milk product price rises				
During holiday	43.9	55.6	50.7	0.000
Dry season	24.6	40.7	34.1	
During holiday & dry season	31.6	3.7	15.2	
Butter into other product				
Yes	45.6	55.6	51.4	0.250
No	54.4	44.4	48.6	
Products from butter				
Ghee	100	100	100	
Spices for butter processing				
Yes	100	100	100	
Problem of marketing				
Yes	56.1	29.6	40.6	0.002

MP=Milk Products, **inform[n]=** Information**,**

The price and demand for milk and milk products, especially butter and cottage cheese, are highly exposed to the revealed factors. The current study indicated that the prices of milk products was highly affected by holidays which accounts 50.7% .This result was agreed with the report of Sintayehu *et al.* (2008) at Shashemene–Dilla area, South Ethiopia.

Overall 51.4% of the respondents in the study area process butter into other products like ghee and all of the respondents used spices for processing butter.

The income will then be used to cover relatively large expenses such as circumcision of children, to provide son in laws family as a gift (Geegeyya in local name) and wedding ceremonies. This finding was in lined with Gebremedhin *et al.* (2014), who reported that, a traditional butter group known as shufo (in local name) exists whereby a group of women come together and each member takes turn to receive butter produced by all other members at Dila Woreda, Southern Ethiopia. According Gebremedhin *et al.* (2014) local saving institutions are also used by butter producers to save part of their income from the sale of butter.

The current study showed that there is a problem of milk product marketing in the study area. Over all 40.6% of respondents reported milk product marketing problem in the study districts. Marketing problem was highly reported in the highland agro ecology as compared to the mid land this is due to lack road access. There is a significant variation in marketing problems of milk products ($p<0.05$).

4.9.4. Market channels of milk products

Butter was the most marketable dairy product having the longest market channel and more intermediates between producers and consumers, while cottage cheese had few intermediates

and reached consumers with the shortest channel as compared to butter market channels in the study area.

In general, prices of dairy products fluctuate and are influenced by a number of drivers such as season, distance and access to markets, fasting periods, festival and holidays, purchasing power of consumers; while quality, origin of the product, sales outlet (farm gate, delivery system or open market) and the production system are especially important for butter.

Market channels for butter and cottage cheese in the study area are listed in the following manner:

1. Butter

   Producer →Consumer

   Producer→Itinerant trader's → Consumer

   Producer → Retailers → Consumer

   Producer → Wholesalers → Consumer

   Produce→ Wholesalers → Retailers →Consumer

2. Cottage

   Producer → Consumer

   Producer→Itinerant trader's → Consumer

   Producer → Retailers → Consumer

   Producer → Wholesalers → Retailers → Consumer

4.9.5. Market chain for milk and milk products

The association of different selling methods provide rise to the market chain. The market chains in the studied district were more simple and traditional. In the study area, outflow of butter from the studied areas to Durame, Shone, Lera, Helaba and Shinshicho areas was transported long

distances. Therefore, butter is the mainly saleable dairy product having more market path over long distances.

The milk and milk product market chain of the study district is showed in Figure 5.

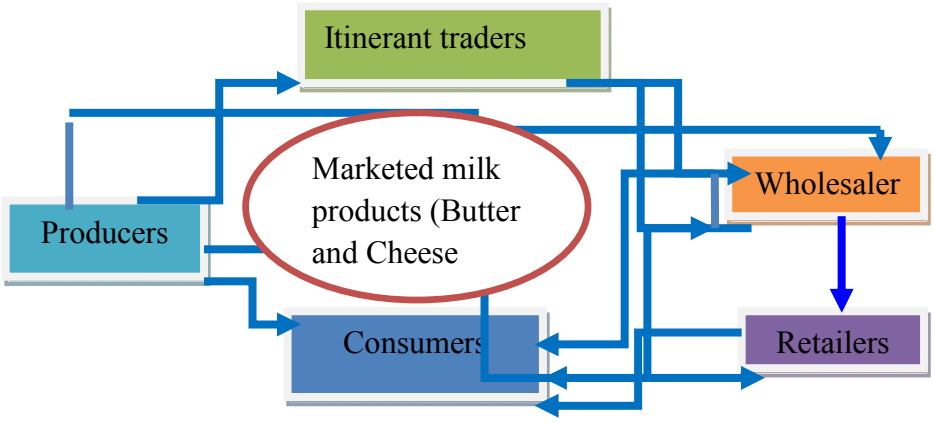

Figure 5: The milk and milk product market chain in the study area.

4.10. Milk Production Constraints in the Study Area

Dairy producers in the studied areas prioritized the major constraints as lack of quality forage/roughages, low milk yield of local cows, high cost of cattle concentrate feed and lack of improved breeds as 1st, 2nd, 3rd and 4th, respectively (Table 20). The extent and significance of the problems and constraints differed between and within the different studied areas. In addition, conservation and utilization of available crop residues are not widely practiced due. The major constraints pertaining to cattle production in the study areas are ranked in Table 20. These observations are in close accordance with the findings (Chali Yimamu, 2014) that shortages of feed followed by shrinkage of grazing areas are the two major causes identified by the respondents in from Arsi Highlands of Oromia region and Bench-Maji zone, South west Ethiopia (Desalegn 2015). The current study is also similar with findings of Andualem *et.al.* (2015), Shortage of improved breeds and low productivity of indigenous cattle are constraints of

milk production reported by the respondents followed by shortage of feed resources and grazing in the area. The result obtained in the current study was agreement with the finding of Bekele *et al.* (2015) and Fayo (2006) who reported feed shortage as the major constraint that donated to the low production and productivity of dairy cattle in Dangila town and in and around Dire Dawa town, respectively.

Table 20: Milk production constraints in the study area

	Agro-ecology				
	Highland (N=57)		Midland(N=81)		
Parameters	Index	Rank	Index	Rank	P-value
Lack of quality fodder/roughage	0.321	1st	0.30	1st	0.000
Cost of cattle concentrate feed	0.234	3rd	0.23	3rd	
Lack of improved breeds	0.201	4th	0.19	4th	
Low milk yield of local cows	0.243	2nd	0.27	2nd	

* Index = [(4 for rank 1) + (3 for rank 2) + (2 for rank 3) + (1 for rank 4)] divided by sum of all weighted parameters mentioned by respondent.

4.11. Milk and Milk Products Marketing Constraints

Dairy product marketing constraints in the study areas are shown in Table 21. Marketing constraints in the studied areas prioritized as marketing channel, transportation problems, distance to market site, poor quality of milk and absence of sufficient buyer as 1st, 2nd, 3rd, 4th, and 5threspectively. This result is similar to the findings of Kassu, (2016) which indicated that distance to marketing points is the major problem. This result is contrary to the report of Tegegne *et al.* (2013) in east Showa Zone of Oromia, that among the several reasons reported by farmers, insufficient amount of milk production and cultural restriction were the most common hindering factors. The major constraints occurred in the studied area mainly during fasting and the rainy season (Kiremt). About 64.5% of the respondents reported that there was less demand

for dairy products during fasting time and the rest 30.4% and 5.1% of respondents reported income and weather or (season) that in the rainy seasons there was a marketing concern due to the increased in milk production in studied areas.

Table 21: Market constraints of milk and milk products

	Agro-ecology				
	Highland(N=57)		Midland(N=81)		
Parameters	Index	Rank	Index	Rank	P-value
Absence of sufficient buyer	0.083	5th	0.14	5th	0.000
Poor quality of milk	0.176	4th	0.15	4th	0.006
Transportation	0.221	2nd	0.23	2nd	0.207
Distance to market	0.333	1st	0.22	3rd	0.000
Marketing system/channel	0.185	3rd	0.26	1st	0.003

* Index = [(4 for rank 1) + (3 for rank 2) + (2 for rank 3) + (1 for rank 4)] divided by sum of all weighted parameters mentioned by respondent.

4.12. Opportunities for Milk and Milk Products Developments

Despite the above constraints, in study areas there is longstanding and strong culture of consumption of dairy products that increase demand for consumption of milk and milk products was identified as an opportunity. Generally in both agro ecologies of the study area producers were more willing to continue and expand dairying due to market opportunities in areas. Because of the rapid urbanization of surrounding town, substantial population growth and change in the living standard by societies in the area, the demand for good quality and quantity of dairy products are highly increasing.

Absence of cultural or religious prohibition of dairy products consumption could also be cited as positive factor for future development. Dairy producers also articulated their motivation to carry on working and expanding their milk production. For instance strong indigenous knowledge

exists in the preservation of milk and milk products in the dairy system using various sources of plant species. On the other hand, Ethiopian government recognizes the importance of livestock in poverty alleviation and it has increased its emphasis on modernizing and commercializing livestock sector in recent years. Development of infrastructural sector, such road access connecting towns with kebeles are another opportunities.

Market opportunity and linkage are main issues for dairy producers, support services in terms of accessing adequate land, organizing input supplies, provision of credit, extension and training services, production and business skills development are essential input for achievement.

The other future opportunities for dairy cattle production in current study areas are fast growing population and urbanization. In this regard, road construction, water supply, electrification, communication activities would favour modern dairying of rural areas.

5. SUMMARY AND CONCLUSION

This study covered dairy cattle milk production practices, processing, consumption and marketing system of milk and its products in Mirab Badewacho district, Hadiyya Zone, Southern, Ethiopia. Milk production system practiced in the study area was crop livestock mixed production system identified and characterized. Hand milking was the only milking procedure in the study area and mothers share almost all of milking responsibility. Thrice milking (87%) per day indicates the highest frequency in both agro ecology of the study area. Majority of respondents were let calves to suckle partially before milking which is (59.6%) and (42.0%) in both high and midland agro-ecologies, respectively.

Reproductive traits of age at first calving(4.57±0.07) and day's open of (198.54±3.56)local cows was longer as compared with (2.98±0.05) and (154.39±2.65)Jersey crossbreed cows. The overall milk yield of local cattle and Jersey cross breed were 1.9 and 5.16 litres respectively.

Butter milk (locally gimma), ergo (fermented milk), whole milk, hadaro (locally natural soured two-three week milk after calving), shiffa (partially churned fermented milk), whey, butter and cottage cheese (ayib) were the common dairy products produced and consumed with varying degree of consumption. Hadaro and shiffa was unique traditionally processed dairy products in the area. Milk processing in the study area was entirely based on souring milk and traditionally processed at home.

The current survey reported the spices *Ocimum kilimandscharicum Guerke (*locally axxi gemenjja) red onion and kosarat (*Ocimumhaardiense*) were commonly used especially during for hadaro and buttermilk processing. *Achytusaspera* (locally minantof) is the most common plant species used to clean vessels used to store milk and milk products.

Marketable milk products in the study areas were butter and cheese. There was no selling practice of fresh and butter milk in the study area. The dairy product marketing system identified in the study area was entirely informal marketing system in which the farmers sell butter and cheese directly to consumers, retailers, neighbours and traders. The most common butter marketing channels were from the producers to consumers, producers to traders and from traders to consumers.

In general, Dairy producers in the studied areas prioritized the major constraints as lack of quality forage/roughages, low milk yield of local cows, high cost of cattle concentrate feed and lack of improved breeds as 1st, 2nd, 3rd and 4th, respectively.

Major marketing constraints reported by respondents were absence of sufficient buyer, transportation, marketing system especially unit less marketing of butter and cheese, distance to market and poor quality of milk.

In general, this study showed that despite the available cattle population and conducive agro-climate for dairy development, the performance of milk production in the study district was low and milk marketing system was undeveloped due to many constraints such as marketing channel, transport access, poor quality of milk and institutional related constraints. Therefore, dairy cattle milk production can be improved by solving constraints such as low milk yield of local cattle's, feed shortage, health care, general husbandry and milk processing facilities, AI and extension services and developing efficient marketing systems.

6. RECOMMENDATIONS

Based on the above findings, the following necessary recommendations have been developed

- Changing the attitude of the farmers through training and other mechanisms should be done to improve the handling practices of milk and milk products and to avoid cultural restriction. On the other hand, establishing strong dairy cooperatives should be done.
- There is a need to build up extension activities to increase milk production in the area and to change the attitude of farmers in the direction of fresh milk sale.
- To improve the situation, strong extension service in feed conservation and utilization techniques and animal health management should be sought.
- In order to achieve these, provision of training to the farming communities is imperative so as to improve their knowledge and skills on the management of dairy animals.
- Provision of training to the farming communities is imperative so as to improve their knowledge and skills on the management of dairy animals, and production of quality milk.
- Dairy production in the study areas can be improved by solving constraints such as feed supply, sanitation, introduction of cross breeds, veterinary care, and milk processing facilities, AI services, extension services and developing efficient marketing systems.
- It is recommended that adequate sanitary measures should be taken at every stage from production up to consumption to produce milk and milk products of good quality and protect the health of the consumers in addition to further research works.

7. REFERENCE

Abebe B, Zelalem Y and Ajebu N (2012). Hygienic and microbial quality of raw whole cow's milk produced in Ezha District of the Gurage zone, Southern Ethiopia. Journal of Agricultural Research 1(11):459-465.

Abebe B. Zelalem, Y. and Ajebu N., 2013. Handling, processing and utilization of milk and milk products in Ezha district of Guragie Zone, Southern Ethiopia. Journal of Agricultural Biotechnology and Sustainable Development. 5(6):91-98.

Abebe Bereda, Mohammed Yesuf Kurtu and Zelalem Yilma, 2012. Handling, Processing and Utilization of Milk and Milk Products in Ethiopia: A ReviewJournal

Adebabay Kebede Belew, 2009. Characterization of milk Production Systems, Marketing and On-Farm Evaluation of the effect of Feed Supplementation Milk yield and Milk Composition of Cows at Bure District. MSc Thesis

Adugna, T. and Aster, A., 2007. Livestock production in pastoral and agro-pastoral production systems of southern Ethiopia. Livestock Research for Rural Development.

Ahmed Muhamed M., Ehui S. K. and Yemisrach Assefa,2004. Dairy development in Ethiopia. Socio-economic and Policy Research Working Paper-58.ILRINairobi, Kenya. pp 47.

Alganesh Tola (2002). Traditional Milk and Milk Products Handling Practices and Raw Quality in Eastern Wollega, Ethiopia.

Amenu, K., B. Szonyi, D. Grace, and B. Wieland, 2017. Important knowledge gaps among pastoralists on causes and treatment of udder health problems in livestock in southern Ethiopia: Results of qualitative investigation. BMC Vet. Res. 13:303. https://doi.org/ 10.1186/s12917-017-1222-1.

Amistu K., Sanago S. and Dawit C., 2016. Assessment of traditional dairy production, milk marketing and processing system: In the case of Alle district, Segen Peoples Zone, Southern Ethiopia. Journal of marketing and consumer research 24.

Andualem Tenagne, Getinet Mekuriaw and Dillip Kumar, (2015). Phenotypic Characterization of Indigenous Cattle Populations in West Gojjam Administrative Zones, Amhara National Regional State, Ethiopia, Journal of Life Science and Biomedicine (JLSB), 6(6): 127-138.

Anteneh,T., M. Tetemke and A. Mogessie, 2011.The inhibition of some food borne pathogens by mixed LAB cultures during preparation and storage of Ayib, a traditional Ethiopian cottage cheese.

Asaminew Tassew And Eyassu Seifu, 2009. Smallholder Dairy Production System and Emergence of Dairy Cooperatives In Bahir Dar Zuria And Mecha Woredas, Northwestern Ethiopia. World Journal of Dairy & Food Sciences 4 (2): 185-192, 2009. Andassa Livestock Research Center, Bahir Dar, Ethiopia.

Asaminew Tassew, 2007. Production, handling, traditional processing practices and quality of milk in Bahir Dar milk shed Area, Ethiopia. M.Sc. Thesis. Alemaya University, Ethiopia.

Asrat A, Zelalem Y and Ajebu N. (2014). Production, utilization and marketing of milk and milk products: Quality of fresh whole milk produced in and around Boditti, Wolaita,Southern Ethiopia pp75-76.

Asrat Ayza*, Ayele Amanuel and Milkias Kassa, 2015. Dairy Cattle Production Systems in Humbo Woreda, Wolaita Zone, Southern Ethiopia.

Asrat Ayza, Feleke, Asfaw and Ermias Belete, 2016. Characterization of Dairy Cattle Production Systems in and around Wolaita Sodo Town, Southern Ethiopia.

Asrat Ayza, Zelalem Yilma* and Ajebu Nurfeta**, 2013. Characterization of milk production systems in and around Boditti, South Ethiopia.

Assefa E, Beyene F and Santhanam A (2008). Isolation and characterization of inhibitory substance producing lactic acid bacteria from Ergo, Ethiopian traditional fermented milk. Livest. Res. Rural Dev. Volume 20, Article #44.

Atashi H., Zamiri MJ. & Dadpasand M. 2013. Association between dry period length and lactation performance, lactation curve, calf birth weight, and dystocia in Holstein dairy cows in Iran. Journal Dairy Science. (6):3632-8.

Ayalewu Mekonnen, 2017. Milk production, Handling, Processing and Marketing in Three Dairy Production Systems of South Wollo Zone, Amhara National Regional State, Ethiopia. MSc Thesis

Ayantu Mekonnen, Aynalem Haile, Tadelle Dessie and Yosef Mekasha, (2012). On farm characterization of Horro cattle breed production systems in western Oromia, Ethiopia.

Aysheshim Bekele, Fekadu Beyene and Mitiku Eshetu, (2015).Chemical composition and microbial quality of cow milk in urban and peri urban area of Dangila town, Western Amhara Region, Ethiopia.; vol. 3(1):081 – 085.

Azage Tegegne, Birhanu Gebremedhin, Dirk Hoekstra, and Nigussie Alemayehu, 2007. Rural Urban Linkage in Market-oriented Dairy Development in Ethiopia: Lessons from the Ada'a Dairy Cooperative. IPMS Project, ILRI, P.O. Box 5689, Addis Ababa, Ethiopia.

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

Azage.T, 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.

Banda PT, 2010. Dairy processing module MAV411.SADC-university of Zimbabwe regional postgraduate program in dairy science and technology, Harare, Zimbabwe. Pp 1 Res 27: 1-6.

Bayou E., A. Haile, S. Gizaw, and Y. Mekasha, 2015. Evaluation of non-genetic factors affecting calf growth, reproductive performance and milk yield of traditionally managed Sheko cattle in southwest Ethiopia.

Bekele Aysheshim, Fekadu Beyene and Mitiku Eshetu. (2015). Handling, processing and marketing of cow milk in urban and peri urban area of Dangila town, Western Amhara region.Global Journal of Food Science and Technology, 3(1):081-085.

Bekele Shiferaw. 1991. Crop-livestock interactions in the Ethiopian highlands and effects onsustainability of mixed farming: a case study from Ada district. AgriculturalUniversity of Norway, Oslo, Norway. 162 pp. (M.Sc. thesis).

Belay Beyene, Demissu Hundie and Geleta Gobena, 2015. Assessment on Dairy Production System and its Constraints in Horoguduru Wollega Zone, Western Ethiopia. Science, Technology and Arts Research Journal. 4(2): 215-221.

Belay D. and Janssen G.P.J., 2014. Small holder milk processing and marketing characteristics at urban dairy farms in Jimma towns of Oromia Regional State, Ethiopia. Globalveternaria. 13(3):285.

Belay Duguma, Yisehak Kechero and G.P.J. Janssens, 2012. Productive and Reproductive Performance of Zebu X Holstein-Friesian Crossbred Dairy Cows in Jimma Town, Oromia, Ethiopia,Department of Animal Science, Jimma University, Jimma, Ethiopia, Laboratory of Animal Nutrition, Ghent University, Merelbeke, Belgium.

Belay D., Y. Kechero and G.P.J. Janssens, 2012. Socio-economic factors influencing urban small-scale dairy management practices in Jimma town, Ethiopia. Libyan Agriculture Research Center Journal International, 3(1): 07-12.

Belete A. 2006. Studies on Cattle Milk and Meat Production Fogera District: Production Systems, Constraints and Opportunities for Development, MSc Thesis, Debub University, Ethiopia.

Belete Anteneh, AzageTegegne, FekaduBeyene and BerhanuGebremedhin, 2010. Cattle milk and meat production and marketing systems and opportunities for market-orientation in Fogeraworeda, Amhara region, Ethiopia.

Beriso Kibru 1 , Berihan Tamir 2 and Teka Feyera 3*, 2015. Characterization of Smallholder Cattle Milk Production System in Aleta Chukko District, Southern Ethiopia.

Beyene F., 1994. Present situation and future aspects of milk production, milk handling and processing of dairy products in Southern Ethiopia. PhD Thesis, Agricultural University of Norway. Norway.

Chali Yimamu, (2014). In Situ Phenotypic Characterization and Production System Study of Arsi Cattle Type in Arsi Highland of Oromia Region, Ethiopia.

Cochran W. G., 1977. Sampling techniques, 3rd edition. New York: John Wiley and Sons.

CSA (Central Statistical Agency). 2010: Livestock and livestock characteristics. Agricultural sample survey. Stat. Bull. 2(468):107. Ethiopia.

CSA (Central Statistical Authority) 2019/20120. Agricultural Sample Survey. Report on Livestock and Livestock Characteristics (Private Peasant Holdings) Volume II Addis Ababa.

CSA (Central Statistics Authority), 2009. Agricultural sample survey 2008/09. Report on livestock and livestock characteristics. Statistical bulletin 446. Addis Ababa, Ethiopia: CSA.

CSA (2016/2017). Federal democratic Republic of Ethiopia, Agricultural sample Survey 2016/2017, Volume 2, Livestock and Livestock Characteristics, Addis Ababa, Ethiopia.

Dairy Value Chains, End Markets and Food Security Cooperative Agreement 663-A-00-05- 00431-0 November 2010.

Debir Legesse, 2016. A Review on Dairy Cattle Breeding Practices in Ethiopia. South Agricultural Research Institute (SARI), Hawassa .Vol.6, No.7.

Demissu Hundie, Fekadu Beyene and Gemeda Duguma. 2013. Early Growth and Reproductive Performances of Horro Cattle and their F1 Jersey Crosses in and around Horro-Guduru Livestock Production and Research Center, Ethiopia. Science, Technology and Arts Research Journal. 2(3): 134-141.

Derese T., 2008. Present situation of urban and peri-urban milk production and quality of raw milk produced in West Shewa Zone, Oromia Region, Ethiopia, M.S. thesis, Haramaya University, Alemaya, Ethiopia.

Dessalegn Genzebu, (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.

Dessalegn Genzebu, Berhan Tamir and Gebre yohanes Berhane, 2016. Study of productive and reproductive performance of cross breed dairy cattle under smallholder's management system in Bishoftu and Akaki Towns International journal of agricultural science ISSN volume-6pp-913-9176 volume6 international Journal.

Endale Tesfaye, 2018. Dairy technology adoption on milk handling quality, consumption pattern and income level of farmers in dairy technology adopters and non-adopter households in Sidama Zone, Southern Ethopia.

Endashaw Terefe, Tadelle Dessie, Aynalem Haile, Wudyalew Mulatu and Okeyo Mwai, (2012). Husbandry and breeding practices of cattle in Mursi and Bodi pastoral communities in Southwest Ethiopia, African Journal of Agricultural Research, 7 (45), 5986 5994.

Esayas, A., B. Fekadu and S. Amutha, 2008. Effect of temperature and pH on the antimicrobial activity of inhibitory substances produced by lactic bacteria isolated from Ergo, Ethiopian traditional fermented milk. Afr. J. Microbiol. Res., 2: 229-234.

Eyassu Seifu and Asaminew Tassew, 2014. Small-scale Milk processing, Utilization and Marketing of Traditional Dairy Products in Bahir Dar Zuria and Mecha Districts, Northwestern Ethiopia.

Falvey L and Chantalakhana C 1999. Smallholder dairying in the tropics. ILRI, Nairobi.

FAO (2005). The Technology of Traditional Milk Products in Developing Countries. FAO animal production and health paper 85. Rome, Italy, p. 34. 15.

FAO (2010). Status and Prospects for Smallholder Milk Production: A Global Perspective. Hemme T, Otte J (Eds.), Rome, Italy.

Fayo Dubiso 2006. Assessment of Milk Production, Marketing, Feeds and Feeding System of Dairy Cows in and Around Dire Dawa Town M.Sc. Thesis presented to the School of Graduate Studies of Alemaya University, Ethiopia.

Fikrineh Negash,Estefanos Tadesse, Esayas Aseffa, Chali Yimamu and Feyisa Hundessa (2012). Production, handling, processing, utilization and marketing of milk in the Mid Rift Valley of Ethiopia.

Gatwech Tang 2012. Dairy production, Processing And Market System: A case Study of Gambella, South West Ethiopia.

Gebremedhin B, Tegegne A, Hoekstra D, Jemaneh S, Shiferaw K, Bogale A. et al . Developing the butter value chain in Ethiopia. LIVES Working Paper 1. Nairobi, Kenya: International Livestock Research Institute.

Gebremichael. D, Belay.B, Tegegne.A (2015). Assessment of Breeding Practice of Dairy Cattle in Central Zone of Tigray, Northern Ethiopia',Jornal of biology,agriculture and healthcare vol 5(23), pp. 96–105.

Getachew Felleke, 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.

Getachew, M. and Tadele, Y. 2015.Constraints and opportunities of dairy cattle production in Chencha and Kucha districts, Southern Ethiopia.', Journal of Biology, Agriculture and Healthcare, 5(15), pp. 38 43.

Getnet Haile Consultant, 2009. The impact of Global Economic & Financial Crises on the Ethiopian Dairy Industry pp-13.

Getu Addis, Tadese Guadu, Shewangizaw Addisu, Asechalew Asefa, Maleda Birhan, Nibrete Mogese, Mersha Chanie, Basazenew Bogale, Atnaf Alebie, Atsedewoyne Feresebhate, Tegegn Fantahun and Tadegegne Mitiku. 2016. Crossbreeding challenges and its effect on dairy cattle performances in Amhara region, Ethiopia. Online J. Anim. Feed Res., 6(5): 96-102.

Gezu Tadesse1, Haftu Kebede1 and Sefa Salo1., 2014. Feed resources and constraints for cattle fattening in Lemo and Soro woredas, Hadya zone, Southern Ethiopia.

Girma Debele and Marco Verschuur, 2014. Analysis of milk value chain: the case of Ada'a dairy cooperative in Ada'a district, East Shawa zone of Oromia regional state, Ethiopia Wudpecker Journal of Agricultural Research Vol. 3(1), pp. 016 025, Income in the Central Highlands of Ethiopia In Proceedings of 8th annual conference of the Ethiopian society of Animal production. (ESAP) 24-26 August 2000, Addis Ababa, pp 139-154.

Girma, A. 2008. Dairy services delivery in Debre Zeit milk shed of Ada'a district, central Ethiopia: Analyzing options to develop pluralistic service delivery in the dairy sector. MSc thesis. School of Graduate Studies, Haramaya University, Haramaya, Ethiopia.

Gonfa A, Howard A F and Wilhelm H H 2001 Field survey and literature review on traditional fermented milk products of Ethiopia, International Journal of Food Microbiology 68: 173-186.

Haile W., Zelalem Y. and Yosef TG. 2012. Hygienic practices and microbiological quality of raw milk produced under different farm size in Hawassa, Southern Ethiopia. Journal of Agricultural Research and Reviews. 1(4):132-142.

Henery T (2006) Food Composition Table for Use in Ethiopia. Part III. Ethiopian health and nutrition research institute. Addis Ababa, Ethiopia, p. 34.

Holden SJ, Coppock DL. Effect of Distance to Market, Season and family wealth on Pastoral dairy marketing in Ethiopia. Journal of Arid environments. 1992;23:321–334.

Holloway, G., C. Nicholson, C. Delgado, C.S. Staal and S. Ehui, 2000. A case study from the Ethiopian highlands. Socio-economic and policy research working paper 28. International Livestock Research Institute (ILRI), Nairobi, Kenya. 28p.

Hunduma Dinka. 2012. Reproductive performance of crossbred dairy cows under smallholder condition in Ethiopia. International Journal of Livestock Production. pp. 25–28.

Ike A, A Mane-Bielfeldt, Girma A and Anne VZ. (2005). Comparison of urban and peri-urban dairying in Awassa, Ethiopia. Paper presented "Rural Poverty Reduction through Research or Development and Transformation in Deutscher Tropentag, October 5-7, 2004 in Berlin.

ILCA (International Livestock Centre for Africa). 1990. Livestock systems research manual.1 (1). ILCA, Addis Ababa, Ethiopia. 399 pp.

ILRI (2017). International Livestock Research Institute for Ethiopia livestock sector analysis.

Kassa T. and Dekamo F., 2016. Dairy production and marketing systems in Kaffa and Sheka Zones, Southern Ethiopia. Journal of Marketing and Consumer Research.1(27).

Kassahun G, Taye T, Adugna T, Fekadu B, and Solmon D (2015). Feed Resources and Livestock Production Situation in the Highland and Mid Altitude Areas of Horro Oromia Regional State, Western Ethiopia. Sci. Technol. Arts Res. J., July-Sep 2015, 4(3): 111-116.

Kassahun Gurmessa1 *, Taye Tolemariam 1 Adugna Tolera2 , Fekadu Beyene and Solmon Demeke, 2015. Feed Resources and Livestock Production Situation in the Highland and Mid Altitude Areas of Horro and Guduru Districts of Oromia Regional State, Western Ethiopia.

Kassahun M. Bilatu A. and Adey M. 2014. Milk marketing and post harvest loses problem in Ada'a and Lumie district of East Shoa Zone, Central Ethiopia. Sky Journal of Food science. 3(4):27-33.

Kassu Tsegaye, 2016. Assessment of milk production and marketing systems, and evaluation of the productive performances of crossbred dairy cows in Bona Zuria district of Sidama Zone, Southern Ethiopia. MSc Thesis.

Kebede Amenu, Barbara Wieland, Barbara Szonyi and Delia Grace. 2019. Milk handling practices and consumption behaviour among Borana pastoralists in southern Ethiopia. Journal of health, population and Nutrition. 38.

Kedija H., 2007. Characterization of milk production system and opportunity for market orientation: A case study of Mieso district, Oromia Region, Ethiopia. A MSc. Thesis, Haramaya University, Dire Dawa, Ethiopia. 184p.

Kefyalew Gebeyew, Solomon Amakelew, Mitku Eshetu and Getachew Animut, 2016.Production, Processing and Handling of Cow Milk in Dawa Chefa District, Amhara Region, Ethiopia.

Keralem Ejigu, 2005. Honeybee production systems, opportunities and challenges in enebse Esarmidir wereda (Amhara region) and Amaro Special Wereda (Southern Nations, Nationalities and Peoples Region), Ethiopia. M.Sc. Thesis, Alemaya University, Ethiopia.

Kiros Abebe, Berhan Tamir, Gebeyehu Goshu, Tilaye Demissie and Fekadu Regassa, 2018. Dairy Cattle Management Practices in Selected Urban and Peri-Urban Areas of Central Highlands of Ethiopia. Global Veterinaria. 20(6): 271-277.

Kosgey. 2004. Characterization of goat production systems and trait preferences of goat keepers in Bench Maji zone, south western Ethiopia.

Lemma Fita. 2004. Assessment of butter quality and butter making efficiency of new churns compared to smallholders' butter making techniques in East Shoa Zone of Oromia. MSc thesis, Alemaya University, Alemaya, Ethiopia: pp129.

Lemma, F., Fekadu, B. and P.B. Hegde, 2005. Rural Smallholders Milk and Dairy Products Production, Utilization and Marketing Systems in East Shoa Zone of Oromia. PP. 17-28. In: Proceedings of the 12th Annual Conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia, August 12-14, 2004.

Lijalem T and Zereu G, 2106. Production and Reproduction Performances of local dairy cattle: In case of Rural community of Wolaita Zone, southern Ethiopia. Review Journal

Meaza Mandefot 2017. Longitudinal Study on Reproductive and Productive Performances of Smallholder Crossbred Dairy Cattle in and Around Wolaita Sodo, SNNPR, Ethiopia. Journal of veterinary science & technology. 8: 458.

Mebrahtom Bisrat and Hailemichael Nigussie. 2016. Comparative Evaluation on Productive and Reproductive Performance of Indigenous and Crossbred Dairy Cow Managed under Smallholder Farmers in Endamehoni District, Tigray, Ethiopia. Journal of Biology, Agriculture and Healthcare. 6(17).

Mebrate Getabalew1,Tewodros Alemneh*2 and Dawit Akeberegn3 2019. Dairy Production in Ethiopia.

Melku M. 2016. Milk production and reproductive performance of local and cross breed cows in selected districts of West Gojjam Zone, Amhara National Regional State Ethiopia. An MSc Thesis presented to the school of graduate studies of Bahir Dar University.

Mengistu D.W., Wondimagegn K.A. and Demisash M.H. 2016. Reproductive Performance Evaluation of Holstein Friesian and Their Crosses with Boran Cattle Breeds in ArdaitaAgricultural

Technical Vocational Education Training College Dairy Farm, Oromia Region, Ethiopia. Iranian Journal of Applied Animal Science. 6(4): 805-814.

Minale G and Yilkal T. 2015. Dairy Production, Processing and Marketing in Chencha and Kutcha Districts, Southern Ethiopia. Journal of Marketing and Consumer Research Journal 9: pp.6-16.

Mirab Badewacho Agriculture and Rural Development office, 2015. Agro ecological condition report of the woreda.

Mitiku Eshetu*, Mekdes Seyoum and Yesihak Yusuf Mummed, (2019). Milk production, marketing practices and qualities along milk supply chains of Haramaya District, Ethiopia.

Mogessie, A. and Fekadu, B. 1993. Effect of container smoking and cleaning on the micro flora and keeping quality of raw milk from a dairy farm in Hawassa, Ethiopia. Tropical Science. 33. 365-376.

Mohamed A.M. Ahmed, Simeon Ehui, and YemesrachAssefa, 2004. Milk development in Ethiopia. EPTD Discussion Paper No. 123. Washington DC, U.S.A.

Mulugeta Ayalew and Belayeneh Asefa, 2013. Reproductive and lactation performances of dairy cows in Chacha Town and nearby selected kebeles, North Shoa Zone, Amhara Region, Ethiopia, World Journal of Agricultural Sciences ,1(1), pp. 008-017.Available online at http://wsrjournals.org/journal/wjas ISSN 2329-9312 ©2013 World Science Research Journals.

Negash, H. 2012. Production, handling, processing, utilization and marketing of milk in the Mid Rift Valley of Ethiopia. Livestock Research for Rural Development. Volume 24, Article 152. Retrieved January 12, 2014, from http://www.lrrd.org /9/nega24152.htm.

Nigatu Alemayehu Dirk Hoekstra and AzageTegegne, 2012. Smallholder dairy value chain development: The case of Ada'aworeda, Oromia Region December pp-7.

Niraj Kumar, Alemayehu Eshetie, Berihu Gebrekidan & Endale Balcha. 2014a. Reproductive performance of indigenous and HF crossbred dairy cows in Gondar, Ethiopia. IOSR Journal of Agriculture and VeterinaryScience. 7(1): 50-61.

Niraj, K., Yemane, A., Berihu, G. and Yohannes, H. (2014). Productive and Reproductive Performance of Local Cows under Farmer's Management in and around Mekelle, Ethiopia. IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS), Volume 7, Issue 5 Ver. III, PP 21-24.

O'Connor, C.B., 1993. Traditional cheese making manual, No.1. International Livestock Center for Africa. Ethiopia, Addis Ababa.

O'lakes L, 2010. The next stage in dairy development for Ethiopia. Dairy value chains, end markets and food security, Addis Ababa, Ethiopia..

Reddy and Kanna, 2016. Agri-business Review on Milk and Milk Products in Ethiopia. International Journal of Economics and Business Management.

Rege, J.E.O., Ayalew, W., Getahun, E., Hanotte, O. and Dessie, T. (2006). DAGRIS (Domestic Animal Genetic Resources Information System). International Livestock Research Institute, Addis Ababa, Ethiopia. http://dagris.ilri.cgiar.org.

Sale Alebachew, Dehinenet, Geze woldemichael and Zemenu Yayeh, (2018) Handling, Processing, Utilization and Marketing System of Milk and Milk Products in Huet Eju Enesie District, East Gojjam Zone, Ethiopia.

Seid Guyo Guje and Berhan Tamir. 2014. Assessment of cattle husbandry practices in Burji Woreda, Segen zuria of SNNPRS, Ethiopia. International journal of technology enhancements and emerging engineering research. 2(4).

Sena Tadesse, Guesh fesaha, Adugnaw Abebe, Beletech Hailu and Workalem Dejen, (2014). Assessment of Productive and Reproductive Performances of Cross Breed Dairy cows in Debre tabor town, Journal of Biology, Agriculture and Healthcare, 4, (23).

Shewangizaw Wolde and Addisu Jimma. 2014. Assessments of knowledge gap and constraints affecting and production and consumption of standardized dairy products Wolyita Soddo town, Southern Ethiopia. African Journal of Agricultural Research. 9(47):3427-3433.

Shewangizaw, A., Ahmed, M. and Nunu, H. (2016) Handling, Processing and Utilization of Milk and Its Products in Gondar Town, Ethiopia. Journal of Life Science and Biomedicine, 6, 120-126.

Sintayehu Y, Azage T, Beyene F, Tegegne A,Gebremedhin B. 2008. Dairy production, processing and marketing systems of Shashemene – Dilla area, South Ethiopia. Improving Productivity and Market Success (IPMS), ILRI, Addis Ababa, Ethiopia.

Stein J., Ayalew W., Mulatu W., Lemecha H. and J. Philipsson., 2006. Trypanotolerance and productivity in Ethiopian cattle breeds. 8th World Congress on Genetics applied to livestock production, August 13-18, 2006. Belo Horizonte, MG, Brasil.

Tadele A. Mitku E. Yoseph M. and Ameha K. 2016. Milk postharvest handling practices across the supply chain in Eastern Ethiopia. Journal of Advanced Veterinary and Animal Research. 3(2):112-126.

Tadele Alemayehu and Nibret Moges. 2014. Study on Reproductive Performance of Indigenous Dairy Cows at Small Holder Farm Conditions in and Around Maksegnit Town. Global Veterinaria. 13(4): 450-454.

Tadesse M., Thiengtham J., Pinyopummin A. and Prasanpanich S. (2010). Productive and reproductive performance of Holstein Friesian dairy cows in Ethiopia. Livest. Res. Rural Dev.

Tariku Woldeyohannes, 2020. Assessment of Husbandry Practices, Production and Reproductive Performance of Indigenous Cattle in Hadiya Zone, Southern Ethiopia.

Tegegne A., Gebremedhin B., Hoekstra D., Belay B. and Makasha 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. Nairobi, ILRI.

Tesfaye Mengistu (2007). Characterization of cattle milk and meat production, processing and marketing system in Metema district, Ethiopia, M.S. thesis, Hawassa University, Awassa, Ethiopia.

Teshome G., Fekadu B. and Mitiku E., 2014. Handling practices and microbial quality of raw cow's milk produced and marketed in Shashemene town, Southern Ethiopia. International Invention Journal of Agricultural and Soil Science. 2(9):153-162.

Teshome Gemechu* and Tesfaye Amene, 2017. Dairy cattle milk production, handling, processing, utilization and marketing system in Bench Maji Zone, Southwest Ethiopia.

Tola, A., 2002. Traditional milk and milk products handling practices and raw milk quality in Eastern Wollega. MSc Thesis, Alemaya University. Ethiopia.

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.

Tollossa Worku, Edessa Negera Gobena, Ajebu Nurfeta, and Haile Welearegay. 2014. Milk handling practices and its challenges in Borana Pastoral Community, Ethiopia. African Journal of Agricultural Research. 9(15):1192-1199.

Tsadkan Zegeye, 2012. Study on cattle milk production, processing and marketing system in enderta district, Tigray regional state.

Tsedey Azeze, 2018. Assessment of butter making practice in Sidama zone, SNNPR

Tsegay Lijalem and Gebreegziabher Zereu. 2015. Hygienic Milk Handling and Processing at Farmer Level in Wolaita Zone, Southern Ethiopia. Food Science and Quality Management.

Weldegebriel, D. 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.

Woldemichael Somano. 2008. Dairy marketing chains analysis: The case of Shashemane, Hawassa and Dale districts milk shed, Southern Ethiopia. MSc thesis.School of Graduate Studies, Haramaya University, Ethiopia.

Woldemichael Somano. 2014. Economics of Smallholder Dairy Production and Gender Roles in Dale District of Sidama Zone, Southern Ethiopia. Ethiopian Journal of Applied Science and Technology. 5(1): 85 – 110.

Yifat D, Kelay Belihu, Bekana M , Lobago F , H. G. and H. K. 2009. Study on reproductive performance of crossbred dairy cattle under smallholder conditions in and around Zeway, Ethiopia. Livestock Research for Rural Development 21(6).

Yilma, Z. and L. Inger, 2001a. Milk production, processing, marketing and the role of milk and milk products on smallholder farmers' income in the central highlands of Ethiopia. In: Proceedings of the 8th Annual Conference of the Ethiopian Society of Animal Production (ESAP). ESAP, Addis Ababa, Ethiopia, 24-26 August 2000: pp: 139-154.

Yilma, Z. and L. Inger, 2001a. Milk production, processing, marketing and the role of milk and milk products on smallholder farmers' income in the central highlands of Ethiopia. In: Proceedings of the 8th Annual Conference of the Ethiopian Society of Animal Production (ESAP). ESAP, Addis Ababa, Ethiopia, 24-26 August 2000: pp: 139-154.

Yitaye Alemayehu, Maria Wurzinger, Azage Tegegne and Werner Zollitsch, 2009.Handling, processing and marketing of milk in the North western Ethiopian highlands. Livestock Research for Rural Development,21,http://www.lrrd.org/lrrd21/7/ayen21097.htm, p 97.

Yonada, 2009 Business Promotion and Consultancy Plc. Value Chain Analysis of Milk And Milk Products In Borana Pastoralist Area. Regional Resilience Enhancement against Drought Project. Care-Ethiopia, Addis Ababa, Ethiopia.

Young Simon. 1994. Rapid Market Appraisal (RMA): A Tool for Market Systems Research in Agricultural Development, Malakand Fruit and Vegetable Development Project (MFVDP), Interco-operation.

ZegeyeYigezu. 2003. Challenges and opportunities of livestock marketing in Ethiopia. In: Proceedings of the 10 annual conference of Ethiopian Society of Animal Production (ESAP), 22–24 August 2002 held in Addis Ababa, Ethiopia. ESAP, Addis Ababa, Ethiopia. 47–54 pp.

Zelalem Y and B Faye 2006. Handling and Microbial Load Of Cow's Milk and Ergo (Fermented Milk) Collected from Different Shops and Producers in Central Highlands of Ethiopia. Ethiopia J. Animal Production,; 6: 67-82.

Zelalem Y, Emannuelle GB and S Ameha, 2011. A Review of the Ethiopian Dairy Sector. Food and Agriculture Organization of the United Nations, Sub Regional Office for Eastern Africa (FAO/SFE), Addis Ababa, Ethiopia. 2011. Available at http://www.fao.org/3/a-aq291e.pdf.

Zelalem Y., 2010. Quality Factors That Affect Ethiopian Formal Milk Business: Experiences from Selected Dairy Potential Areas. Netherlands Development Organization (SNV), Addis Ababa, Ethiopia.

Zenebe Tekle, Tadesse Guadu, Kassa Demissie, Fentahun Mitku and Yitayew Demessie. 2016. Assessment of Reproductive Performance of Crossbred Dairy Cattle among Dairy Farms in and Around Addis Ababa, Central Ethiopia. Global Veterinarian. 17(4): 358–364.

Zewdu W., Thombre B. M. and Bainwad D. V. 2013. Effect of non-genetic factors on milk production of Holstein Friesian × Deoni crossbred cows. Int. J. Livest. Prod., 4:106- 112.

Zewdu Wuletaw, 2004. Indigenous cattle genetic resources, their husbandry practices and breeding objectives in North-western Ethiopia. M.Sc. Thesis. Almaya University of Agriculture, DireDawa, Ethiopia. 127p.

ZewuduWuletaw, 2004a. Performance Evaluation of Cattle Crossbreeding Program of Integrated Livestock Development Project: Case study on the contribution of crossbred animals on the livelihood of the rural community. North Gondar, Integrated Livestock Development Project (ILDP), Gondar Ethiopia. Unpublished.

8. Appendices

Appendix 1: House hold questionnaires

I. Household characteristics

A. Socio economic information of respondent

Enumerators name _____Date of interview_____

Agro-ecology 1. Highland 2. Midland

1. Name of house hold head _____
2. Sex of household head _____1)male 2) female
3. Age of the house hold head _____years
4. Household size 1) 2, 2) 3-5, 3) 6-9, 4) Above 9
5. Total number of household members

	Age group (in years)					
	<2	2-10	11-15	16-30	31-50	>60
Male						
Female						
Total						

6. Marital status of the farmer _____ 1) Single, 2) Married 3) divorced 4) widowed
7. Educational status

Category	Educational level			
	Illiterate	Grade1- 8	Grade 9-12	>12 grade
Male				
Female				
Total				

8. Land holding (hectares) (ha)

N	Purpose	Own	Rented	Communal
1	Crop (including fallow land)			
2	Grazing & Forage production			
3	Other			
Total				

9. What are feed resources used for your dairy cattle's? 1. Natural grass 2.Crop residues 3. Improved forages 4. AIBP 5. Others
10. Is there problems of livestock feed? 1.yes 2.no
11. At what season shortages of feed happened? 1.dry 2.wet
12. Do you supplement feed for your dairy cattle's? 1. yes 2. no
13. Number of livestock resources and utility by type, sex & age

	Livestock type		Breed type		Total	The most important species
			Local	Cross/exotic		
1	Calves(<1year)	Male				
		female				
2	Heifer					
3	Bulls					
4	Steers(castrated)					
5	Dry cows					
6	Pregnant cows					
7	Lactating cows					

14. Income source 1)Cash crops 2)Live animal sale3)Milk and its products 4) Others_____
15. Socio economic benefits of dairy production. 1) to get additional income 2) for children school fee 3) to fulfil household necessities to 4) purchase of dairy inputs

II. Milk Production Systems, milking practices and constraints

A. Milk Production Systems

1. What is your major farming activity?
   1) Livestock production, 2) Crop production, 3) Mixed production 4) other specify
2. If both livestock and crop production, which one is more important to you (please rank)
   1) Livestock 2) Crop
3. If yes, please list the reasons of keeping livestock (list and rank them)

No.	Importance or reasons of keeping livestock	Rank the importance or reasons of keeping livestock
1		
2		
3		

4. For what purpose do you keep cattle mainly? (Rank 1, 2, 3...)
   1) For traction 2) For milk production

3) For meat production
4) For manure
5) Income generation
6) Other, specify_____

5. Do you produce milk? 1) yes 2) no
6. If yes, for what purpose do you produce milk and milk products? 1) Home consumption 2) market3) for both 4) Others (specify):_____
7. From which species of animals do you produce? 1) Cattle 2) Goats 3) Sheep 4) Others
8. What is your major livestock farming? 1) Cattle production 2) Small ruminant production 3) Poultry production 4) Honey production 5) Other:_____
9. Which part of your farming contributes most of your families' income?

1) Livestock production 2) Crop production 3) Livestock and crop production 4) Off-farm

10. Total amount of Milk yield

Type of breeds	Total milk yield in litre during stage of lactation		
	Early lactation (0-3 month)	Mid lactation (4-6 month)	Late lactation (Above 7 months)
Local			
Jersey Cross			

B. Milk yield and lactation length

1. Fill milk yield, AFC, CI, LL, and others that are put in the table for milk cows

Cow no.	Breeds type	AFC	Current parity	CI between the last two calves (months)	LL for the last completed one (months)	Milk off-take per day (current lactation, peak)	Milk off-take per day (current lactation, lowest)

2. Do you mix evening and morning milk every morning? 1)yes 2) no
3. Do you plan to increase the amount of milk you produce? 1)yes 2) no

4. If yes, how do you plan to increase your milk production? (Ranking it)

1) Increase the number of dairy cows 2) Improve the grade of dairy animals 3) Produce more quality feed 4) Buy more amount of concentrate feed

C. Milking practices

1. Who is the responsible person for milking? 1) women 2) men 3) both
2. Milking procedure used: 1) Hand _____ 2)Machine _____ 3)Both_____
3. Milking frequency per day: 1) Once_____ 2) Twice_____3)others
4. Do you have separate milking place? 1.yes 2. no
5. Type of milking practices:

   1) Milking without suckling 2) Few suckle before and after milking 3) Suckling before milking only 4) Milking before suckling 5) Others (specify)_____
6. Do you practice complete milking practice? 1)yes 2) no
7. What type of milking materials used 1) plastic 2) small clay pot 3) 4 others specify
8. What type of milk storage container do you use? 1) Clay pot 2) Plastic jar 3) small clay pot and plastic 4).others specify
9. Do you wash milking and milk storage utensils? (1) yes (2) no
10. How often do you wash the container?

    1) Before every use 2) After every use 3) Before and after every use
11. How do you wash milking equipment before milking?

    1) By water only 2) By water and detergent 3) By water and some plants
12. Do you let calves suckle partially before milking? 1) yes 2)no
13. If the calf is died by what mechanisms do you take milk from the cow) how do you milk?

    1) By washing udder 2) By providing artificial calf made from skin and teff straw (locally Bahaa) 3) By providing feed for the cow 4) Stop milking
14. How do you perform milking hygienic practices?

    a) Do you wash your hands before and after milking? 1) yes 2) no

    b) Do you dry your hands? 1)yes 2) no

    c) By what you dry? 1) Own cloth 2) Towel

    d) Do you wash udder and teats before and after milking?1) yes 2) no

e) Do you wash and dry udder and teats? 1. yes 2. no

f) At what time wash udder and teats? 1. Before milking 2. After milking 3. Before and after milking

g) What type of water source do you use for hand and udder wash?

1) Piped/ tap 2. Stream 3. Hand dug well

h) Type of water used to wash udder and teat? 1) Cold 2) Warm

i) Do you use towel for washing and cleaning udder and teats? 1) yes 2) no

j) If your answer is yes for question 13 (g), what type of towel do you use? 1) Individual towel 2) collective towel

15. Are milking times fixed always? 1) yes 2) no
16. Do you stimulate the udder before milking? 1) yes 2) no
17. If yes what is the means of stimulation? 1) Allowing the calf to suckle 2) rubbing with hand 3) massaging by towel using warm water
18. Do you allow partial suckling? 1) yes 2) no
19. How much teats the calf will suckle? Please circle that you have chosen (1, 2,3 teats).
20. Do you know how much milk is taken by the calf? 1) yes 2) no
21. If your answer is yes how much? _____ Litre.

D. Milk production constraints

22. Do you think there are any significant constraints to the milk production practices?
    1. Yes 2. No
23. If answered yes, which are the three main constraints you are facing with your milk production practices (choose 3 and rank from 1 to 3 in the order of importance, with 1 being the most important)?
    1. Lack of quality fodder or roughage
    2. High cost of concentrate feed
    3. Lack of credit to buy improved breeds
    4. Low milk yield of local cows
    5. Low market price of milk and milk products
    6. Others_____

1. What are the possible solutions for dairy development in the future? (Ranking .....)

1) Improving feeding and watering program 2) improving breeding system 3) improving veterinary service 4) improving housing condition 5) improving extension service 6) others specify

2. Do you continue dairy production to the future? 1.yes 2. no
3. If yes, why?----------,----------,----------,----------

III. Housing and cleaning practices

1. How do you house your animals?
   1) Housed together with humans 2) separate house 3) Other (specify)_____
2. Do you clean the barn? 1.yes 2. no
3. Frequency of cleaning the barn
   1) Daily basis 2) Two times a day 3) Three times a day 4) Others (specify) ____
4. How do you dispose the cattle dung from the barn? 1) Draining system 2) Labour
5. Frequency of disposing manure from the barn
   1) Once per day 2) twice a day 3) Three times a day 3) four times and above
6. By what mechanisms removes cattle dung. 1. as fertilizers 2. as fuel
7. What methods you use to dispose waste materials from cattle barn? 1) Storing in one place 2) drainage systems 3) scattering on crop and grass lands 4) others specify_____
8. What are the materials you use to dispose cattle waste from the barn? 1) Bamboo tree basket 2) Sack 3) Plastic material 4) others specify_____
9. What are the facilities in the barn? A) Water trough (WT) B) Feed trough (FT) C) WT+FT D) No facility

IV. Milk handling practices and Milk processing

A. Milk handling practices

1. What methods do you use to increase the shelf life of milk and milk products?
   1. Smoking of containers 2. Washing containers with half boiled water and plants
   3. Washing containers with detergents 4. Others (specify) _____
2. Do you smoke milking and storage materials? 1) yes2) no
3. If yes do you use plants to smoke milking equipment? 1.yes 2. no

4. If yes, what are the plants used for smoking milking equipment? 1) Kosorote (*ocimumhaardiense*) 2)Whitetree 3)Tenadem (*Rutachalepensis*) 4) Woyira (*Olea africana* 5) others _____
5. What is the purpose of smoking? 1) For good flavour 2) To increase shelf life 3) To improve texture 4) All-purpose
6. What is your storage material? 1) Clay pot 2) gourd 3) Clay pot and Plastic 4) others
7. Do you clean the storage materials? 1) yes 2) no,
8. If yes, by what time interval? 1) Daily 2) after 2 days 3) others
9. Do you use local plants for washing and fumigating your milking and milk handling? Equipment? 1) yes _____2) no_____
10. Type of plants used for cleaning milk containers and milking equipment's
    1. Kosorote *(ocimumhaardiense)* 2) Minantofa (*Achynthesaspera*) 3)Tenadem *(Rutachalepensis*) 4) others _____
11. Method of cleaning milk containers 1) washing 2) smoking 3) both

B. Milk processing

1. Do you collect milk? 1)yes 2) no
2. If your answer is yes, why you collect? 1. Sale 2. To process into other products 3. If milk is not enough for process 4) others specify
3. Means for storage 1. Cooling by water 2. Placing on clay pot neck 3. If others _____
4. Frequency of processing your milk?1)Every day 2) Every two day 3) Every three day 4)others specify_____
5. If the daily milk yield is not enough for processing, what method you use?1) storing 2) others
6. Do you process milk into other products? 1) yes 2) no
7. Why you process milk?
   1) To increase shelf life
   2) To add value
   3) To have variety of products
   4) All (to increase shelf life, to add value and to have variety of products)
   5) To increase shelf life and to add value
8. Do you measure the amount of milk that you used for processing? 1) yes 2) no

9. If you measure, how? 1) Small clay pot 2) By plastic jug 3) Others_____
10. Do you measure the amount butter and cheese those were produced? 1) yes 2) no
11. If you measure how? 1) Plastic dish 2) Kg 3) By fingers 4) Others_____
12. What milk products do you process?1) Butter 2) Cheese 3) Butter milk 4)Yoghurt 5) Hadaro6) Whey 7)Others
13. Do you produce butter? 1) yes 2) no
14. What type of churning system use? 1) local 2) others
15. What type of churning materials do you use? 1) Gourd 2) Clay pot 3) plastic 4) other specify_____
16. If you use both (gourd and clay pot), which one is more efficient materials in butter production? 1) Gourd 2)Clay pot
17. How many times do you churn in a week? 1) Day to days 2) Two times 3) Three times 4) others specify_____
18. Equipments for butter handling. 1. Small clay pot 2. Plastic materials 3. Stainless steel
19. When do you process milk more frequently? 1)fasting period 2)wet season 3)dry season 4) other specify _____
20. How many litres of fermented milk are required to produce one k/g of butter?
21. How many k/g of butter you get from one churning based on breed type?
    1. Local_____ 2) Crossbreed _____
22. Do you process butter further into other products? 1. Yes 2. no
23. If yes what are the products 1) ghee 2) others specify
24. If processed to ghee, for what purpose 1) consumption 2) other
25. To process butter, do you use spices or plant materials? 1. Yes 2. No
26. Ghee storage length (in month)----------
27. If yes, what type of spices or plant materials?
    1. Spices 2. Plant materials
    ……
28. For how long can you store butter with minimum spoilage? (year) _____
29. For how long can you store ghee with minimum spoilage? (year) _____
30. Do you make cheese? 1) yes 2) no
31. If yes what types of milk do you use to produce cottage cheese? 1) Butter milk 2) Other

32. Amount of butter milk required producing one k/g of cottage cheese? _____lt.

33. What others traditional milk products do you produce? _____

34. Spices used in traditional dairy product processing 1) onion, gemenja and kosarat 2) Tosign 3) Abish 4) Kororima 5) others_____

V. Consumption of milk and milk products

1. Which milk products do you use for family consumption?

Milk products	Amount	Prioritize rank of home consumptions						Remark
		1	2	3	4	5	6	
Fresh milk								
Fermented milk								
Butter milk								
Cottage cheese								
Ghee								
Whey								
Other								

2. For what purposes do you use of butter?

   1) Consumption 2) For market 3) Ointment 4) all

3. How is milk consumed? 1) in its raw states 2) after souring 3) after boiling 4) others

4. How do you consume the amount of milk? (Specify in litter)

   1) Consumed at home, 2) selling 3) processing 4) others (specified)

5. How is butter consumed? 1) with coffee 2) With food 3) Drinking fermented butter

6. Frequency of consuming milk per day. 1. Once 2. One time/two days 3.others

7. Frequency of consumption of milk products 1) every day 2) once a week 3) three times a week `4) during special occasion 5) others specify

8. Who commonly consume? 1) children 2) women 3) men 4) others specify

9. Constraints of traditional dairy products consumption 1) fasting days 2) seasonal demand and supply 3) spoilage 4) others specify_____

10. When you consume more milk and milk products1) every day 2) during holiday 3) others

11. How many times do you use milk in a day?

    1) One time 2) two times 3) one times/ 2 Day 4) Others----------

12. Uses of butter 1. Consumption 2. For market 3. Ointment 4. Other (specify)

13. Uses of buttermilk 1. Consumption 2. For market 3. For cottage cheese making

4. for consumption and cottage cheese 5. Other (specify): _____

14. Uses of whey?

1. Consumption for children 2. For porridge making 3.Providinganimals 4. Other (specify):

15. Fill the following tables.

No.	Breed type of cow	Amount of milk churned at a time (lit)	Time required for churning(hrs)	Amount of butter produced (kg)	Amount of cheese produced (kg)
1.	Local				
2.	Jersey crossbred				

16. How much milk, butter and cheese produced, consumed and sold per week (In kg)?

	Breed type	Produced	Used for home consumption	Sold
Milk				
Butter				
Cheese				

VI. Dairy products marketing

1. For whom do you sell your dairy products? 1) to individual 2)to retailers 3) whole sellers
2. Do sell milk? 1.yes 2. no
3. If your answers is no, what is your reasons 1. Preference to process 2. Lack of demand 3. Lack of market 4. Low milk yield 5 cultural taboos
4. What type of product you sell?

   1) Whole Milk, 2) Butter, 3) Cheese, 4) Butter Milk, 5) Others (specified)_____
5. Do you collect butter and cheese for sale? 1) yes 2) no
6. If yes, how many days you collect for sale? 1) Butter--------days 2) Cheese -----days
7. What are the quality parameters for milk and milk products sale and consumption?

   1) Cleanness 2) Colour 3) Freshness 4) flavour and aroma 5) all
8. How do you transport milk and milk products to the market? 1) On foot 2) Cart 3) others
9. Where do you sale? 1) Local market 2) Neighbouring consumer 3)others_____
10. From where do you get marketing information? 1. Extension agent 2. Neighbours

    3. Personal visit 4.Traders 6.others_____
11. At what time the price of milk products rises? 1) During holydays 2) Dry season 3) both

12. For what purpose do you mostly use the money that you get from the sale of milk and milk products 1) Farm inputs 2) Food and non-food items 3) House construction 4) school fee 5) Other_____

13. What are the factors that affect the price of milk products?1) fasting season 2) income 3) weather condition (dry and wet season) 4) others_____

14. At which season/month(s) do you fetch the maximum and minimum price from the sale of milk and milk products?

Products	Minimum		Maximum	
	Season and/ months	Price(birr)	Season and/ months	Price(birr)
1.Milk				
2.Butter				
3.Cheese				
4.Yogurt				
5.Others				

15. The frequency of selling milk product in a month 1) Once 2) Twice 3) Three times 4) Others specify_____

16. . Have you ever experienced spoilage of milk and milk products due to lack of market?

1.yes 2.no

VII. Dairy products market constraints

1. Do you ever have difficulties/problems of selling your milk and its products? 1. yes 2. no
2. If yes, what are the marketing constraints in dairy productions? (Rank 1, 2, 3…)

1) Absence of sufficient buyer

2) Poor quality of milk/sour milk

3) Transportation access

4) Distance to the market

5) Traditional taboos

6) Marketing systems 7) others specify_____

3. Is there any period that you have problem of marketing your milk products? A. yes b. no
4. If yes, which months? A. Fasting months B. In any months of the year, specify

VIII. Progeny history survey

A**. Cattle performance survey**

1. Fill the table below for individual milking cows performance

No	Breed type of this cow		Age of the cow	Physiological state of the cow	Days open (calving to conception	Milk production per day	Body condition score	No. of days dry off before next calving (DPL)	Identification method
		blood level (If cross breed)							
1									
2									
3									

2. How many months passed after the cow has calved?

   1) 0-3 months 2) 4-6 months 3) 7-9 months 4) Above 9 months

3. How much is the milk production of this cow (L/day)? In its

   1) 0-3months after calving _____

   2) 4-6month's_____

   3) Above 7 months _____

4. Do have an experience of culling cows? 1) yes 2) no
5. If yes, why do you culls? 1) Infertility 2) low milk yield 3) low butter yield 4) others
6. Do you keep records of your farm? 1) yes 2) no
7. If you keep records, what information do you record_____

Appendix Table1: Way, frequency & consuming milk products per day

Parameters	Agro-ecology			
	Highland (N=57)	Midland (N=81)	Overall (N=138)	
	%	%	%	P-value
Freq. of consuming M/day				
Once	38.6	50.6	45.7	0.265
One time/two days	50.9	37.0	42.8	
Others	10.5	12.3	11.6	
Reasons for processing milk				
To increase shelf life	8.8	3.7	5.8	0.071
To add value	0.0	8.6	5.1	
To obtain variety of products	49.1	53.1	51.4	
All	42.1	34.6	37.7	
Measure milk processed				
Yes	61.4	87.7	76.8	0.000
Ways of measuring milk				
Small clay pot	63.9	33.8	43.9	0.006
Plastic jug	25.0	56.3	45.8	
Others	11.1	9.9	10.3	
Measure butter				
Yes	71.9	87.7	81.2	0.020
Ways of measuring butter				
Plastic dish	52.4	60.6	57.5	0.696
Finger	28.6	23.9	25.7	
Others	19.0	15.5	16.8	

Appendix Table 2: Breed preferences, total livestock unit and blood level of cross breed cattle's in the study area

	Agro-ecology			
	Highland (N=57)	Midland (N=81)	Overall (N=138)	
Parameters	%	%	%	P-value value
Local cattle	64.9	42.0	51.4	0.006
Jersey cross	24.6	51.9	40.6	0.117
Holstein cross cattle	10.5	6.2	8.0	0.026
Blood level of Jersey Cb				
<50%	54.5	32.3	39.8	0.097
50-75%	39.4	55.4	50.0	
>75%	6.1	12.3	10.2	
Blood level of HF Cb				
<50%	66.7	29.2	45.2	0.049
50-75%	22.2	54.2	40.5	
>75%	11.1	16.7	14.3	
Livestock types	**Conversion factor**	**Total TLU/LLU**		
Local cow	0.8	2.16		
Cross breed cow	1.8	1.95		
Local oxen	1.1	1.89		
Cross breed oxen	1.9	0.102		
Local heifers	0.5	0.72		
Cross breed heifers	0.7	0.7		
Local calves	0.2	0.56		
Cross breed calves	0.4	0.538		
Local bulls	1.1	0.86		
Cross breed bulls	1.9	0.115		

Appendix Table 3: Milking methods, identification, feed problems, supplementation and facilities in the barn.

	Agro-ecology			
	Highland (N=57)	Midland (N=81)	Overall (N=138)	
Parameters	%	%	%	P-value
Milking methods				
Hand	100	100	100	
Wash Hands before milking				
Yes	100	100	100	
Dry hands before milking				
No	66.7	43.3	52.9	0.007
Identification methods				
Coat colour	50.9	53.1	52.2	0.074
Naming	36.8	22.2	28.3	
Ear tag	12.3	24.7	19.6	
Facilities in the barn				
Water trough	8.8	6.2	7.2	0.000
Feed trough	47.4	22.2	32.6	
Water & feed trough	7	46.9	30.4	
No facility	36.8	24.7	29.7	
Problems of feed				
Yes	93.0	96.3	94.9	0.382
Season of feed shortage				
Wet	3.5	3.7	3.6	0.952
Dry	96.5	96.3	96.4	
Supplement feed				
Yes	71.9	90.1	82.6	0.005

Appendix table 4: Ways increasing milk production

	Agro-ecology				
	Highland(N=57)		Midland(N=81)		
Parameters	Index	Rank	Index	Rank	P-value
Increasing no. of dairy cows	0.131	4th	0.173	4th	0.000
Improving grade of dairy cows	0.322	2nd	0.283	2nd	0.000
Produce more quality fodder	0.376	1st	0.302	1st	0.212
Buying high amount of concentrate. feed	0.170	3rd	0.240	3rd	0.000

* Index = [(4 for rank 1) + (3 for rank 2) + (2 for rank 3) + (1 for rank 4)] divided by sum of all weighted parameters mentioned by respondent.

Appendix Figure 1: Plant species used for dairy equipment cleaning and smoking

a) Attada/Kessie (*Ocimum hardiense*) b) Minantofa/gullo (*Achynthes aspera*)

Appendix Figure 2: Spicing plant species for dairy products in the study area

a). *Ocimum kilimandscharicum Guerke (*locally Atti Geemenja) b) Kosorat (*Ocimumhaardiense*)

Appendix Figure 3: Different dairy cattle's feeding materials in the study area

a) Locally made wooden feed and water trough b) Plastic feed and water trough.

Appendix Figure 4: Milk collection and sharing materials/utensils in the study area

a  b 

Appendix Figure 5: Interviewing about housing and managerial practices in the study area

a) Calf feeding practices during dry season.

b) Lactating cows housing and feeding condition c) Interviewing about milk production and processing

Appendix figure 6: Ghee making utensils in the study area

a) Small pot for boiling spiced butter (locally korrano) b) Sieve for filtering butter after boiling.

Appendix figure 7: Traditional milk processing materials and utensils in the study area

a  b 

a) Traditional butter making pratices(Churning) b) Traditional hadaro making practices in medium pot

c  d 

c) Butter measuring and sharing tools (locally Bittera) d) milk cooling systems in the study area

Appendix Figure 8: Dairy products marketing trends in the study area

a  

a) a) Local traders collecting butter and cheese from market by using suspended weighing balance

c 

b) Dairy products marketing place in the town c) Cheese and butter selling practices in the area according to cooling mechanisms

Appendix Figure 9: Dairy waste removing materials in the study area

Locally prepared basket for manure disposing material (locally Keshshe).

BIOGRAPHICAL SKETCH

The author was born in November1980 E.C in Hadiyya Zone, SNNPR Region. He attended his primary and secondary schools in Elfeta and Shone high schools and Preparatory school respectively.

The author joined Wolaita Soddo ATVET College in October, 2005 and graduated with Diploma in Animal Science on 07 July 2007. He worked in Agriculture Office of the Mirab Badewacho District, Hadiyya Zone of SNNPR as Animal Production Development agent from September 07 2007 up to January, 2015.

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