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**URBAN DAIRY PRODUCTION PRACTICES AND ANALYSIS OF FEED AND
MILK QUALITY AND SAFETY ACROSS VARIED VALUE CHAIN ACTORS IN
OROMIA SPECIAL ZONE SURROUNDING FINFINNE, ETHIOPIA**

PhD DISSERTATION

BY

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**Addis Ababa University, College of Veterinary Medicine and Agriculture
Department of Animal Production Studies
PhD Program in Animal Production**

**March, 2022
Bishoftu, Ethiopia**

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**A Dissertation Submitted to the College of Veterinary Medicine and Agriculture of
Addis Ababa University for the Fulfillment of the Requirements for the Degree of
Doctor of Philosophy in Animal Production**

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DEDICATION

This dissertation is dedicated to my father Fikadu Yadeta for nursing me with affection, unreserved help and for his enthusiastic encouragement in my academic carrier. Since he was passed during this dissertation work, he is unlucky to share with me the success I have been achieving in academic endeavors. I pray to God to rest his soul in peace.

BIOGRAPHICAL SKETCH

The author was born on the April 13, 1987 in West Wollaga Zone, Manasibu district. He attended his elementary and secondary school educations at Mendi Mekaneyesus Junior Secondary and Mendi Senior Secondary Schools, respectively. In 2003, he completed secondary school education successfully, and passed the Ethiopian Schools Leaving Certificates Examination (ESLCE) and joined Haramaya University in 2003/2004 to pursue his BSc study and graduated with BSc degree in Agriculture (Animal Production and Health) in August 2006. After graduation, he was employed as Junior Instructor at Nedjo Agriculture Technical Vocational Educational and Training College (NATVETC) in September, 2006. During his stay, he also served as department head of animal science department in the college. After serving for 4 years of service, he joined the School of Graduate Studies of Haramaya University in October, 2011 to pursue his MSc study in Animal Production and graduate with MSC degree in animal production in June, 2013. After MSc graduation, he was employed by Assosa University as a lecturer in the College of Agriculture and Natural Resources in the department of Animal Science. During his stay at the University, he was also served as College Educational Quality Coordinator. In October 2016/17, he has got the chance to join Addis Ababa University, College of Veterinary Medicine and Agriculture to pursue his PhD study in Animal Production program. During his career, he published seven scientific articles on the reputable international journals.

STATEMENT OF AUTHOR

First, I declare that this dissertation is my *bonafide* work and that all sources of materials used for this dissertation have been duly acknowledged. This dissertation has been submitted in partial fulfillment of the requirements for a PhD degree at the Addis Ababa University, College of Veterinary Medicine and Agriculture and is deposited at the University Library to be made available to borrowers under rules of the Library. I solemnly declare that this dissertation is not submitted to any other academic institution anywhere for the award of any academic degree, diploma or certificate.

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ACRONYMS AND ABBREVIATIONS

ADF	Acid Detergent Fiber
AFB1	Aflatoxin B1
AFB2	Aflatoxin B2
AFG1	Aflatoxin G1
AFG2	Aflatoxin G2
AFM1	Aflatoxin M1
AFM2	Aflatoxin M2
AFC	Age at First Calving
ANOVA	Analysis of Variance Analysis
AOAC	Association of Analytical Chemists
CC	Coliform Count
CFU	Colony Forming Units
CSA	Central Statistical Authority
CP	Crude Protein
DDE	Dairy Development Enterprise
DM	Dry Matter
EMDIDI	Ethiopia meat and dairy industry development institute
EFDA	Ethiopia Food and Drug Administration
FAO	Food and Agriculture Organization
GLM	General Linear Model
GTP	Growth and Transformation Plan
IPS	International Project Service
ILRI	International Livestock Research Institute
ILCA	International Livestock Center for Africa
LC	Liquid chromatography
LMP	Livestock Master Plan
ME	Metabolizable Energy
PIC	Preliminary Incubation Count
PPE	Personal Protective Equipment

SAS	Statistical Analysis System
SNF	Solid Non Fat
SPC	Standard Plate Count
SPSS	Statistical Package for Social Sciences
IVOMD	<i>In vitro</i> Organic Matter Digestibility
TS	Total Solid
UAAC	Universal Agency for analysis on Cancer
USFDA	United State Food and Drug Administration

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URBAN DAIRY PRODUCTION PRACTICES AND ANALYSIS OF FEED AND MILK QUALITY AND SAFETY ACROSS VARIED VALUE CHAINS ACTORS IN OROMIA SPECIAL ZONE SURROUNDING FINFINNE, ETHIOPIA

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ABSTRACT

The study was conducted in Burayu, Sululta and Sebata twons of Oromia special zone surrounding Finfinne, Ethiopia, to assess urban dairy production practices and analysis of feed and milk quality and safety across varied value chains actors. A total of 90 urban dairy producers, 30 from each town who at least own 10 dairy cows were randomly selected. The farmers were interviewed individually using the survey questionnaire and for aflatoxinB1 (AFB1) and aflatoxineM1 (AFM1) analysis feed and milk sample were collected and analyzed by high-performance liquid chromatography (HPLC). For physico-chemical and microbial quality analysis of milk, 30 milk samples from each urban, 10 from farm, 10 from milk collectors, and 10 from the cafeteria were used. The General Linear Model (GLM) was used for variance analyses of data. For the survey study, 48% and 52% of the interviewed dairy farm owners were female and male respectively. The major sources of feed were feed that mixed at home (75.6%) and few purchased feed and mixture with home-mixed feed (24.4%). The average age at first calving (AFC), calving interval (CI) and days open (DO) were 2.26 ± 0.05 years, 20.8 ± 0.05 months and 161.76 ± 34.80 days respectively. The milk and feed aflatoxin analysis indicate that the occurrence of aflatoxinM1 in all samples of milk was ranged from 0.02ppb to 0.08ppbL. Overall, 64 (71.1%) out of the total of 90 milk samples contained less than or equals to 0.05 ppb of aflatoxin M1. Moreover, 26(28.9%) milk samples contained more than 0.05 ppb. Overall, out of a total of 90 feed samples collected, about 66 (73.3%) contained aflatoxinB1 at a level less than or equal to 20 ppb. Likewise 34 (26.7%) of the feed samples contained AFB1 at a level exceeding 20 ppb. The Linear regression model indicated significant associations between the presence of AFB1 in the feed and the levels

of presence of AFM1 in milk. It was learnt from the result that percentage of added water, P^H , and Specific gravity in milk were significantly different ($P < 0.05$) between the study town, but the titratable acidity and freezing point was not significant among the study towns. All the physical parameters of milk quality obtained from farms, milk collectors, and cafeterias were significantly different ($p < 0.05$). The overall mean result of protein, lactose, and fat were significantly different ($p < 0.05$) between towns but the difference in TS, solid not fat and ash percentage were not statistically significant ($P > 0.05$). Except for ash, all the chemical compositions of milk were significantly different ($p < 0.05$) among the value chain actors. The overall mean \pm SE values of coliform counts log₁₀cfu/ml of raw milk from Burayu, Sabeta and Sululta towns were, 3.31 ± 0.0055 , 5.85 ± 0.467 and 5.12 ± 0.34 respectively. There was no statistical significant difference ($p > 0.05$) between overall mean coliform count (CC) of Sebata and Sululta towns. However, significant difference was observed between mean coliform count (CC) of Burayu, and others two towns' milk samples. The coliform result obtained from value chain actors showed, no significant difference ($P > 0.05$) among the milk collectors and cafeteria, however there were significant difference ($p < 0.05$) between milk producer and milk collectors, as well as milk producer and cafeteria. The finding of total bacteria count in study towns showed significant difference ($p < 0.05$) between Burayu and the rest two towns, however there was no statistical difference ($p > 0.05$) among Sebata and Sululta towns. The result of total bacteria count among milk value chain actors revealed significant difference ($P < 0.05$) of raw milk between farm and other value chain actors but there is no statistical significant difference between milk collectors and cafeteria. Laboratory analysis of yeast and mold was non-significant ($P > 0.05$) between the urban study area, likewise it was non-significant ($P > 0.05$) among the value chain actors. The level of aflatoxin pollution found during this study in milk, and feed ought to prompt action to spot appropriate interventions. The current findings strongly call for hygienic feed production and storage system in order to minimize aflatoxinM1 contents in the milk.

Furthermore, physico-chemical property and microbial quality of milk sample obtained from farm fulfill the minimum requirement of Ethiopia milk quality standard. However, when it comes to milk collectors and cafeterias, the physico-chemical content was below

the limits of Ethiopian milk quality standard. Furthermore, the average numbers of microbial load were above the limit set by the Ethiopia milk quality standard, certainly indicating that there were milk adulterations along the value chain actors from farm to consumers. The finding of this study provided recent information on milk aflatoxin, physico-chemical and microbial quality from farm to the cafeteria which can be an important input for regulatory bodies of Ethiopia. High price of feeds, shortage of land, unavailability of dairy cow/heifer in time, feed quality, unavailability of feed in nearby area, diseases and lack of access to credit and inadequate training were among the major constraint of dairy production that need urgent intervention to utilize the untapped resources in the study area.

Key words: *Aflatoxin, Feed, Milk, Quality, Safety and Urban Dairy Production*

1. INTRODUCTION

In Africa, animals are an important physical and financial capital for many urban households. Throughout Africa, milk comes from town farms or the peri-urbs areas (Moustier and Danso, 2006). As a regular supply of income, dairy production constitutes a form of financial savings. It also generates physical capital in the form of manure (Prain, 2006). However, the major difficulty in many of these developing countries is the lack of gratitude of urban agriculture as a major earner to food self-sufficiency and its many other actual and potential benefits towards sustainable urban development. In most of these countries, there is no even baseline data and information on the very activity of urban dairy farms (Jacobi *et al.*, 2000). From an economic point of view, cattle mainly dairy cattle are the most important of all livestock species besides small ruminants and poultry, which make a significant contribution to the urban economy and to the human diet. Thus, urban dairy production plays a substantial role in reducing poverty and contributing to household food security and health in the cities.

Most developing countries in the world and Sub-Saharan Africa in particular, are experiencing rapid economic growth in recent decades (World Bank, 2017). This growth is accelerated by per capita income, resulting in increased consumption of animal products such as milk and meat (Delgado, 2003). Population growth and high levels of urbanization seen in developing countries have also contributed to the increase in demand for livestock products. According to Delgado (2003), the demand for livestock, meat and milk in sub-Saharan Africa will increase between 3.2 and 3.3% per annum between 1997 and 2020 to 2030 and 2050, respectively. FAO, (2013) suggest also limited growth rates for these products in Africa. The situation in Ethiopia is similar and the Ethiopian Livestock Development Master Plan predicting a 53% deficit in meat supply and a 24% deficit in milk supply compared to demand by 2028, in the absence of appropriate interventions (LMP, 2015). These conditions provide significant development opportunities for the general livestock sector and the dairy sector in particular. These opportunities have arisen in the form of milk supply in urban dairy intensification, increased employment and the emergence of a wider market for millions of rural and

urban and emerging smallholder farmers seeking livelihood through livestock production. Increasing demand for livestock products not only provides for business development opportunities, but also requires government intervention to maximize the potential for economic benefits through increased national income and exports, as well as to reduce potential risks to human, animal and environmental health.

To address this, the Ethiopian government has prioritized the development of the livestock sector and established livestock development master plan that aims to contribute to the achievement of livestock development goals in the second Growth and Transformation Plan (GTP II, 2015-2020). In this priority program, the Ethiopian dairy sector is given priority over other sectors such as cattle and poultry production and aims to increase milk production by 93% by 2020 through genetics, nutrition, and traditional systems improvement (LMP, 2015).

Urban livestock production constitutes an essential subsector of the agricultural production in Ethiopia. However, yet, dairy keepers in the urban areas of Ethiopia are still receiving little attention in terms of policy, institutional and technical support targeted at their needs (Azage, 2004). The contribution of urban livestock production consists of profits and employment generation, poverty relief, and development of human nutrition and health (Azage, 2004). Keeping animals in urban area isn't new and nowadays the practices of keeping livestock in urban area are growing in lots of developing country (FAO, 2011).

In Ethiopia, market-oriented urban and peri-urban dairy production systems are evolving as essential components of the milk production systems. This system is of much help to fill in the huge gaps between supply and demand on the milk and milk products in urban centers, where the consumption of milk and dairy products is very high (Azage and Alemu, 1998). Market-oriented smallholder and large scale urban dairy production systems have great potential for development and may play an important role in minimizing the acute shortage of dairy products in urban areas. However, the complex nature of cattle production, coupled with a low technical base and long generation time has slowed down the progress. However, urban and peri-urban dairy production systems

have been constrained by various biological, technical, and economic factors. Among the challenging biological and technical factors, inadequate feed resources both in quantity and quality, lack of appropriate feeding system, prevalent livestock health problems, and lack of well-developed dairy herd health management systems are the major ones (Azage and Alemu, 1998; Yoseph *et al.*, 2003). Dairy waste, which is itself world's best organic fertilizer, specific type of waste, being biodegradable in nature and only awareness among dairy owners combined with strict implementation by concerned local bodies is required to prevent this valuable resource ending up in drains and leading to odor pollution/ water pollution. The methods for disposal/ utilization of solid wastes (dung) may be adopted: Composting/*Vermicomposting* Biogas/Compressed biogas production (*anaerobic digestion*) and manufacture of dung wood to be used as fuel (Anuradha and Sharma, 2019)

Dairy production, among the sectors of farm animal production systems, may be an important issue in Ethiopia wherever farm animal and its products provides vital sources of food and financial gain, and dairy farming has not been totally exploited and promoted within the country (Sintayehu *et al.*, 2008). Due to the pivotal role that dairy production plays in the economy of the country as well as the enhancement of the nutritional status of the citizens, the development of the sector is crucial. The efforts to improve the productivity of urban dairy production and improve its market orientation should be supported by a detailed understanding of the current and dynamic conditions of production, handling, and consumption of milk and milk products (Asfaw, 2009).

Milk contains macro and micronutrients of fats, proteins, carbohydrates, vitamins, minerals, and active compounds having a task in health protection (Merwan *et al.*, 2018). Milk could be an advanced mixture of fats, proteins, carbohydrates, minerals, vitamins, and alternative miscellaneous constituents spread in water (Harding, 1999). One gram of milk fat gives 9.3 cal and one gram of protein and lactose gives 4.1cal (Zerihun, and Getenesh, 2019). In Ethiopia, 95% of milk is produced from cattle (CSA, 2010), and cow milk is the utmost used up in the world followed by that of goat, camel, and donkey (Cisse *et al.*, 2019). The Ethiopian per capita consumption is lower (17 kg) compared to different African nations average. About 62.5 kg milk consumption per capita and per

year is counseled as a minimum level to satisfy the necessity for a diet and therefore the world's per capita average consumption is 100 l/year (FAO, 2010).

The composition and microbial safety of cows' milk is most important for the dairy farm trade, since, its quality and safety are highly influenced by composition and foreign body. In order to those physical properties, chemical compositions, and microbial load of milk are the symptoms of qualities and safety with the hygienically normal (Haftu *et al.*, 2018). In Ethiopia most milk assortment centers and milk shade unit inspect the standard of milk victimization, physical properties of alcohol check and relative density for its freshness throughout milk assortment. Additionally, pH scale and titratable acidity were helped to check the standard of milk for process in milk plant (Zerihun, and Getenesh 2019).

Aflatoxins are also the important hurtful secondary metabolites of some genus fungi like *Aspegillus flavus*, *Aspegillus parasiticus* and infrequently *Aspegillus nomius*, that present contaminants animal feeds and human food (Abdel *et al.*, 2019). Aflatoxins may be separated into aflatoxins AFG1, AFG2, AFB1, AFB2, and AFM1 and AFM2 (Akiama *et al.*, 2001). Aflatoxin B1 could be a genotoxic and cancer plant toxin that's made by *A.flavus*, and *A. parasiticus*. AFB1 can be processed to aflatoxin M1 within ruminant livestock. Aflatoxin B1 is produced within feeds, and can decrease production, slow fertility and increase susceptibility to infections. Both types of toxins have been suggested to be cancer-causing and genotoxic to end-user (Senerwa *et al.*, 2016). When consumed, aflatoxin B1 is hydroxylating to aflatoxin M1 and secreted within milk (Applebaum *et al.*, 1982). Aflatoxin B1 is of particular importance, as it is in most of the feed/food and beverages, and is a malignant tumor that initiates the disease of the liver in humans. An elevated amount of Aflatoxin B1 within the feed ends in elevated stages of aflatoxin M1 in milk and milk products (Liu *et al.*, 2012).

In addition, every aflatoxin B1, and aflatoxin M1 are classed by the international agency for analysis on malignancy as category cancer-causing agent universal agency for analysis on cancer (UAAC, 2002). This implies that milk and milk products would

possibly contain toxins that make a threat to humans, considerably kids who consume it. Moreover, exposure to aflatoxins can cause growth impairment (Khlanguiset *et al.*, 2011) and disorder (Bondy & Pestka, 2000) in animals and humans. Substantial association between impaired child growth and aflatoxin coverage was reported from several countries in Sub-Saharan Africa (Benin *et al.*, 2004) and (Land, and Ohingo, 2004).

For these reasons, Ethiopia's standard authority collaborated with the veterinary drug and feed administration control authority considered strict limitations for aflatoxin regulation. The extreme amounts are 20ppb of AFB1 has been recognized in dairy feed. Also the last commission, regulation of the European Union (EU) No 165/2010 determines the limited level is 8 mg/kg of AFB1 has been established in food subjected to sorting or physical treatment before human consumption, and also the corresponding 2 mg/kg of AFB1 for direct human consumption. The limited level of AFM1 in milk is 0.05 ppb that has been set by Ethiopia Food and Drug Administration (EFDA) derived from FAO and WHO. The feed and drug management in the USA (USFDA) sets action level for AflatoxinM1 in milk and total aflatoxinB1 in animal feed to be 0.5 ppb and 20 ppb correspondingly (National Grain and Food Association, 2011).

Unlike rural livestock production within the country, which has recently given great emphasis for development so as to satisfy the livelihood of livestock farmers, research and development interventions are very restricted for urban livestock production in general and dairy production along with dairy feed and milk safety and quality in particular. Currently, very limited research works have been reported particularly in urban dairy production and aflatoxin contamination of milk and feed in Oromia special zone surrounding Finfinne. Therefore, taking into consideration these gaps, this study was designed to assess urban dairy production practices and analysis of feed and milk quality and safety across varied value chains actors in Oromia special zone surrounding Finfinne, Ethiopia.

Objectives of the Study:

The study was aimed at addressing the following general and specific objectives.

General objective:

- ❖ to assess urban dairy production practices and analysis of quality and safety of feed and milk across different value chains actors in Oromia special zone surrounding Finfinne, Ethiopia.

Specific objectives:

- ❖ to assess urban dairy production practices in Oromia special zone surrounding Finfinne, Oromia,
- ❖ to analyze nutritional quality and level of aflatoxin B1 in dairy ration,
- ❖ to detect level of aflatoxin M1 in raw milk,
- ❖ to analyze physico-chemical and microbial load of raw milk across varied value chains actors.

2. ITERATURE REVIEW

2.1. Urban Dairy Production in Ethiopia

Urban dairy production practice is the prominent forms of milk production in the tropics and sub-tropics. The system involves the production, processing and marketing of milk and milk products in the urban centers. The presence of dairy farming in urban is mainly encouraged by the availability of a good market for animal products, the need for job creation (Ayaga *et al.*, 2005), the economic limitations of urban dwellers (Ishagi *et al.*, 2002, Mlozi 2005). Dairying constitutes an important sub-sector of agricultural production which contributes towards filling in the large demand-supply gap for milk and milk products in urban. In addition, urban dairying using improved dairy cattle is highly profitable (Limbu 2006) the research that conducted in Dar es Salaam city of Tanzania

Urban dairying is not defined in terms of rigid geographical boundaries around a city, rather it is well-defined by consumer center with its dairy shed and the processing and marketing actors and processors linked to them (Ray, 2003). Olaloku and Debre, (2007) stated that, urban dairy production has assumed increasing importance in the past decade, as more and more milking herds are established within 50 km radius to major cities and towns, while (Tsehay, 2008) stated that urban milk production system includes smallholder and commercial farmers in proximity of Addis Ababa and other regional towns. Under this system, producers are located around 150 km radius from Addis Ababa and 50 to 80 km radius of regional towns. Well-developed dairy industries are not common in sub-Saharan Africa although they exist to some degree in few countries around urban centers (Tesfaye, 2005). The majority of urban dairy farmers practice a large-scale system, the herd is dominated by improved / integrated dairy cows and the production system is market-oriented and milk production is for sale. As compared to other systems they have relatively better access to inputs (e.g. feeds) and services (e.g. good housing system and AI) that are provided by the public and private sectors and use an all-inclusive management system. Milk marketing is organized through direct communication between producers and consumers, and / or includes retailers / processors, partner companies and retailers.

Dairying is developed in response to the fast growing demand for milk and dairy products around urban centers. The genetic compositions of those dairy cattle range from zebu to pure exotic holstein- Friesian dairy cattle. The level of management varies from highly intensive large peri urban farms to relatively less intensive farms in secondary town. The number of animals per farm also varies from two to 150 cows. Currently, with increase in the intensity of management due to increase in economic pressure, competition for limited resources, together with increase in the level of intensification and level of exotic breed inheritance, new challenges in the management, control of disease and reproductive problems are becoming important factors in influencing these production systems (Million and Azage, 2000). Intra-urban dairy farms in Addis Ababa are characterized as intensive production units using high grade crossbred cows based on zero grazing. It is little or no grazing in the cities and stall-feeding is based on bought hay and concentrates. The level of exotic blood in the herd is among the maximum. Yearly milk production per cows is high and milk is directly sold to the local market (Azage *et al.*, 2005).

The more commercially driven husbandry system is largely urban and peri-urban based on intensive dairy farming. Unlike those operating in the traditional system, farmers engaging in „modern“, commercialized methods of dairy production have been able to access animals which are bred for and therefore genetically suited to commercial milk production. They also benefit from better access to market and support services, such as credit and genetic improvement programs such as Artificial Insemination (AI) services and livestock identification. However, farms which operate using these systems also suffer from their own problems, including, but not limited to supply and escalating price of feed, fluctuating demand for milk products, low competitiveness in the face of imported products, lack of access to land, challenges of waste disposal, and inadequate veterinary services. The animals used to produce milk and its products in this system appear to be more susceptible to a number of disease including bovine tuberculosis than the local breeds kept by rural and pastoralist dairy farms (Vordermeier *et al.*, 2012).

2.2. Characteristics of Urban Dairy Production

The urban milk production system is one of the many types of dairy systems in the tropics and sub-tropics. Crossbreed and pure dairy cows dominate the production process. The average milk production ranges from 5 to 15 liters per head per day (Nell, 2002). According to Rey *et al.* (2003); Stall and Shapiro, (2006) the production system consist of production, processing and marketing of milk and milk products that are channeled to consumers in urban centers. Urban dairy production systems have come in to picture with an intension to satisfy the increasing demand for milk in urban centers as result of increasing urbanization, rising per capita income, weak foreign exchange and increasing cost of imported milk and milk products (ILRI, 2016).

The role of urban dairy production system, to overall development includes income and employment generation, poverty alleviation and improving human nutrition and health. According to ILRI (2016) was stated that to make the contribution more effective, input output relationship is used as a yardstick to measure the efficiency of the production system. Urban dairy production systems are complex with diverse activities including production, processing and marketing and several technologies at each level in commodity chain that make up the system. Each activity of the system is affected by diverse biological, economic and social factors and their interactions (Rey *et al.*, 2003). In general, urban and peri-urban dairy production constitutes an important sub sector of the agricultural production systems in sub Saharan African countries. For instance, in Ethiopia, a recent survey undertaken by Addis Ababa Agricultural Bureau shows that there are a total of 10,167 small, medium and large dairy farms in and around Addis Ababa city. From these dairy farms the amounts of total milk production were 34,649,450 liters per annum. Out of this, 10% is used for home consumptions 73% were sold, 9.4% go to calves and 7.6% is heavily processed into ayib and butter. (Azage and Alemu, 1998; Azage *et al.*, 2002).The total amount of milk available to Addis Ababa is 43,849,675 liters per annum.

However, the annual total milk production in Ethiopia is very low. It is estimated at about 1.5 million tons per annum and is growing at a rate of only 1.4% per year. On the other

hand, the human population, estimated at 67 million, is growing at a rate of more than 3% per year. FAO (2018) reported that the per capita consumption of milk in Ethiopia is about 19.2 kg/year, which is very smaller than the worlds and Africa per capita average of about 37.2 and 105 kg/year, respectively.

2.2.1. Gender and education level

Currently in urban dairy production practice, female-headed dairy farmers are boosting. As an example, female-headed dairy farms are higher in urban-based dairy production than within the peri-urban crop-livestock mixed farms within the greater Addis milk shed, central highlands of Ethiopia (Fekede *et al.*, 2013). This means the role of gender in dairying increases and varies supported the assembly system and market orientation (Azage *et al.*, 2013). Therefore, dairying is supporting the livelihoods of female-headed households in urban areas (Fekede *et al.*, 2013). The amount of education of dairy farmers is a vital factor determining the managerial capacity, adoption of latest technologies, and also the overall improvement of small holder dairy cattle production (Fekade *et al.*, 2013). For instance, Azage *et al.* (2013) reported to the tutorial status of the dairy producers is higher within the urban dairy system than within the peri-urban system. Farmers with lower education levels adopt new technologies lower than higher educated farmers (Ofukou *et al.*, 2009).

2.2.2. Family size and age of urban dairy producer

Azage *et al.* (2013) and Fekade *et al.* (2013) described that the large family size is an advantage for the dairy producers to involve the labour force in different events of dairying and considered as an asset and an issue which assurances of social security within the household in dairying based livelihoods. According to CSA (2005) the average family size for the whole Ethiopia dairy farmers was (5.15 persons). Solomon *et al.* (2009); Belay *et al.* (2012); Haile *et al.* (2012); Abdi *et al.* (2013) reported that the average value of family size in North-eastern Amhara region, Jimma town, Hawassa City and West Hararghe was 5.7, 6.02, 7.1 and 5.42 persons/household, respectively. Comparatively the higher average

family size per household in Ejere (7.08) and Sululta (7.21) than the urban (6.19 persons/household) based dairy production in Girar-Jarso the greater Addis milk shed, Central Highlands of Ethiopia (Fekade *et al.* 2013). The average age of household head of the dairy farmer in Holeta town was 43.08 ± 8.84 years reported by (Asseminew, 2014), Hawassa City 45.17 years by (Haile *et al.*, 2012) and for Bako and Nekemet 48 and 46 years, respectively by (Diriba *et al.*, 2014).

2.3. Feeds and Feeding of Urban Dairy Cows

2.3.1. Concentrate feed ingredients

According to Azage *et al.* (2013) stated that in the urban areas, supplementary feed for crossbred lactating dairy cows are by-products of agro-industry like middling, seed cakes, bran, and molasses. Consistence with research conducted by, Zewdie *et al.* (2011) the ingredients of feed used (agro-industrial byproducts, hays or crop residues) are very low in calcium and prosperous. The byproducts agro-industry contains a lot of phosphorus than calcium, a condition that's terribly possible to cause calcium deficiency (Adugna, 2008). Feed concentrate mix is formulated to enhancement a basal diet and since it is not a balanced diet (Lukuyu *et al.*, 2012). Dairy animals are feed a selection of feed materials, the combination relying mostly on convenience (Staal and Shapiro, 2006). The intense use of feed materials by farm producers rather than nutritionally-balanced business concentrates might contribute to the low productivity (Staal and Shapiro, 2006).

2.3.2. Composition of concentrate mixtures

Many authors in Ethiopia those conducted their research on crossbred cows feeding were used concentrate mixture for control group feeding contains greater than or equals to 220g/kg of crude protein (CP) in the dry matter (DM). For instance, Tekeba *et al.* (2013) Rehrachie *et al.*, (2003); Mesfin *et al.*, (2009) used 225, 236, and 243 g/kg DM of CP at

the Holetta Agricultural Research Center, central Ethiopia and Andassa Livestock Research Center, respectively. The same authors also reported for metabolizable energy (ME) contents of the same concentrate mixture fed to crossbred cows control group for similar research and time was contained 12.3, 12 and 11.7 MJ/kg DM. A research conducted by Nega *et al.* (2006) in the peri-urban and urban middles of Central Rift Valley, Ethiopia (Arsi -negelle, Ziway, Wonji Kuriftu and Lume worada) farms, home-mixed concentrate for crossbred dairy lactating cows, it was contained 213 g/kg DM of CP, 10.6 MJ/kg DM of ME, 3.4 g/kg DM of calcium (Ca) and 12 g/kg DM phosphorus (P). Mesfin *et al.* (2013) studied that dairy farmers home-mixed concentrate for crossbred lactating dairy cows in peri-urban dairy production scheme of Central Ethiopia, contained 260g/kg DM of CP and 10.8 MJ/kg DM of ME.

2.3.3. Concentrate feeding level of dairy cows

In a previous study at the Holetta Agricultural Research Center, where 10, 8, 6, 4, and 2 kg of similar type of concentrate mixture fed to lactating dairy cows per day and, 6 kg/cow/day were endorsed (Tadesse *et al.*, 2007). According to Mohammed (2011) reported that, Crossbred cows produced lower rates of rising in the marginal yield response, and economic use from the marginal level increased above 0.5 kg of concentrates per kg of milk yield, this level are taken the point of biological and economic targets. Similarly SMDP, (2009); Pandey and Voskuil, (2011) stated that, recommended that feeding concentrate at the rate of 0.5 kg per kg of milk yield with *ad libitum* roughages feeding.

2.3.4. Nutrient requirement of dairy cows

Nutrition incorporates a profound influence on the productive and generative performance of milk cow. Due to the high rate of metabolic and the need for milk secretion, lactating cows have a special need for nutrients (Indetie, 2009). In follow, milk yield and composition are influenced principally by the dietary provides of energy and macromolecules like protein (Tadesse *et al.*, 2003). Energy and protein, of feeds, are

central in determining nutritional adequacy and feeding levels for different classes of stock (Streeter, 2006). Rations should be formulated to confirm that the animal consumes the desired amount of nutrients in a day (Adugna, 2008). Well-balanced diets should prevent severe negative energy balance and an excess intake of specific dietary components (Leroy *et al.*, 2010).

2.3.5. *Basal feed resources*

The urban dairy production feeding operations depend on the hay produced in pasturelands as a source of roughage feed in the Central Highlands of Ethiopia, the greater Addis milk shed (Fekede *et al.*, 2013). The foremost roughage feed resources for dairy animals across all the various production systems included natural pasture/grasslands, grass hays, crop residues non-conventional feed resources (Asaminew and Eyassu, 2009; Yitay *et al.*, 2009; Azage *et al.*, 2013). The crude protein content of pastures is not up to the forage crude protein content of 7% which might cover the maintenance requirements of ruminants (McDonald *et al.*, 2002). Good grass and legume hays are adequate for maintaining most classes of livestock, particularly those in a very non-productive state (Streeter *et al.*, 2006). Therefore, dairy cows depending on poor quality basal feeds will not express their full genetic potential

2.4. Milk Yield and Composition

2.4.1. *Milk yield*

The profitability of a dairy enterprise depends on obtaining as high level of milk production as possible with available feeds, relative to the maintenance cost of the animals (Saeed *et al.*, 2007). The lactation milk yield and days in milk of indigenous and crossbred breeds in Ethiopia reported by previous researchers are summarized in Table 1. The milk production potential of indigenous cattle is very low. In addition, milk production potential of temperate breeds in the tropical environments is higher than the

indigenous breeds, although the yield is still far below the genetic potential (Kelay, 2002).

Table 1: Milk Yield of Dairy Cattle in Urban and Peri-Urban Production Systems

Breed	Location	Milk yield/head/day (liter)	Source
Local	Urban Awassa	1.7	Ike <i>et al.</i> , 2005
Crossbred	Peri-urban Awassa	5	
Crossbred	Urban Awassa	11.6	
Crossbred	Peri-urban Awassa	7	
Crossbred	Intra-urban (Addis Ababa)	5.91	Yoseph, 1999
Crossbred	Secondary town Deber Zeit	9.96	
Crossbred	Large peri-urban	8.92	

Smallholder milk producers, however, face numerous problems, from identifying the types of animals to use, through how to manage them, and producing enough feed to achieve their potential for milk production. Processes to clear up those troubles are numerous and closely related to the production systems (ILCA, 2003). Average milk production of local cattle per head per day is very low. Total milk production is further affected by relatively short lactation length, and extended post-partum an oestrus period resulting in lower reproductive efficiency (Mukasa-Mugraw, 2007). This is basically due to the reality that these animals have been decided on by and large for survival trait and own nicely set up adaptive tendencies to the surroundings wherein they're anticipated to live on and convey. Milk composition is highly variable and influenced by intrinsic factors like breed, species, stage of lactation, and external factors like environmental stress, changes in feeding, etc. Milk composition and production are the interaction of many elements within the cow and her external environments (O'Connor, 2005).

However, it is generally accepted that the dairyman can alter many of these factors to achieve milk production and increase profit.

Milk has distinct physical, chemical and biological characteristics, which justifies its high quality for consumption. These characteristics present a favorable environment for the multiplication of various bacteria (Hemalatha and Shanthi, 2010). Milk quality can also refer to the properties of milk based on one or a combination of butterfat content, bacterial counts (microbial quality) and physical appearance of milk relating to color, smell and presence of foreign or dirt particles (Lore *et al.*, 2006). Milk that is received at collecting centers or processing plants is graded based on its quality. This grading helps in deciding whether to accept or reject the milk. Broadly speaking milk quality also refers to the good and bad attributes of a milk sample (Lore *et al.*, 2006).

2.4.2. *Chemical composition of milk*

The major components of milk are water, fat, protein, ash and lactose. However, the exact composition of cattle milk varies with individual animals, breed, season, diet, feeding system, stage of lactation and microbial quality (Pandey and Voskuil, 2011; Kittivachra *et al.*, 2007). Milk composition and production are the interaction of many elements within the cow and her external environment (Asaminew, 2007). Milk composition varies between species, breeds and individual animals depending on the management systems. As a general rule, any ration that increases milk production usually reduces the fat percentage of milk (Soyeurt *et al.*, 2007; Schennink *et al.*, 2008). Different breeds differ in their milk protein and fat contents. Jersey milk has higher protein and fat contents than Friesian (Schennink *et al.*, 2008). The gross milk composition of cows contains 87.2% water, 3.7% fat, 3.5% proteins, 4.9% lactose and 0.7% ash (Park, 2009). (Dehinenet *et al.* 2013) reported protein percentage for crossbred milk was 3.12%. Also Negash (2012) reported that 5.48±0.19% fat, 9.10± 0.09% SNF and 3.46±0.04% protein raw milk in the Mid-Rift Valley of Ethiopia. In the other study the overall mean (±SD) of raw cow's milk for moisture, fat, SNF, Lactose, protein, ash

and total solid were 86.04 ± 1.10 , 4.19 ± 0.70 , 9.77 ± 0.58 , 5.39 ± 0.31 , 3.53 ± 0.26 , 0.78 ± 0.09 and 13.96 ± 1.10 , reported by (Tadesse *et al.*, 2020), respectively

2.4.3. *Physical properties of milk*

The natural composition and Physico-chemical properties of milk could be amended by adulteration of milk by intentional addition of water or alternative substances square measure a typical downside in several developing countries. Adultery is illegal because it alters the natural composition of milk and may introduce harmful bacteria and other harmful substances into the milk. Water adulteration lowers the particular gravity and will increase the melting point of milk. The traditional milk relative density ranges one.026 to 1.032 milk assortment centers and processors habitually verify the particular gravity of milk and reject milk suspected of getting been adulterated (Kurwijila, 2006).

Milk, at its normal state, has unique physical properties, which are used as quality indicators. High- quality milk ought to be white in look, don't have any objectionable odors, and be freed from abnormal substances like pesticides, supplemental water or antibiotic and antiseptic residues. Titratable acidity is decided within the dairy farm business chiefly for 2 reasons: (a) to see the freshness of milk and milk product and (b) to regulate the manufacture of refined (fermented) dairy farm product (McCarthy and Singh, 2009). The initial acidity of milk from individual cows varies within the range 0.08–0.25% lactic acid but the titratable acidity of fresh bulk milk seldom falls outside the range of 0.14–0.16% (McCarthy and Singh, 2009). The pH of normal bovine raw milk is about neutral milk at 25⁰C. It is among 6.5 and 6.7, with 6.6 being the foremost common rate. Differences in pH and buffering between individual lots of fresh milk reflect compositional variations (McCarthy and Singh, 2009). Dessalegn (2017) reported that, overall mean of raw milk quality for pH, freezing point, density, added water, acidity, fat, protein, SNF, total solid, lactose and ash contents were 6.66 ± 0.04 , -0.55 ± 0.03 , 1.028 ± 0.002 , 2.80 ± 3.60 , 0.176 ± 0.01 , 3.60 ± 0.53 , 3.27 ± 0.15 , 7.78 ± 0.41 , 11.38 ± 0.78 , 3.93 ± 0.25 and 0.62 ± 0.05 , respectively in the value chain points.

2.5. Milk Consumption

Milk and milk products are a source of high quality animal protein. Milk and milk products form part of the diet of many Ethiopians; they consume dairy products either as fresh or boiled milk or in a sour form. The consumption of milk and milk products varies geographically between the highlands and the lowlands and depending on the level of urbanization (Mohammed *et al.*, 2004). In the highlands, the rural people are farmers who regularly raise livestock and crops. The main component of their diet consists of grains and legumes. Milk is used to raise calves, man babies, and whatever is available more and more is boiled with a drink (irgo) and / or butter. Among the lowland people, mainly pastoralists and agro-pastoralists represent the lowland people, where milk forms a major part of their diet. The production varies according to season, where during the dry season, little milk is available. However, since they own a number of milking animals, they have some milk for home consumption over and above that for calf rearing, unless there is a severe drought (FAO, 2009). Local consumption of fresh milk is mainly limited to children (Fekadu, 2004).

In most cases the milking animals are kept for the night with the remainder of the stock during a shade or in an enclosure. Because these areas aren't kept clean without dung removal so milking cows are contaminated with manure and urine. Since it's not a standard practice to wash the udder and hindquarters before milking the milk is contaminate. The quality of hygienic milk production is taken into account unsatisfactory (FAO, 2009).

2.6. Milk Microbial Quality

According to Linzell and Peaker (2000) report milk is sterile produced in healthy cow's udder but due to its complex chemical structure and high water performance, milk is useful as an excellent media for the growth and development of many strains of bacteria. Therefore milk can be contaminated within the udder, if the cow gets infected by bacterial agents like that of milk from mastitis cows (Fernandet *et al.*, 2004). On the other hand milk can be contaminated by microorganisms free living environment during the process of milking (Fernand *et al.*, 2004 and Courtenany *et al.*, 2005), processing (Elmagli and Ibtism, 2006), collecting and transporting (Abdel Moneim *et al.*,2006). Milk may contain both pathogenic and non-pathogenic organisms. In most developed dairy countries, milk quality is defined by the somatic cell count (SCC) and the bacterial count (“standard plate count”) in pre-pasteurized bulk tank milk. Somatic cells are composed of white blood cells and occasional sloughed epithelial cells. Regulations require that bacteria and somatic cell counts of Grade “A” raw milk must not Exceed 100,000 Standard Plate Count (SPC) and 750,000 Somatic Cell Count (SCC), respectively. Some of milk microbial quality indicator are the standard plate count (SPC), coliform count (CC), and somatic cell count (SCC). In addition to this, milk is hourly subordinated to more detailed laboratory analysis to separate and identify specific pathogens to man and cows itself (Jay, 2000; Loir *et al.*, 2003; Kivaria *et al.*, 2004; Kessel *et al.*, 2004).

Coliform count (CC): Coliform isn't biological category, however a running definition given to a group of microorganism, which inhabit the intestinal tracts of animals (Jay, 2000). E.coli is the maximum coliform in animal intestines and derived nearly completely from animal droppings (Quinn *et al.*, 2002). Coliform may be originate in the soil, on vegetables and poor sanitation water (2003; Kessel *et al.*, 2004). Coliform counts >100 cfu/ml suggest poor milking practices, dirty equipment, contaminated water, dirty milking facilities, and/or cows with subclinical or clinical coliform mastitis (Oliver, 2010).

Standard plate count (SPC): The standard plate count (SPC), which is also called total bacteria count (TPC) of raw milk gives an indication of the total number of aerobic bacterial present in milk at the time culturing the samples. The number of bacteria in aseptically drawn milk varies from animal to animal and even from different quarters of the same animal. On average, aseptically drawn milk from healthy udders contains between 500 and 1000 bacteria per ml of milk. Many countries have milk quality regulations, including limits in the total number of bacteria in raw milk, to ensure the quality and safety of the final product (Worku *et al.*, 2012). High initial counts (more than 500,000 bacteria per ml of milk) are evidence of poor production hygiene (Oliver, 2010). However most countries have put 200000cfu/milliliter as the acceptable bacterial limit and the United States has a standard of 100000 bacterial cells per milliliter (Lore *et al.*, 2005).

Somatic cell count (SCC): The somatic cell count (SCC) is internationally recognized as a parameter for assessing milk quality and udder health (Degraaf *et al.*, 2007). EU standard requires that the milk should not contain more than 400,000 somatic cell/ml. Milk market routinely rely on somatic cell count to ensure a quality product. Somatic cell count levels are mentioned to ensure compliance with set quality product. Today most markets in developed countries pay a premium for low SCC, good quality milk. One can appreciate the reasons, for paying a bonus for quality milk when the relationship between mastitis (high SCC) and milk composition is understood. Chemical change in milk composition due to mastitis reduced milk quality (Rice and Bodman, 2007). The most frequent cause of high somatic cell count is poor cleaning of milking systems. Most herd milk contains between 200,000 to 500,000 somatic cells/ml of milk. These herds are losing at least 8% in potential milk production. Thus, methods of mastitis control that reduce somatic cell count (SCC) will not only improve milk yield and composition but will also decrease economic losses due to mastitis. It is widely accepted that individual cow SCC greater than 150,000 cells/ml or individual heifer SCC greater than 120,000 cells/ml indicates presence of infection (O'Brien, 2008)

2.7. Reproductive Performance of Dairy Cattle in Ethiopia

Reproductive efficiency of a herd is an important component of dairy cattle productivity in Ethiopia. Economic losses because of poor fertility can be attributed to the cost of prolonged calving interval, increased insemination costs, reduced returns from calves born and forced replacements in the event of culling. A delay in conception because of poor fertility increases calving interval mostly due to the increase in the number of days from calving to conception (Nishida *et al.*, 2006).

2.7.1. Age at first service

Age at first service (AFS) means the age at which heifers attain body condition and sexual maturity for accepting service for the first time (Gidey , 2001). The age at the beginning of the service indicates the onset of calf production and fulfillment and affects both the reproductive life and fertility of the female by its effect on her calf's life span. Age at first service is influenced by genotype, nutrition and other environmental factors (Zewdie, 2010). Age at first mating coupled with reproductive efficiency to first and subsequent breeding determines age at beginning of calving since the length of the gestation period is a fixed period (282 days) at which time the pregnancy occurs. Thus, the major reproductive challenge for breeding age crossbred heifers is to achieve conception by 14 to 16 months of age. Rearing crossbred heifers to initiate puberty by 11-13 months so that breeding can occur in a timely fashion is critical to the overall success of a heifer rearing program (Head, 2002). Habib (2011) and Amin *et al.* (2013) reported that average age at first of crossbred and local heifers were 40.2 months and 42 months respectively.

2.7.2. *Age at first calving*

Age first calving is closely associated with generation interval and, therefore, influences response to selection. Under controlled breeding, heifers are usually mated once they are mature enough to face up to the strain of parturition and lactation. This raises the prospect of early conception after parturition. In traditional production systems, however, breeding is usually uncontrolled and heifers are bred at the primary opportunity. This frequently leads to longer subsequent calving intervals (Dayyani *et al.*, 2013).

The overall estimated average age initially calving was found to be 40.9 ± 6.6 months, of which 47.16 ± 8.7 months for local dairy cows, and 37.95 ± 9.4 months for crossbred cows. Age initially calving is affected by factors like breed, nutritional status, and management differences of dairy cows. Pure exotic and cross-bred cows attain AFC differently. As an example, crossbred cows in Addis Ababa (Ayenew *et al.*, 2009) had lower (29.7 months). This means that pure exotic heifers reach puberty before cross-bred cows. Since the results were reported from different cities then management and feeding differences might be the explanations. Farm size has been showing to have an emotional impact on AFC in dairy animals. Consistent with (Lemma and Kebede, 2011) small and enormous dairy farms in Addis Ababa had longer (34.2 months) and shorter (32.6 months) AFC, respectively.

2.7.3. *Calving interval*

A calving interval may be a time elapsed between two consecutive successive parturitions. The estimated mean calving interval of local and crossbred dairy cows was found to be 23 ± 4.3 months of which for local dairy cows and for crossbred 12 ± 4.4 months, the general calving interval was prolonged, and on the opposite hand, crossbred cows calving interval was shorter and better than local cows (Mulugeta and Belayeneh, 2013) local cow. Calving interval is a crucial thing about measuring the breeding efficiency and directly correlates with the economics of milk production. Reproduction in dairy cows with regular and shorter calving intervals

(365-420 days) may be a key feature for the rapid multiplication of the breeding stocks. However, studies in urban and peri-urban areas of East Africa have reported long calving intervals (406 to 562) for dairy cows. Long calving interval may be a common problem in urban and peri-urban areas and it's linked to poor body condition score and lack especially inorganic phosphorus (Swai *et al.*, 2005b). The long mean calving intervals end in low calf crop and low level of production

2.7.4. Days open

Days open, the number of days between births to pregnancy, influences the profitability of the dairy industry. A major nutrient deficit in dairy cows is due to the negative energy balance that causes the delay in early ovulation (or low oocyte quality) and the increased incidence of fetal death in the period from birth to pregnancy which increases by more than 120-130 days (Rossi *et al.*, 2008). Loyoy *et al.* (2010) reviewed and concluded that the absence of estrus events during the first calving in dairy cows was due to a negative energy balance. The report also shows the magnitude and length of prenatal energy status (i.e., negative energy balance) has a negative impact on the reproductive and productive performance of the next generation of high-yielding dairy cows (Nishany *et al.*, 2013).

The average length of the most recently opened days in dairy cows combined in Ethiopia was 85.6 to 197 days (Zewdie *et al.*, 2011; Belay *et al.*, 2012b; Hunduma, 2012; Niraj *et al.*, 2014). For example minimum number of open days (DO) squares received 285 ± 4.3 days, compared with (Giday Yifter, 2001) reports of 280 ± 3.4 days of Fogera breeding on a cattle farm in Andassa. On the other hand, Haile-Mariam and Goshu (1996) reported that the 151 ± 13 -day DO for the lowest Fogera breed also (Niraj Kumar *et al.*, 2014) reported the DO of Cow in indigenous $148.33a \pm 38.44$ and HF-cross $93.3b \pm 43.87$. Gideon, (2001): Ababu Dekeba, (2002) reported 215 days and 250 days of DO for highland cattle and lowland areas, respectively.

2.7.5. *Number of services per conception*

NSC is of the best measurements for reproductive efficiency, it indicates the fertility level of the dairy farm. NSC is simple straightforward to calculate and understand and also it's an honest measure of reproductive status, but still, it always doesn't indicate reasons on heifers and cows that fail to conceive. The NSC basically depends on the breeding system used. It's higher under uncontrolled natural breeding and lows where hand-mating or AI is employed. The NSC was significantly suffering from the herd, season, placenta expulsion time, lactation length, and milk yield (Abdel and Alemam, 2008). The amount of service per conception is directly associated with the conception rate in a herd. Conception rate or the proportion of cows inseminated that actually become pregnant is often reported as "percent successful services". As previously mentioned, estrus detection accuracy may significantly influence the conception rate. It should be noted that albeit estrus detection accuracy plays a serious role, it's not the sole thing that affects the conception rate. Physiological stress from increased milk production or heat stress, reproductive disorder (such as metritis, mastitis, retained placenta, cystic ovaries (Whittier *et al.*, 2002).

Motlagh *et al.* (2013) found that the amount of service per conception tends to rise significantly with an increase in age (47 to 48 months). The possible cause of the low NSC for younger cows was not clear. Razi *et al.* (2010) observed that the conception rate of parity 3 and 4 was 77% and 75%, respectively. Cows with parity 3 and 4 have several times increased conception rate than nulliparous. Among the age group, the highest conception rate was in between 4 and 5 years, 71% and 74%, respectively, and the lowest conception rate was in cows of 9 years of age or above. Animals with 1-2 services showed a conception rate of 61% and animals with 3 and more than three services showed a conception rate was 50%. The conception rate was significantly increased in both parity 3 and parity 4 than nulliparous, but cows with an age group more than 9 have significantly decreased conception rate than another age group. However, (Habtamu *et al.*, 2010) working with Jersey cows observed that there is an insignificant effect of parity

number on the number of services per conception. Comparable results also were reported by (Hammoud *et al.*, 2010) study on reproductive performance of Friesian cows under semiarid conditions in Egypt, who reported that Parity had no significant effect on NSC. The NSC was highest at the third lactation followed by the first lactation.

2.8. Dairy Housing and Manure Management

Kelay (2002) reported that in Addis Ababa, 84 percent of small scale farms and all of the medium scale and large scale farms had barns. Most of the barns of the small- scale and medium scale farms were constructed within the living compound of the households and, thus, were small and crowded. However, most of the large scale farms had a separate farm compound usually at the outskirts of the city and had well-constructed and modern types of barns. Similarly, Ike *et al.*, (2005) reported that housing of the animals follow a similar pattern with 76.7 percent of the farms in the urban area keeping the cattle in the barn all the time, except when cleaning the barn and 78 percent of the farms in the peri-urban area housing the cattle at night and during the hot period of the day as well. In many countries, cow dung is highly valuable as fuel for cooking and heating, reducing expenditures for firewood or fossil fuels. It represents the major fuel supply for households use by millions of farmers in Asia, Africa, and in parts of the near east and Latin America.

Cattle manure provides an important fraction of the demand for domestic fuel in areas with limited wood availability. Compost sales contribute significantly to income generation (Anderson, 2004). The production of biogas from manure is an excellent source of fuel for wood or firewood for farmers in tropical countries (Kumar and Biswas, 2002). An appropriate dairy and poultry system must meet the basic needs of cattle, in accordance with the principles of healthy animal care (Hurnik *et al.*, 2009). There are three main objectives for environmental management in dairy herds (Radostitis *et al.*, 2004):

- Reduce the total number of germs in the environment.
- Reduce the chances of contact between germs and cattle.
- Minimize the negative effects of nature on the animal, which may change the way visitors are protected.

2.9. Opportunities and Constraints of Urban Dairying

Dairying for the urban poor takes place under challenging circumstances. Resources, such as space, capital and feed are limited and the institutional and legal environments appear to be unfavorable. However, the continuing existence and increasing importance of urban dairying for the poor indicate that the positive aspects of urban dairying outweigh the negative aspects.

2.9.1. Opportunities and key strengths

The following opportunities and key strengths have been recorded (FAO, 1993; Maxwell, 1994; Azage and Alemu, 1998; Yoseph, 1999; Azage *et al.*, 2002; Nyapendi *et al.*, 2004.

- Rapid urbanization has led to increasing demand for livestock products: The proximity to those markets is a plus for the poor.
- Higher come per unit land from dairying: needs less or no land and guarantees higher returns per unit land used.
- Utilization of available resources: The conservation of urban livestock provides access to household waste, agricultural industrial products such as molasses and alcohol waste, weeds and grass from public areas and crop residues and grass from markets.
- Provision of employment and income to the unemployed or low-income urban families.
- Provision of a social safety and security for the poor: Vulnerable teams, like female headed households, children, retired individuals, widows and folks with

restricted formal education square measure concerned in urban stock keeping as a variety of social insurance strategy.

- Provision of supplementary financial gain to the utilized, poorly paid socio-economic class urban dwellers. Source of commercial and economic activity for the well to do who can invest in intensive urban-based milk production to cater the specialized demands of the city dwellers.
- Contribution to the food security of urban households that can't afford to get all of its feed wants.

In general, urban agriculture has multi-purpose activity, urban farm animal keeping fits completely different keep ways and contributes to food security, financial gain and employment generation, saving and insurance. It provides simply convertible assets for covering necessary expenditures (school fees, health treatments, etc.).

2.9.2. *Constraints and weaknesses*

In none of the systems reviewed above neither optimum performance nor the potential economic returns is achieved. Technical, institutional and policy-related constraints are responsible for this below optimum performance (FAO, 2003; Azage and Alemu, 2008; Smith and Olaloku, 2008; Azage *et al.*, 2002).

Technical constraints: In general, urban dairy production in Sub-Saharan Africa is characterized by low milk yields. In comparison to production levels in other regions, milk yields in Africa have been reported to be 2.5 times lower than in Latin America and Asia, 10 times lower than in Europe, and 15 times lower than in North America (Smith and Olaloku, 1998). Technical constraints responsible for such low productivity revolve around three factors: 1) Feed availability and quality: seasonal quantitative and qualitative feed shortages. 2) Poor livestock health: poor veterinary healthcare and management. Moreover, urban dairy production units are often in very close proximity to high concentrations of people, raising the importance of zoonosis; that is, the transfer of diseases from animals to humans and 3) Low genetic potential for milk production and unavailability of supply of improved genotype. In Africa particularly in Sub-Saharan

Africa, information access and adoption of improved technologies is unthinkable for poor urban livestock keepers. As information sources and advice services are lacking, poor livestock keepers often have limited knowledge of livestock husbandry practices.

Institutional constraints: A weak infrastructural base and poor support services are major ones among institutional constraints. Inadequate infrastructures include poor feeder roads, unreliable power supply, unavailability or inefficient cooling and processing capacity. Weak institutional support services in terms of credit facilities, veterinary health delivery, artificial insemination services, input supply and distribution, and technical advisory services are some of the bottlenecks. Inappropriate waste management is also a serious issue. There is strong evidence that animal waste disposal in its current form causes environmental and public health problems. However, in Ethiopia much of cow dung is made into cakes and sold for fuel or used by the households as wall plastering material for traditionally built houses.

Policy-related constraints: Government policies play a crucial role in livestock development. They do not only affect the economic environment, but also directly affect production, marketing, consumption and external trade in livestock products. Policy issues that may constrain or promote the dairy industry performances include: foreign exchange, dairy import, and commodity price policies, poor support for networking and establishment of cooperatives.

2.10. Occurrences of Aflatoxin in Dairy Feed and Milk

Aflatoxins are a group of chemically related poisonous carcinogens and mutagens that are produced as natural by-products during the growth of certain common molds and it is families of toxins formed by definite fungi that are originate on certain crops. Children are mainly affecting from aflatoxin exposure, which is related to retarded growth, delayed development, damage of liver, and cancer of the liver. The aflatoxins are labelled as B1, B2, G1, G2, M1 and M2. Aflatoxin B1 is that the major toxin produced, and is regulated within the limit at 20 ppb in agricultural products which will be utilized in human food.

The clinical effects of aflatoxins may include death, cancer of the liver, reproductive problems, anemia, system suppression, and jaundice. New born animals may be harshly affected by a toxic derivative of aflatoxin (aflatoxin M1) that can be passed through milk. When feed and food are contaminated with the species of *Aspergillus*, specifically *Aspergillus flavus* and *parasiticus fungi* are metabolites to aflatoxin, which are naturally occurring contaminants of food and feed.

Aflatoxin M1 (AFM1) is that the principal hydroxylated AFB1 substance gift in milk of cows feed with a diet contaminated with AFB1 and excreted at intervals twelve hours of administration of contaminated feeds. According to Yohannis *et al.* (G, 2017) stated that when AFB1contaminated feed is withdrawn, AFM1 in milk is relapse and after 3-4 days of withdrawal no traces of aflatoxin in milk being detected. Commonly Aflatoxin in fresh milk should checked; if the concentrations of M1 above 0.05 µg kgG1, it is not desirable for consumption and also such milk cannot be used for products processing that go into the human food chain. Commonly, grains like corn, oil seeds and their by-products are sources of aflatoxine. In Ethiopia, previous research reported that, staple cereals like red chili pepper and ground peas are highly susceptible for aflatoxin contamination. From Sub-Saharan Africa including Benin and Kenya reported showed that there was highly significant association among aflatoxin exposure and impaired child growth.

The stringent parameters for aflatoxin regulation was considered by, the Commission Regulation of the European Union (EU) No 165/2010. The directive forwarded concentrated level of 8 ppb of AFB1 has been conventional in food endangered to sorting or physical treatment before human consumption and the optimum level of 0.05 ppb has been limited for AFM1 in milk. The Food and Drug Administration in the USA (USFDA) sets action level for AFM1 in milk to be 0.5 ppb and total aflatoxin in animal feed to be 20 ppb. From recent study, the level of Aflatoxin M1 and aflatoxin B1 within milk and feed were high, which indicated samples collected from around Addis Ababa result. The level of contamination of AFB1 and AFM1 is varying among different location of Ethiopia. Aflatoxins impurity is controlled by many countries; now the used

harmonized legislation at the international level. The toxigenic fungi cause to decrease the yield, decreases animal productivity and harmful from a human health perspective.

Aflatoxins are toxic metabolites of *Aspergillus* fungi that can contaminate various foods and feed products. Aflatoxins are the most common mycotoxins and even more potent mycotoxins. They are a type of mycotoxin produced by *Aspergillus* species of fungi, such as *A. flavus*, *A. parasiticus*, *A. nomius* and *A. nigrum*. However, there are a number of *Aspergillus* species that produces aflatoxin, but in rare condition. Aflatoxin is mostly linked with crop such as corn, rice, sorghum, barley, rye, wheat, groundnut, soyabean and cottonseed (Burch and Rowsell, 2001). Different types of cereals like nuts, spices, figs and dried fruit are sources of aflatoxin when they are contaminated with mold. However, maize and groundnut are the two high aflatoxin risk crops in the world (Moss, 1998). These two crops play an important role in the diets of Ethiopian people. The contamination of these crops by aflatoxicogenic fungi and hence infection with aflatoxin is principally higher. Consequently, the exposure of human and animals to this toxin is higher and cause huge health and economic problems. *A. parasiticus* and *A. flavus* are common and widely distributed in tropical and sub-tropical parts of the world (Habtamu *et al.*, 2001).

Ethiopia as a tropical country has a high risk of aflatoxin contamination. Infestation of grains with *Aspergillus* species and aflatoxin contamination could occur before harvest and at storage. Aflatoxins are acutely toxic, immunosuppressive, mutagenic, teratogenic and carcinogenic compounds targeting mainly the liver for toxicity and carcinogenicity (Peraica *et al.*, 2009). The extent of damage by aflatoxin depends on the concentration of aflatoxin, way of exposure, the condition of the organism and others. After occurrence of aflatoxin injury, it is difficult for treatment. However, it is possible to control aflatoxin contamination of grains by different management practices.

Aflatoxin contamination of grains causes several damages to human and animal health and economic losses. Ethiopia is comfortable for the progression of aflatoxicogenic fungi and hence aflatoxin infection of grains. According to Amare *et al.* (2006) report 123 samples of maize products were analyzed, of which 16 were positive with levels of

0.78ppb. Several studies also showed that liver diseases are increasing in Ethiopia and cause the death of many individuals; this may be due to aflatoxin contamination of food. Since the common agent for this aflatoxin, aflatoxin contamination of animal feeds, livestock and animal products like milk also are increasing within the country. The contaminated dairy cow feed by aflatoxin B1 is hydrolytes to Milk and milk products infected with Aflatoxin M1. These indicate that the hurt due to aflatoxin in Ethiopia is growing; this may be due to lack of alertness, lack of conventions, poor management system and other. The quantitative study of aflatoxicogenic fungi and aflatoxin has been conducted by several authors in Ethiopia. Most of this report indicates that aflatoxin is increasing in the country and causes huge damage. In addition, lack of adequate information on status and effects of aflatoxin contamination leads to an enormous damage to the country.

3. MATERIALS AND METHODS

3.1. Description of the Study Area

The study was conducted in three towns, namely Burayu, Sebeta and Sululta, Oromia special zone surrounding Finfinne (Fig. 1). Oromia special zone has seven administrative towns. It is situated at an altitude between 1700-3600 meters above sea level. The average minimum and maximum annual temperatures are 23⁰C and 26⁰C, respectively. The mean annual rainfall ranges between 800-226 mm. The pattern of rainfall is bimodal, in which the long and heavy rainfall is received during the months of June through to September, while the short and small shower is received during February to April. The livestock population of the special zone is estimated at 1,114,498 cattle, 374798 sheep, 79052 goats, 54161 horses, 120198 donkeys, 8575 mule and 491185 poultry, (CSA 2016). The study towns were chosen based on their milk production potential.

Burayu Town: Burayu Town is located at 17.5 km west of Addis Ababa capital city of Ethiopia and situated at a longitude of 9°02'07"N 38°39'39"E in Oromia Regional State, Ethiopia. It is found at an average altitude of 2449 m a.s.l.

Sebeta Town : Sebeta Town is located at 24km South west of Addis Ababa at a latitude and longitude of 8° 55'N 38° 37'E and an elevation of 2356 m.a.s.l.

Sululta Town: Sululta Town is situated between 9°4'30"N to 9°30'59"N and 38°31'26"E to 38°58'49"E. It is found at an average altitude of 2500 m a.s.l. (Source zonal agricultural office)

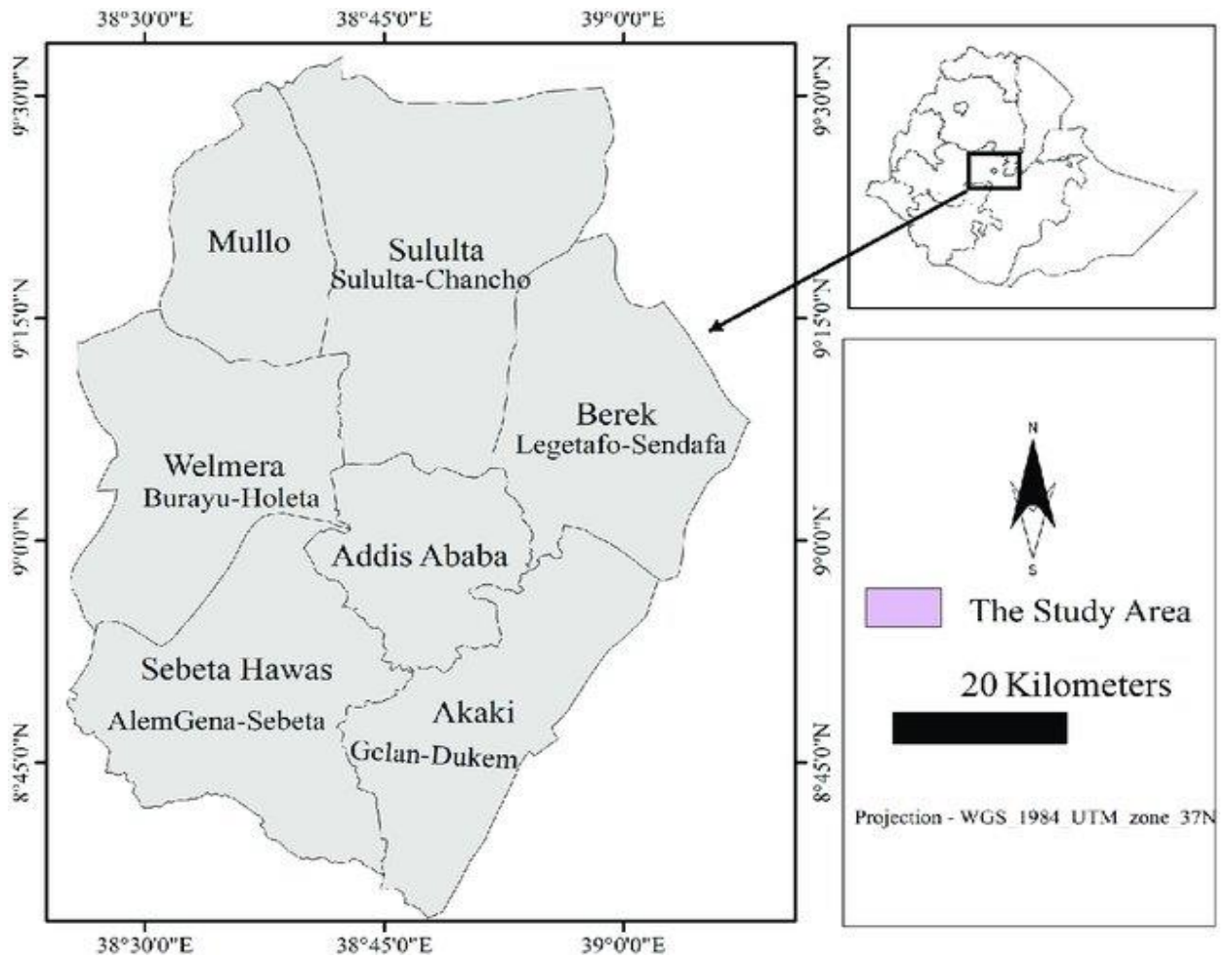


Figure 1 Map of Oromia Special Zone Surrounding Finfinne

3.2. Study Population and Design

Urban dairy farmers and dairy animals kept by the dairy farmers represented the study population. Cross-sectional and retrospective types of studies were conducted to collect data using questionnaire. On-farm observations and laboratory analysis were also conducted on relevant data.

3.3. Sample Size Determination

The sample size for data collection through dairy farmers' survey was determined using the sample size determination formula proposed by (Yamane 1967).

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

Where, n= designates the sample size the researcher uses;

N= designates total number of households heads

e= designates maximum variability or margin of error

l= designates the probability of the event occurring

$$n = \frac{840}{1 + 840(0.1)^2} = 90$$

Accordingly, a total sample size was 90 urban dairy farmers/producers were selected from the three study sites. Then random simple sampling technique was applied to determine samples from each city and 30 dairy farmers were included from each urban town.

3.4. Sampling Procedure

Two-stage sampling techniques were used to collect data. The first stage involved purposive selection of three towns out of the seven towns based on the practice and the availability of dairy farms in those areas. In the second stage, urban dairy farmers were selected randomly from the list of urban dairy farmers from each selected town and for laboratory analysis, the feed and milk samples were collected from these farmers. For the purpose of Key Informant Interview (KII), 6 to 9 persons from relevant organizations such as agricultural offices, development agents' workers, and experienced persons were purposefully included to get reliable data and for Farmers Group Discussion (FGD), 9 to 12 persons were identified and interviewed.

3.5. Data Collection Methods

The methods employed for collecting data in line with the objectives of the study were questionnaire survey, key informants interview, on farm observations and laboratory analysis.

3.5.1. Questionnaire survey

Primary data were collected through interviews using a structured questionnaire. The interview mainly focused on milk production and waste management practices, awareness of aflatoxin, the socio-economic characteristics of the respondents, herd size, blood level and finance, housing systems, feeding and watering system, diseases and, institutional support and extension services, and age at first calving ,age at first service ,calving interval, length of lactation , milking time, number of lactating animals, number of animals available in farms and, the major constraints and opportunities of urban dairy farming, barriers for future expansion of dairy farming, threats to urban dairy farming, challenges faced by urban agricultural offices working on dairy production were collected by interviewing the selected households and key informants in each town. Since the survey was based on a one visit interview, it was not possible to record the milk

production performance parameters during the study time, rather dairy farmers were asked on the performance parameters and their previous records maintained at the farms. Based on the information gathered, the milk production per lactating dairy cow per day and total farm milk production were calculated.

3.5.2. Milk and Feed sample collection

Feed and milk collection was made at the same date and time in each site by trained enumerators. Feed samples were collected first and then the next day milk samples were collected. The total of 90 milk and home-mixed dairy feed samples were collected from the three study towns. Milk were analyzed for aflatoxin at Bless Agri- Food Laboratory Services PLC, (ISO 17025-2005 Accredited) in Lega Dadhi Lega Xafo, Oromia, Ethiopia. The feed samples analyzed for aflatoxin and chemical composition at the Laboratory of Animal product, Veterinary drug and feed quality assessment center in Addis Ababa. Determination of aflatoxin for both milk and feed were analyzed by using a very competent method of Higher Performance Liquid Chromatography (HPLC) techniques. For chemical composition analysis of feeds was used Near-infrared - NIR Technology.

For physico-chemical and microbial analysis of milk similarly 90 sample sizes were used. From total of 90 samples, 30 milk samples were collected in every three study towns. 10 from the farm/producer, 10 from collectors, and 10 from the cafeteria of each study towns. Accordingly, the dairy farm, milk collectors, and cafeteria/restaurant were the sources of data. From the producer raw milk samples were collected from pooled containers of dairy farms, while for the collectors it's from bulk tank containers where milk was assorted, and from cafeterias by ordering two cups of raw milk that was being meant for boiling but the milk samples were obtained before being boiled. All samples collected were subsequently analyzed in the Dairy Laboratory of the Ethiopia meat and dairy industry development institute (EMDIDI), Bishoftu, Ethiopia. About 250 ml of milk samples were collected in exceedingly sterilized glass bottles. Samples were labeled and put in an icebox maintained at 4°C and transported to the laboratory and transferred

into a refrigerator adjusted at a temperature of 4°C. Then, the milk samples were analyzed for physico-chemical and microbial quality. Samples from the farm were collected during the early morning while milk samples from collectors were from 8:00am-9:00 am and Samples from the cafeteria were collected next to sample from collectors.

3.6. Milk Physico-Chemical Quality Analysis

Analyses of physicochemical properties of milk was performed at Dairy Laboratory of the Ethiopia meat and dairy industry development institute using a Lacto scan to determine the percentage composition added water, specific gravity/density, titratable acidity/lactic acid, freezing points, P^H, lactose, protein, fat, solid not fat(SNF), Ash and total solids(ST). Percent of Solids-not-fat was calculated by this formula: $SNF = \% \text{Total solids} - \% \text{ Fat}$

3.7. Milk Microbial Quality Analysis

3.7.1. Coliform count

Coliform count is a test used to measure the number of bacteria from a manure or contaminated environment. A 1ml sample of milk was added to a sterile test tube containing 9 ml of peptone. After mixing, the sample was diluted 1: 10⁻⁷ in a row and the sample (1ml) was poured into a 12-15 ml solution of violet red bile agar solution (VRBA). After mixing thoroughly, the coated sample was allowed to harden and incubated at 30°C for 24 hours. Finally, colonial calculations were performed using colon counter (Marth, 1978). The presence of 100 colony units (CFU) ml⁻¹ is considered acceptable for milk intended for pre-feeding. (Jones and Sumner, 1999; Ruegg, 2003) stated that if statistics of coliform count in raw milk is less or equal to 10CFUml⁻¹ it is desirable to directly consume.

3.7.2. *Standard plate count/ total bacteria count*

It is used to measure the general sanitary quality of milk, and determines the total number of bacteria that can grow and form countable colonies on standard agar when aerobically incubated for 48 hours, at 32°C (90°F). Putting one ml of milk sample into a sterile test tube having 9 ml peptone water and mixing, the sample was serially diluted up to 1:10⁻⁷ and make samples duplicate. Each culture was constituted of 1ml of the diluted solution poured on a petri-dish, and was added 12-15 ml of “*standard plate agar*”. After solidifies of solution in the petri-dish, it was put into incubator for 48 hours at 32°C. Grew bacteria and that became visible colonies were counted using a colony counter and expressed as number of colony forming units per milliliter (cfu/ml) of milk (APHA, 1992). The equivalent total coliform count (TCC) and total bacteria count (TBC) were computed from duplicate plates containing between 25-250 colonies. Plates having less than 25 colonies were taken as less than 25 expected counts and plates holding greater than 250 colonies for all dilutions were recorded as too numerous to count (TNTC) (Maturin and Peeler, 2001).

3.7.3. *Yeast and mold count*

To determine the concentration level of yeast and mold in milk one ml of milk sample was consecutively diluted in 1:10⁻⁴ and 1:10⁻⁵ using peptone water and then transferred into sterile plates. By using Potato Dextrose Agar (PDA) the total yeast and mold count was carried out, the plates were incubated at 25°C for 48hours and the number of colony forming units (N) of yeast and mold bacteria per milliliter of the sample was calculated as per FAO (2007).

3.7.4. *Somatic cell count*

The somatic cell count test was according to the procedure stated by (Francesconi, 2006). About 0.01ml milk become unfold homogeneously over a microscopic slide through using a sterile-standardized loop. After the milk layer has dried up, Ethanol 96% was added. Once waiting for 15 minutes, Tolouidin Blue 0.2% was added. The slide was then

kept on open air for five minutes, once that it absolutely was washed with faucet running water, dried and so determined by employing a magnifier at a hundred times magnification. Somatic cells in twenty completely different fields (A) were counted. The magnifier zoom dimension was given (F; in this case = 0.0346) and the somatic cells amount (N) was calculated as $N = A \times 10000/F$.

3.8. Feed Quality Compositions Analysis

Sample home mixed concentrate dairy feed were collected from the study site and sealed in plastic luggage for chemical analyses. Chemical analyses of the feed samples were performed at the animal product, veterinary drug, and feed quality assessment center laboratory Addis Ababa. For determination of chemical composition of feeds Near-infrared - NIR Technology was used. The DM and ash contents of feed samples were determined by oven drying at 105°C overnight and subsequently by igniting the dried feed samples in a muffle furnace at 600°C for 6 hrs (AOAC, 1990). Nitrogen (N) content was resolve by the Kjeldahl techniques and crude protein (CP) was calculated as $N \times 6.25$ (McDonald *et al.*, 2002). The two-stage *in vitro* technique developed by (Tilley and Terry 1963) was followed to determine *in vitro* organic matter digestibility (IVOMD) of the feeds. Metabolizable energy (ME) was calculated from the *IVOMD* as $ME \text{ (MJ/kg DM)} = 0.016 \times (\text{g/kg IVOMD})$ (McDonald *et al.*, 2002).

3.9. Analysis of Aflatoxin B1 in Dairy Feed

Samples of home mixed concentrate feed were analyzed for aflatoxin also at the Laboratory of Animal product, Veterinary drug and feed quality assessment center in Addis Ababa. Determination of aflatoxins in feeds was done using a very competent method of High Performance Liquid Chromatography (HPLC) techniques (AOAC, 2000). For determination of aflatoxin B1 Extraction and clean-up procedure: A test portion of 20 g feed sample and extraction solution of 2 g NaCl with 80 mL methanol and 20 mL deionized water and 50 mL of hexane was added to the prepared sample. A pressure pumper was used to extract and the therefore final extract was collected within the column reservoir and the solution was passed undergone filtration. Aflatoxin

derivatization: After adding n-hexane (200 μ L) within the derivatization vial to re-dissolve aflatoxin, 50 μ L of trifluoroacetic acid was added and it's mixed on a vortex mixer for 30 sec. Layers were allowed to separate and an aqueous layer (lower layer) containing aflatoxins was filtered and so injected onto the liquid chromatography (LC) column, and this liquid chromatography determination with fluorescence detection, then the mobile phase (acetonitrile: methanol: deionized water within the ratio of 20:20:60) was degassed with sonicator before use. Aflatoxin B1 peak was identified in derivatized extract chromatograms by comparing its retention time with the corresponding peak within the standard chromatogram. The number of the aflatoxin was resolve within the derivatized extract (injected) from the respective standard curves.

3.10. Milk Aflatoxin M1 Analysis

Milk samples analyzed for aflatoxin level at Bless Agri- Food Laboratory Services PLC, (ISO 17025-2005 Accredited) in Lega Dadhi lega xafo, Ethiopia. This was also analyzed by using a very competent method of Higher Performance Liquid Chromatography (HPLC) techniques. The sample should keep in the refrigerator before the analysis proceeds; take about 100ml of the sample, and warm-up it at 40C⁰. Centrifuge the warmed sample and remove the upper layer, and repeat the centrifuge, if there was a layer that was not thin. Take 50ml of sample and set in the clean-up system (which uses the immune affinity column (Aflaclean M1 of Aflatoxin M1) and elute by 3ml of Acetonitrile and evaporate. Reconstitute the residue by 1ml of acetonitrile. Inject the reconstituted solution using HPLC System and analyze the chromatogram from HPLC and take the result. This was according to the procedure determination of Aflatoxin M1 (AOAC 2000).

3.11. Data Analysis

All the collected data from survey and laboratory tests were fitted in the excel sheet, then coded and entered in to a data base using statistical package for social sciences (SPSS) and statistical analyses System (SAS). Descriptive statistics such as mean, standard error, percentiles, and frequencies were calculated, and GLM (general linear model), ANOVA (analysis of variance) and Least Significant Difference (LSD) test of the SPSS statistical software were used to analyzed the data (SPSS virgin 20) for the survey study, and the contamination of aflatoxinM1 in milk and aflatoxin B1 in feed samples was designed based on the limited level of aflatoxinM1 and aflatoxinB1 0.05ppb and20ppb (ESA2009), respectively and the result was compared with this Ethiopia milk and feed standard limitlevel. By using General Linear Model (GLM) procedure of the Statistical Analysis System version 9.1(SAS), the microbial and physiochemical laboratory result of milk sample were analyzed. Mean separation was administered using the Least Significant Difference (LSD) method when ANOVA shows significant differences between means. The results were expressed as mean \pm mean error. Differences were considered statistically significant at 5%, significance levels.

The numbers of microorganisms (colony forming unit) per milliliter of milk were calculated using the following mathematical formula (APHA, 1992)

$$N = \Sigma c / ((1 \times n1) + (0.1 \times n2)) d$$

Where N = is the number of colonies per 1ml of milk,

Σc = is the sum of colonies on plates;

n1 = is the number of plates on the lower dilution

n2 = is the number of plates in the next higher dilution count and

d = is the dilution from which the primary counts have been acquired

All microbial counts were transformed to the base 10 logarithm of the variety number of colony forming unit(cfu) in keeping with per ml of raw cow milk samples (logcfu ml-1), and from these means their standard error were calculated. The statistical models used in the present study included:

Model 1: Urban dairy production system in Burayu, Sebeta and Sululta

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

Where, Y_{ij} = Variables (management, productive and reproductive performance of dairy cattle)

μ = overall mean

M_i = the effect of study areas (Burayu, Sebeta and Sululta)

e_{ij} = random error

Model 2: The milk microbial and physicochemical statistics:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + e_{ijk}$$

Where Y_{ijk} = individual observation for each sample

μ = the overall mean

α_i = the i th milk sources sites effects (i.e Burayu, Sebeta, and Sululta)

β_j = the j th milk sample type effect (farm, collectors, cafeteria)

e_{ijk} = Random error

4. RESULTS

4.1. Socio-Economic Characteristics of the Study Area

The socio-economic characteristics of the study sites are presented in Table 2. The study showed that 48% of the surveyed dairy farms were owned by female households while 52% of them were owned by male households. The majority of the dairy farmers had greater than five years of dairy farming experience demonstrating the fact that dairying has been long established in these towns, which are literally called as one of major milk supplier to Addis Ababa and literally these towns are called the Addis Ababa milk shed. The average age of the dairy farmers was 41.5 years (ranging from 24 to 59 years). Larger percentages (96.7%) of the dairy farmers were married, 1.1% was single and 2.2% were widows. Most (51.1%) of the dairy farmers had no side line business and exclusively engaged in dairy alone while a total of 49.9% of the respondents either run small business (shopping and waving) or government employees or civil servants engaged in dairying as a side line business. The average family size was 5.5 persons (ranging from 1 to 11 persons per household). The average farming experience was 3.41 years, which ranged from 1 to 10 years. The herd size per farm ranged from 10 to 39 dairy animals with a mean of 13.77 animals per household. Highest number (43.3%) of the dairy farmers attended primary education (1-8), 25.6% attended secondary education (9-12), 14.4% attended tertiary education and 16.7% had no formal education.

Table 2: Socio-Economic Characteristics of the Study Area

Variable	No. Respondent	%
Sex		
Male	47	52.2
Female	43	47.8
Age (yrs.)		
24-38	23	25.5
39-48	49	54.7
50-59	18	19.8
Average age	41.5	
Marital status		
Married	87	96.7
Single	1	1.1
Widows	2	2.2
Educational level		
Informal education	15	16.7
Primary education	39	43.3
Secondary Education	23	25.6
Tertiary education	13	14.4
Farming exper(yrs.)		
0-3	18	20
4-5	23	25.6
>5years	49	54.4
Sideline business		
Small business	38	42.2
Civil servants	6	6.7
Dairy only	46	51.1
Family size		
1-3	10	11.1
4-7	67	74.4
8-11	13	14.4
Herd size		
10-15	74	82.2
16-24	10	11.1
>24	6	6.7

4.2. Household Labor Allocation for Dairy Farm Activities

Household labor allocation to dairy farming and related activities are shown in Table 3. The study showed that all of the dairy farmers were used both hired labor and family member labor as a source of labor for the farm operation. The major farm activities like feeding, cleaning, milking, milk selling and input purchasing and other related farming activities were run by household wives, husbands and daily laborers (hired labor). Most of the chores that require physical activities like feeding (62.2%), cleaning (67.7%), and milking (56.7%) were accomplished by hired labor. Next to daily laborers, household wives engaged in larger responsibility for feeding (21.1%), cleaning (13.3%) and milking (28.9%). Also the household wives were more responsible for milk selling (53.3%) and the husbands were more responsible in purchasing inputs (66.7%). Though daughters were involved in some less labor demanding dairy farm activities, the share of young sons were nonexistent except in cleaning, which accounts only 2.2% of the labor share. This provides compelling evidences that, unlike our forefathers, the present day young generations or youths were less interested in agricultural activities that demand continuous labor input.

Table 3: Household Labor Allocation for Dairy Farm Activities

Activists	Husband		Wife		daughter		Young Son		Servant/ maids	
	N	%	N	%	N	%	N	%	N	%
Feeding	14	15.6	18	21.1	1	1.1	-	-	56	62.2
Cleaning	13	14.4	12	13.3	2	2.2	2	2.2	61	67.8
Milking	9	10	26	28.9	4	4.4	-	-	51	56.7
Milk selling	20	22.2	48	53.3	10	11.1	-	-	12	13.3
Input	60	66.7	28	31.1	-	-	-	-	2	2.2
Purchasing										

4.3. Purpose of Dairy Rearing and Source of Stocks and Finance

The main purpose of rearing dairy cattle in the study towns was mainly for income generation and home consumption (57.8%) (Milk and meat when the animals get older) followed by income generation only (42.2%). Unlike in other mixed crop-livestock systems widely practiced in the highlands of Ethiopia where the major purpose of dairy is for producing male oxen for draft power, dairying is an entirely market-oriented business in towns. The sources of foundation stocks were through buying from private organization (91.1%), donation from NGO (7.8%) and supported by government (1.1%). The main source of money to finance the dairy farming was from micro finance institution (75.55%), family itself (5.56%), personal saving (7.77%) and religious organization (11.11%). These all played a great role by lending money to start the urban dairy farming and financing it in the process of rearing.

Table 4: Purpose of Rearing and Source of Stocks

Purpose of dairy farming	Number of respondents	%
Income generation only	38	42.20
Income generation and home consumption	52	57.80
Home consumption only		-
Source of foundation stocks		
Buying from private organization	82	91.10
Supporting by gov't organization	1	1.10
Donation by NGO	7	7.80
Source of finance		
Micro-finance institutions	68	75.55
Family/friends	5	5.55
Personal saving	7	7.77
Religious Organization	10	11.11

4.4. Level of Exotic Gene Inheritances and Parity

The genotype of dairy cows in the study towns are indicated in Table 5. The genotype of dairy cows ranged from 50% Holstein Friesian gene inheritances to high-grade dairy cows that even exceed 75% exotic gene inheritances. Herd composition showed that, 50, 62.5, $\geq 75\%$ and pure Holstein Friesian cows that account for about 24.4%, 38.9%, 24.4%, and 11% of the herd, respectively. The majority of the farmers start up their dairy business with heifers (33.3%) followed by first parity cows (28.9%) and less interested in older cows (Table 5)

Table 5: Level of Exotic Gene Inheritances and Parity

Blood level dairy breed	Number of respondents	%
=50%	22	24.4
=62.5%	35	38.9
$\geq 75\%$	22	24.4
Pure exotic	11	12.2
Parity classes of dairy animals		
Heifers	30	33.3
First parity	26	28.9
Second parity	6	6.7
Third parity	2	2.2
Mixed all class	26	28.9

4.5. Feed and Feeding System

The types of feeds used by dairy farmers and feeding system are shown in Table 6. The study showed that 20% of dairy farmers used only formulated feeds purchased from commercial feed industry and the others 55.6 % were purchased feed ingredients raw materials and mix at home while 24.4% of the respondents used both practices. It was observed that all home-mixed feeds were almost all prepared from local available feed ingredients like wheat bran, noug (*Giyzotia abyssinica*) seed cake, and wheat middling, linseed cake, bean hulls, cottonseed meal, and brewery by-product, teff straw and salt. These raw materials were purchased from crop harvested area, oils factories, brewery industries and floor factories. The study exposed that the feed storage condition was good, fair, and poor were 26.66%, 45.55% and 27.77% respectively.

The result showed that 24.44% of farmers have awareness of aflatoxin while 75.55% of the farmers were not aware about aflatoxin. The study revealed that one of the most bottlenecks in the study area was high price of feeds, unavailability, and low quality of dairy feed that accounts 60%, 31.1% and 8.9%, respectively. The majority of the feeding system was individual feeding (68.9%) followed by group feeding (31.1%). The amounts of feed provided per head per day were based on their milk yield, body weight only and both their milk yield and bodyweight in the order of 53.3%, 2.2%, and 44.4% respectively. The study indicated that the majority (84.4%) of the dairy farmer's supplement their cows with green grass and legumes feed while 15.6% of them were used only grass hay as basal diet.

Table 6: Types of Feed and Feeding System of the Study Area

Variables	Number of respondents	%
Types of feed		
Purchased/commercial	18	20.0
Home mixed	50	55.6
Both Purchased and Mixed at home	22	24.4
Feed storage Quality		
Good	24	26.66
Fair	41	45.55
Poor	25	27.77
Awareness of aflatoxin		
Yes	22	24.44
No	68	75.55
Problems of Purchased Feed		
Low quality	8	8.9
Price of feed	54	60.0
Unavailability	28	31.1
Method of feeding		
Individual Feeding	62	68.9
Group feeding	28	31.1
Amount of feed provided /day/head		
Based on Body Weight	2	2.2
Based on Milk yield	48	53.3
Based on body wt and milk yield	40	44.4
Provisions of green feed		
Yes	76	84.4
No	14	15.6

4.6. Water Sources and Frequency of Watering

Water sources and watering frequencies in the study areas are shown in Table 7. The study showed that dairy farmers in the study areas had three different water sources for their dairy cattle's. These include tap water, water hole and pond water. 74.4% of the dairy farmers were used tap water followed by water hole 14.4% and the others 11.1% was used pond water. The majority of the respondents provide water to their dairy cows twice a day 64.44% while 35.5% of the respondents provide *ad libitum* (free accesses), this indicating that water was not a critical problem in the study sites. On the other hand, it can be showing that dairy farmers in the study sites were well aware of the importance of frequent watering on the production performances and wellbeing of dairy cows.

Table 7: Source of Water for Dairy Cows in Study Area

Source of Water	No. of respondents	%
Hole Water	13	14.4
Tap Water	67	74.4
Pond Water	10	11.1
Frequencies of provisions water		
Free Accesses(<i>ad libitum</i>)	32	35.5
Morning and Afternoon only	58	64.44

4.7. Dairy Cattle Housing System

Housing condition and housing type of dairy cows in the study are indicated in Table 8. The study showed that about 81.1%, 17.8% and 1.1% of the dairy farmers were used the stanchion housing system, loose type and free stalls housing system, respectively. All dairy farmers were constructed dairy cattle house separated to the main residence house but it was constructed within the living fences of the residence. From this study about 76.7% of the dairy houses were not constructed according to recommended dairy housing

design while 23.3% followed standard barn construction design. The study also indicated that 91.1% of the dairy houses have enough ventilation and light whereas the remaining 8.9% was not enough light and ventilation. According to the respondent, the main reason for not getting proper light and ventilation indicating the fact that dairy producers are not receiving adequate extension and advisory services from extension agents and/or they are not consulting professionals during dairy house construction. It was observed that the majority of the houses were not conducive for the rearing of dairy cattle based on dairy housing standards. They were poorly constructed in terms of housing orientation and waste dumping.

The study showed that 66.7% of the dairy houses had individual pen while 33.3 % of dairy cattle house was managed in free stall. The study showed that about 94.4% of dairy houses had maternity pen while 5.6% of the dairy house didn't have maternity pen. In this study area, 47.8% of dairy farmers practiced head to head cow standing followed by 35.6% were tail to tail and 16.7% of the cow standing were neither head to head nor tail to tail (free standing). The majority of the dairy house 83.3% used only for dairy cattle while 16.7% of dairy cattle house were not used for only dairy cow but mixed with other livestock like sheep and donkey. The floor design for housing was concrete, stone - paved and ground types 90%, 4.4%, and 5.6% respectively. From study urban about (97.8 %) of the roof were rainproof (corrugated iron sheet cover) and nearby 86.7% of the barns were with good drainage whereas, 7.77% had satisfactory drainage. Generally in the study urban area, farm hygienic condition was satisfactory.

Table 8: Dairy Housing Condition of the Study Area

Variables	No. of respondents	%
Type of house		
• Free stall	1	1.1
• Lose type	16	17.8
• Stanchion	73	81.1
Housing Condition		
• With other livestock	15	16.7
• Dairy cattle only	75	83.3
Standard or recommended house design		
• Yes	21	23.3
• No	69	76.7
Enough Ventilation and Light		
• Yes	82	91.1
• No	8	8.9
Provision Individual pen		
• Yes	60	66.7
• No	30	33.3
Maternity pen		
• Yes	5	5.6
• No	85	94.4
Frequencies of House Cleaning		
• One time a day	23	25.6
• Two times a day	60	66.7
• Three times a day	5	5.6
• As needed	2	2.2
Type of floor		
• Concrete	81	90
• Stone slab	4	4.4
• Ground compact	5	5.6
Type of roof		
• Rain proof	88	97.8
• Not rain proof	2	2.2
Drainage		
• Good	78	86.66
• Satisfactory	7	7.77
• Poor	5	5.5
Farm hygiene		
• Good	11	12.2
• Satisfactory	74	82.2
• Poor	5	5.5

4.8. Disease and Bio-Security Measures

Disease management practices and dairy farm biosecurity practices are shown in Table 9. According to the respondents, 81.11% of the farmers were call veterinarians for veterinary services while 19.99% of them treat their animals by themselves. All the respondents replied that their dairy cows received vaccination services from government service providers. The most commonly occurring disease was swelling of the udder, which is most likely associated with mastitis. Based on the information obtained from the town's veterinary officers, the most common bacterial diseases that occurred in the study urban dairy farms were mastitis and less frequently brucellosis. Among the viral disease foot and mouth disease rarely occurred. The study showed that about 78.8% of the dairy farmers used boots and overall cloths when they were entering into the dairy house as one of a biosecurity measure against diseases. It was observed that only 23.3% of the dairy farmers used foot bath at the entrance of the dairy houses. The most common foot baths used by the dairy farmers were detergents like '*Berekina*' which is not actually known for its effectiveness.

According to the dairy farmers, blind teat happened due to mastitis diseases mainly occurred in the farm that negatively affects milk quality and quantity. In the study area about 97.8% of dairy farm had mastitis disease and only 2.2% reported have no mastitis disease. The majority 78.9% practiced external parasite control followed by internal 65.6% while the remaining 21.2 and 34.4% don't used external and internal parasite control systems, respectively. According to respondents 98.9% of the farmers used annual vaccination program to vaccinate their animals indicating the fact that dairy farmers in the study towns are aware of the importance of vaccinating their dairy cows against any diseases. Also all the dairy farmers were isolate the sick dairy cow from the health dairy cattle into isolation pen and 67.8% of dairy farmers cull their dairy cow when the dairy cow treated and not heal, old and low productivity while 32.2% of the farmers in the study area were not culled the animals until those cattle had died.

Table 9: Disease and Bio –Security Urban Dairy Farm in the Study Area

Variables	Number of respondents	%
Presence of mastitis disease in farm		
Yes	88	97.8
No	2	2.2
Who treat sick dairy cow		
Call veterinary doctors	73	81.111
Famers by them selves	17	19.99
Using of PPE		
Yes	71	78.88
No	19	21.11
Availability of foot bath		
Yes	21	23.3
No	69	76.7
Ecto parasite control		
Yes	59	65.6
No	31	34.4
Deworming		
Yes	71	78.9
No	19	21.1
Annual vaccination		
Yes	89	98.9
No	1	1.1
Culling practice		
Yes	61	67.8
No	29	32.2

Where PPE= personal protective equipment

4.9. Institutional Support and Extension Services

Institutional support and extension service of the study area are indicated in Table 10. The study showed that, the majority (73.3%) of the dairy farmers were supported by the expert of extension services while 26.7% had no experiences of receiving extension services. Institutional supports like training and veterinary services were provided by the urban agricultural offices while loan providers were provide training on the financial management. It is interesting to note that about 35.6% of the respondents reported to receive credit and veterinary services together to start dairy farming, which is more interesting in livestock business. Overall, 53.3% of the dairy farmers received training before or after they start up dairy business while 46.7% received no training at all. Out of these, a quarter of the dairy farmer 27.8% received trainings before starting the business while 25.5% of dairy farmers received training after they established dairy farms. The training that they received was ranges from a few days to one month. For instances, the study showed that the farmers received training for one month, a few weeks and few days were 8.9% , 5.5%, and 38.9% respectively while 46.7% of dairy farmers were had no training. The training was provided by various institutions like urban agricultural offices, micro and small-scale enterprises and NGO (like religion organization) operating in the city. 52.2% of the dairy farmers get training by the urban agricultural office, and 1.1% was by NGO.

Table 10: Institutional Support and Extension Service of the Study Area

Variables	No. of respondents	Percent (%)
Provision of extension service		
Yes	66	73.3
No	24	26.7
Frequency of extension service		
One a week	29	32.2
Once in two	20	22.2
Once a month	17	18.9
No extension service at all	24	26.7
Types of service given		
Veterinary service	28	31.1
Credit service	7	7.8
Credit and veterinary service	25	27.8
No service	30	33.3
Training services		
Yes	48	53.3
No	42	46.7
Time of training		
Before start the business	25	27.8
After start thee business	23	25.5
No training	42	46.7
For how long to take training		
Few days	35	38.9
Few weeks	5	5.5
One month	8	8.9
No training	42	46.7
Training provided by		
Urban agricultural office	47	52.2
NGO	1	1.1
No training	42	46.7

4.10. Productive and Reproductive Performances

4.10.1. Average daily milk yield

The estimated average daily milk yield is presented in Table 11. The economics of any dairy cattle is measured by its daily, lactation and adjusted 300 days milk yield. The estimated overall mean daily milk yield based on the sampled household was 13.4 ± 0.4 kg/cow/day. The overall estimated mean yield at 1st parity, 2nd parity, and 3rd parity were 10.7 ± 0.26 , 13.33 ± 0.31 and 16.06 ± 0.61 kg/cow/day, respectively resulting in mean peak yield of 18.13 ± 0.39 kg/cow/day, which is greater the average milk yield. The mean yield of early lactation and late lactation were 12.5 ± 0.35 and 8.5 ± 0.23 kg/cow/day, respectively. In the study towns, the average age at peak yield was 4.33 ± 0.08 year and the estimated lactation length mean in the study site was 9.52 ± 0.08 months. In the study towns, the overall mean of lactating animals, pregnant animals and culled animals on the farm were 8.27 ± 0.25 , 3.32 ± 0.182 , 0.98 ± 0.11 and 0.44 ± 0.11 , respectively. The average numbers of dairy cattle reared in the study towns was 13.01 ± 0.652 , which falls under the category of medium scale dairy farming.

4.10.2. Reproductive performances

Reproductive performances of dairy cows are measured by age at first calving (AFC), day open (DO), number of services per conception (NSPC) and other parameters that measure the efficiency reproduction in dairy cows. This parameter is mainly affected by management than genetics. In any dairy farming AFC marks the beginning of productive age dairy cattle. According to the respondents of the study towns, the average age at first calving (AFC) was 2.26 ± 0.05 years, which is by far the lowest in the Ethiopian dairy system. This is an indication of market-oriented dairy production system where dairy farmers reduce non-productive age of heifer by through better calf and heifer management practices. Early AFC reduces unproductive periods and a higher the AFC will be the additional rearing cost of the animal (Panja and Taraphder, 2012). Age at first

calving is closely related to generation interval and therefore, it influences response to selection

Calving interval is a time elapsed between two consecutive successive parturitions. In this study, the overall estimated mean calving interval was 20.8 ± 0.05 months in the study towns. Coupled with short lactation length reported in this study, CI is shorter than expected, which signals for putting better management practices in place. Furthermore, the number of days that between calving to conception is influences the profitability of the dairy industry. The overall estimated mean days open in the study site was 161.76 ± 34.80 days.

NSC is one of the measurements for reproductive efficiency. It expresses the fertility level of the dairy herds. The present study data showed that the mean of the numbers of services per conception is $3.22 \pm .58$.

Table 11: Productive and Reproductive Performance of Study Area

Variables	Mean ±SE
Milk production performances	
Average daily milk yield (ADMY)/cow/day	13.3±0.4
Yield at 1 st parity	10.7±0.26
Yield at 2 nd parity	13.33±0.31
Yield at 3 rd parity	16.06±0.61
Yield at early lactation	12.5±0.35
Peak yield at mid lactation	18.13±0.39
Yield at late lactation	8.5±0.23
Age at peak lactation	4.33±0.08
Lactating animals in farm	8.27±0.25
Length of lactation	9.52±0.08
Reproduction performances	
Age at first calving (years)	2.26±0.05
Days open (days)	161.76±34.80
Calving interval(CI) (years)	1.88±0.05
Number of service per conception (NSC)	3.22±0.58
No. of dairy cow in farm	13.01±0.652
No. of pregnant animals in farm	3.32±0.182
Animals sick by mastitis in farm	0.98±0.11
Proportion of culled animas in farm	0.44±0.11

4.11. Dairy Farm Waste Management Practice

The study revealed that about 73.3% of manure was the major waste in their farms followed by roughage feed left over (14.45%) and dust (12.25%) depending on the type of housing system (Figure 2).

The study revealed that the major constraints that encountered the urban dairy farmers were lack of convenient waste disposal pit, nuisance odor and disinterest of daily laborers. Furthermore, bulkiness manure was reported to be inconvenient for transportation as facilities were lacking.

According to the respondents 52.2% and 47.8% of the dairy farmers remove waste two times per day and one time per a day, respectively. About 81.1% of the farmers were used wheel barrow for transportation while 18.9% used polythene and hessian sack. About 62.5% of farm wastes in the study urban were disposed at non comfortable manure disposal pit while 30% of the farmers were transported to rural area and used it as a fertilizer in their own garden and 7.7% of the farmers were given freely to neighborhoods.

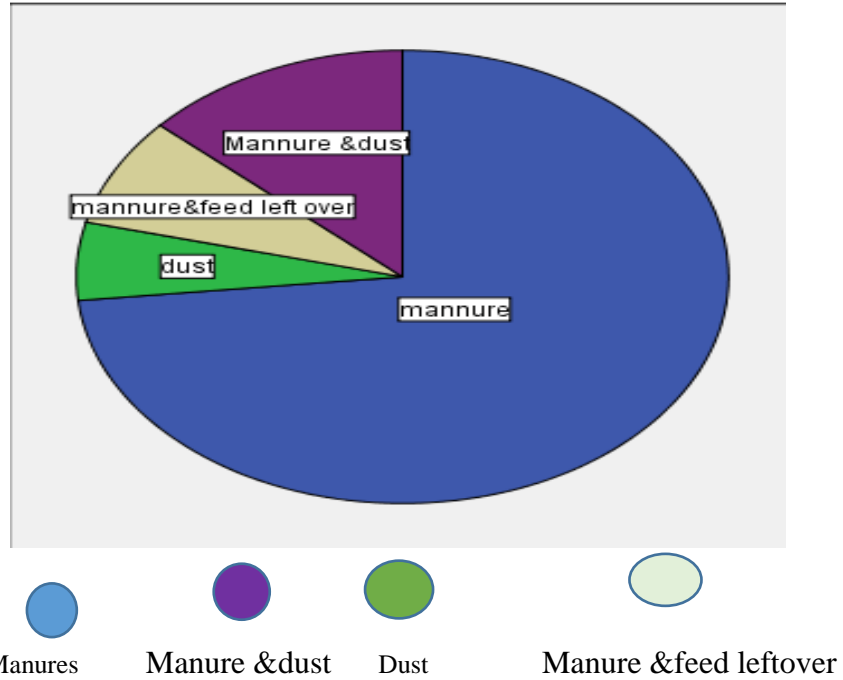


Figure 2: Common Wastes of Dairy Farm in the Study Areas

Animal manure is one of the best sources for producing biogas and generates energy for household consumption. Contrary to this fact, only 4.4% used manure to produce biogas and 85.6% of the respondents were not used the manure to produce biogas.

Table 12: Methods of Waste Removal of the Study Site

Variables	Number	Percent (%)
Frequency of removing waste		
Every day	43	47.8
Two times a day	47	52.2
Means of transportation		
By wheel barrow	73	81.1
By polythene and hessian sack	17	18.9
Kinds of disposal methods		
Dispose in pit or damp site	56	62.2
Use as fertilizers in their own garden	27	30.0
Give free to the other farmers	7	7.8
Presence of absence of biogas		
Yes	4	4.4
No	86	95.6

Waste management is one of the major constraints in dairy cattle farming. In this study, dairy farmers were given a chance to rank some of the major constraints in waste management practices. Accordingly, dairy farmers ranked lack of convenient dumping site as a major constraint, which ranked 1st followed by nuisance odor, lack of transportation facilities, lack of market for selling the manure and shortage of labor in that order (Table 13).

Table 13: Major Constraints of Waste Disposal in Study Area

Constraints	1 st	2 nd	3 rd	4 th	5th	Index	Rank
Lack of convenient dump site	49	21	18	2	0	0.29	1
Nuisance odor	31	45	8	4	2	0.27	2
Lack of transportation	8	23	24	3	32	0.17	3
Lack of market for selling manure	0	0	20	55	15	0.14	4
Shortage of labor	2	1	20	26	41	0.12	5

4.12. Constraints of Urban Dairy Production

Some of the major constraints facing dairy farmers in the study towns are presented in Table 14. According to farmers perspective, one of the major constraints that hamper dairy development in the study town, which are indeed prevailing constraints at national level were high price of feed, which ranked 1st followed by shortage of land, source of heifers to start up the business, steadily increasing heifer/cow prices, poor feed quality, shortage of feed suppliers, cow health problems, lack of access to credit, shortage of water and inadequate training in the order as portrayed in Table 14. With such pervasive and widespread bottlenecks, dairy farmers are currently facing a clear threat and might be forced to close their business in the future as abandoning dairy farming are becoming daily routine across Ethiopia due to the aforementioned constraints.

Table 14: Constraints of Urban Dairy Farming of Study Area

Constraints	1	2	3	4	5	Index	Rank
Price of feed	88	2	0	0	0	0.0091	1
Shortage of land	1	63	17	4	2	0.0064	2
Unavailability of dairy cow/heifer in time	0	3	35	25	0	0.0034	3
High cost of dairy cow/heifer	0	5	12	30	1	0.0024	4
Feed quality	0	2	10	13	30	0.0012	5
Unavailability of feed in nearby area	1	7	4	5	15	0.0014	6
Health problem	0	1	2	3	8	0.0023	7
Lack of access to credit	0	5	3	2	29	0.0013	8
Shortage of water	0	0	5	7	3	0.00065	9
Inadequate training	0	2	2	1	2	0.00036	10

It was also noticed that dairy farming is facing other clear threats as indicated in Table 15. Aside from the ranking of constraints, respondents explained that they may close their business due to increasing feed cost (55.55%), displacement from their residences due to land leasing and grabbing (21.1%), encroachment of house development programs by towns (18.9%), complaint arising from neighbors due bad odor and disease outbreak (5.55%).

Table 15: Threats to Urban Dairy Farming in Study Area

Threats	Frequency	%
Increase in cost of feed	50	55.55
Displacement from their residence	19	21.1
Compliant from neighbors due to nuisance odor	17	18.9
Disease outbreak	5	5.55

Some of the barriers that hamper dairy farms expansion in the future is indicated in Table 16. The major of the respondents worried that shortage of land 62.2% is the main barrier for future the expansion of urban dairy farm followed by the increase in price of formulated dairy cattle feed 28.8% ,and lack of capital 8.9%. Such clear threats and barriers need to be addressed by policy makers and development planners if dairy is believed to continue as a viable business and pathway out of poverty in the future.

Table 16: Barriers for Future Expansion of the Dairy Farm in Study Area

Variable	Frequency	%
Shortage of land	56	62.2
High price of feed	26	28.9
Lack of capital	8	8.9

4.13. Physical Properties of Milk

The mean \pm SE of the added water, pH values, titrable acidity, specific gravity and freezing points of milk sampled from the Burayu, Sebeta, and Sululta towns and value chain actors are shown in Table 17 and 18.

4.13.1. Added water

The current study indicated that there was significant milk adulteration ($P < 0.05$) in all study towns as well as among milk value chain actors (producers, collectors and cafeterias) involved in the process. For instances, the overall mean values of added water contents at the farm/milk producer, milk collectors, and the cafeteria was 0.58 ± 1.017 , 2.31 ± 1.203 , and 5.68 ± 2.19 , respectively. Such progressively deteriorated milk quality along the value chain by value chain actors requires functional policy and regulatory bodies who can monitor milk qualities along the chain.

4.13.2. The pH Value

The mean \pm SE p^H of milk from Burayu, Sebeta, and Sululta towns was 6.4 ± 0.127 , 6.24 ± 0.041 , and 6.28 ± 0.032 , respectively. The result indicated that there was a significant difference between Burayu and the other two towns, but no significance difference ($P > 0.05$) between Sebeta and Sululta towns. The p^H value of all the milk samples collected from farms, milk collectors, and cafeterias were found to be 6.41 ± 0.048 , 6.28 ± 0.036 , and 6.24 ± 0.0303 , respectively (Table 18). Milk samples collected from the farm were significantly higher in p^H than milk samples collected from collectors and cafeterias. However, the p^H value of milk collected from collectors and cafeterias were acidic and below the required standard.

4.13.3. Titratable acidity

The overall mean \pm SE of titratable acidity/lactic acid percentage of sampled milk from Burayu, Sebeta, and Sululta towns were 0.198 ± 0.006 , 0.179 ± 0.0033 , and 0.176 ± 0.01 , respectively and were not significantly different ($P > 0.05$) among the three towns. However, the overall mean (\pm SE) of titratable acidity milk sample collected from the farm, collectors, and cafeterias were 0.156 ± 0.0034 , 0.187 ± 0.0084 , and 0.189 ± 0.004 , respectively and was significantly different ($P < 0.05$) along the value chain actors (collectors and cafeteria), but no significant difference ($p > 0.05$) between collectors and cafeteria.

4.13.4. Specific gravity

The specific gravity of milk obtained from Burayu, Sebeta and Sululta towns were 1.027 ± 0.01 , 1.028 ± 0.001 , and 1.035 ± 0.0011 , respectively. The result revealed that the specific gravity of milk sampled from sululta was higher than the specific gravity of milk obtained from Sebeta and Burayu towns. Therefore, significant differences ($P < 0.05$) were perceived for density between sululta town and the other two study towns. The specific gravity/density of collected samples from farms, collectors, and cafeterias were 1.029 ± 0.00039 , 1.026 ± 0.0091 , and 1.026 ± 0.0023 , respectively and were significantly different ($P < 0.05$) between milk sampled from farm to the other collectors and cafeteria but there was non-significant ($p > 0.05$) between collectors and cafeterias.

4.13.5. Freezing point

The Mean \pm (SE) freezing point of milk sampled from Burayu, Sebeta, and Sululta towns are also shown in Table 17 and 18. The result indicated that there was no critical distinction ($p > 0.05$) among the three study towns. Overall average and standard error of the temperature of milk from the farm (milk producers), milk assortment, and cafeterias were evaluated. The freezing point of milk samples collected was considerably varied ($P < 0.05$) among the value chain actors.

Table 17: Physical Quality Characteristics of Raw Milk in the study towns

Study area	N	Added water	p ^H -value	Titratable acidity	Specific gravity	Freezing point
Burayu						
Farm	10	0.107±0.107	6.55±0.05	0.189±0.0035	1.029±0.00037	-0.56±0.0038
Collector	10	1.15±0.28	6.37±0.042	0.192±0.0039	1.028±0.00048	-0.56±0.0031
Café	10	12.00±3.52	6.31±0.035	0.212±0.0098	1.024±0.0029	-0.455±0.227
Overall mean		4.42^a±1.302	6.4^a±0.127	0.198^a±0.006	1.027^b±0.0011	-0.525^a±0.078
Sebeta						
Farm	10	0.62±0.37	6.28±0.057	0.192±0.0039	1.029±0.00043	-0.57±0.0063
Collector	10	6.43±1.76	6.23±0.037	0.17±0.0025	1.029±0.00076	-0.556±0.013
Cafe	10	7.64±1.44	6.21±0.028	0.175±0.0034	1.027±0.00055	-0.551±0.141
Overall mean		3.9^b±1.19	6.24^b±0.041	0.179^a±0.0033	1.028^b±0.001	-0.575^a±0.053
Sululta						
Farm	10	1.002±0.54	6.4±0.0365	0.188±0.0047	1.0291± 0.0004	-0.55±0.006
Collector	10	4.36±1.57	6.23±0.030	0.165±0.0037	1.055±0.026	-0.543±0.011
Cafe	10	5.41±1.60	6.21±0.028	0.175±0.012	1.026±0.0035	-0.53±0.011
Overall mean	30	3.59^c±1.24	6.25^b±0.032	0.176^a±0.01	1.035^a±0.01	-0.541^a±0.009

Mean value with different subscripts letters for each milk quality parameters in the columns are Significantly different ($p < 0.05$)

Table 18: Physical Quality Characteristics of Raw Milk in Allover value chain actors

Parameter %	Farm	Collector	Cafeterias	P-value
Added water	0.58 ^c ±1.017	2.31 ^b ±1.203	5.68 ^a ±2.19	0.0004
P ^H -value	6.41 ^a ±0.048	6.28 ^b ±0.036	6.24 ^b ±0.0303	0.001
Titrata. acidity	0.156 ^b ±0.0034	0.187 ^a ±0.0084	0.189 ^a ±0.004	0.039
Specific gravity	1.029 ^a ±0.00039	1.026 ^b ±0.0091	1.026 ^b ±0.0023	0.26
Freezing point	-0.56 ^a ±0.0035	-0.533 ^b ±0.009	-0.43 ^c ±0.126	0.0021

Mean value with different subscripts letters for each milk quality parameters in the rows are Significantly different ($p < 0.05$)

4.14. Chemical Composition of Raw Milk

The laboratory result for chemical composition of raw milk sampled such as protein, lactose, fat, ash, solid not fat (SFN), and total solid are shown in Table 19 and 20.

4.14.1. Protein content

The mean \pm SE of protein content obtained in Burayu, Sebeta, and Sululta towns was 3.16 ± 0.0551 , 3.31 ± 0.098 , and 3.14 ± 0.095 , respectively. There was a significant difference ($P < 0.05$) between the Sebeta and the other two towns but there was no statistical difference ($P > 0.05$) between Burayu and Sululta towns. The average protein contents of milk sampled from farm, milk collectors and cafeteria were 3.45 ± 0.051 , 3.34 ± 0.086 , and 2.84 ± 0.111 , respectively. Statistical analysis showed that there was a significant difference ($P < 0.05$) in protein percentage among the three value-chain actors. Low protein content at consumer levels in cafeterias showcased that this value actor is making a clear sabotage and harm to consumers.

4.14.2. Lactose contents

The mean \pm SE lactose contents of raw milk samples collected from Burayu, Sebeta, and Sululta towns were 3.35 ± 0.133 , 3.59 ± 0.154 , and 3.85 ± 0.164 , respectively. These results showed that there was a significant difference ($p < 0.05$) among the study towns. The average lactose content of raw milk collected at producers, milk collectors, and cafeteria were 3.83 ± 0.127 , 3.72 ± 0.148 , and 3.45 ± 0.176 , respectively. Statistical analysis showed that there were also significant difference ($p < 0.05$) among producer, collectors, and cafeteria demonstrating deterioration in milk quality along the value chain actors.

4.14.3. Fat contents

The mean \pm SE of fat compositions of raw milk sampled from Burayu, Sebeta, and Sululta towns were 3.64 ± 0.204 , 4.11 ± 0.179 and 4.13 ± 0.371 , respectively. The statistical analysis indicated that there was a significant difference ($P < 0.05$) among the study areas in terms of fat contents. The mean \pm SE of fat content in milk samples collected from producers,

collectors, and cafeteria were 4.33 ± 0.253 , 3.45 ± 0.314 and 3.103 ± 0.186 , respectively. The result revealed that there were also significant difference ($p < 0.05$) along the value chain actors.

4.14.4. Solid not fat

The mean \pm SE of SNF contents of raw milk samples collected from Burayu, Sebeta, and Sululta towns were 7.46 ± 0.153 , 7.71 ± 0.172 , and 7.603 ± 0.197 , respectively. It was found that there was non-significance difference ($P > 0.05$) between the study towns. The overall mean values of solids not fat (SNF) contents of raw milk samples collected from producers, collectors, and cafeterias were 7.99 ± 0.126 , 7.77 ± 0.184 , and 6.99 ± 0.212 , respectively. Statistical analysis showed that there were significant differences ($P < 0.05$) within the SNF content of milk collected in the different milk value chain points

4.14.5. Total solid

The overall mean \pm SE result of TS contents in raw milk sampled in Burayu, Sebeta, and Sululta towns were 11.79 ± 0.307 , 11.83 ± 0.252 and 11.73 ± 0.507 , respectively. Statistical analysis showed that there were non-significance differences ($P > 0.05$) in the TS content of milk collected from the study town. The mean value of total solid contents of milk samples collected from producers, collectors, and cafeterias were 12.34 ± 0.294 , 11.88 ± 0.315 , and 10.44 ± 0.46 respectively (Table 19&20). The result revealed that there were significant differences ($P < 0.05$) within the milk value chain actors.

4.14.6. Ash contents

The overall mean value \pm (SE) result of ash contents in raw milk sampled from Burayu, Sebeta, and Sululta towns were 0.74 ± 0.101 , 0.713 ± 0.022 , and 0.713 ± 0.11 , respectively (Table 19&20). The result showed that there were non-significance differences ($P > 0.05$) within the ash content of different types of raw milk samples collected from study towns. The average \pm SE ash contents of raw milk samples collected from producers, collectors, and cafeteria were 0.73 ± 0.187 , 0.74 ± 0.0187 , and 0.697 ± 0.026 , respectively as shown in

Table 19 and 20. It was found that there were statistical differences in raw milk samples collected from the different value chain actors.

Table 19: Chemical Composition of Raw Milk in the Study Area

Study area	N	Protein	Lactose	Fat	SNF	Total solid	Ash
Burayu							
Farm	10	3.37±0.033	3.94±0.065	4.29±0.24	8.59±0.06	12.33±0.25	0.73±0.26
Collector	10	3.39±0.0301	3.64±0.124	4.28±0.173	7.79±0.119	12.08±0.23	0.76±0.016
cafe	10	2.73±0.1023	3.08±0.209	2.34±0.198	6.54±0.28	10.96±0.44	0.73±0.026
Overall mean		3.16^b±0.055	3.35^c±0.133	3.64^a±0.204	7.64^a±0.153	11.79^a±0.307	0.74^a±0.101
Sebeta							
Farm	10	3.59±0.079	3.52±0.191	4.93±0.34	7.56±0.183	12.81±0.375	0.77±0.021
Collectors	10	3.48±0.114	3.87±0.11	3.92±0.095	8.06±0.162	11.98±0.21	0.71±0.023
Cafe	10	2.855±0.103	3.69±0.162	3.48±0.103	7.21±0.17	10.69±0.17	0.66±0.022
Overall mean		3.31^a±0.098	3.59^b±0.154	4.01^c±0.179	7.61^a±0.172	11.83^a±0.252	0.713^a±0.02
Sululta							
Farm	10	3.38±0.044	4.032±0.125	3.76±0.18	8.11±0.134	11.87±0.256	0.69±0.28
Collectors	10	3.08±0.114	3.64±0.21	4.11±0.29	7.47±0.27	11.58±0.505	0.75±0.017
Cafe	10	2.95±0.128	3.58±0.156	4.52±0.642	7.229±0.186	11.75±0.76	0.70±0.0298
Overall mean		3.14^b±0.095	3.85^a±0.164	4.13^b±0.371	7.603^a±0.197	11.73^a±0.507	0.713^a±0.11

Mean value with different subscripts letters for each milk quality parameters in the columns are Significantly different ($p < 0.05$).

Table 20: Chemical Composition of Raw Milk over Value Chain Actors

Parameter	Farm	Collector	Cafeterias	P-value
Protein	3.45 ^a ±0.051	3.34 ^{ab} ±0.086	2.84 ^b ±0.111	0.0001
Lactose	3.83 ^a ±0.127	3.72 ^{ab} ±0.148	3.45 ^b ±0.176	0.018
Fat	4.53 ^a ±0.253	3.25 ^{ab} ±0.314	3.103 ^b ±0.186	0.0067
SNF	7.99 ^a ±0.126	7.77 ^b ±0.184	6.59 ^c ±0.212	0.0001
Total solid	12.34 ^a ±0.294	11.88 ^b ±0.315	10.44 ^{bc} ±0.46	0.001
Ash	0.73 ^a ±0.187	0.74 ^a ±0.0187	0.77 ^a ±0.026	0.083

Mean value with different subscripts letters for each milk quality parameters in the rows are significantly different ($p < 0.05$).

4.15. Raw Milk Microbial Quality Analysis

Bacterial load determination: The milk that was collected from value chain actors were analyzed for determination of the microorganism load in milk such as Coliform Count (CC), Total bacteria Count (TBC), Yeast and mold count (YMC) and Somatic cell count (SCC).

4.15.1. Coliform count (CC)

The overall mean \pm SE values of coliform counts $\log_{10\text{cfu/ml}}$ of raw milk samples collected from Burayu, Sebeta and Sululta towns were, $3.31 \pm 0.055 \log_{10\text{cfu/ml}}$, $5.85 \pm 0.467 \log_{10\text{cfu/ml}}$ and $5.12 \pm 0.34 \log_{10\text{cfu/ml}}$ respectively (Table 21). There was no statistical significant difference ($P > 0.05$) between mean CC of Sebeta and Sululta towns. However, significant difference ($P < 0.05$) was observed between mean CC of Burayu and the other two towns (Sebeta and Sululta). The average value of coliform count (CC) of milk sampled from milk producer, milk collectors and cafeteria were $3.485 \pm 0.129 \log_{10\text{cfu/ml}}$, $5.73 \pm 0.362 \log_{10\text{cfu/ml}}$ and $5.07 \pm 0.37 \log_{10\text{cfu/ml}}$, respectively. There was no significant difference ($P > 0.05$) among the milk collectors and cafeteria in coliform count (CC). However there were statistically significances difference ($p < 0.05$) between milk

producer and milk collectors, as well as milk producer and cafeterias. The overall mean of coliform count obtained from raw milk in the present study is $4.76 \pm 0.287 \log_{10} \text{ cfu/ml}$., which is in the range of acceptable level of coliform bacteria count of $5.0 \times 10^4 \text{ cfu/ml}$ recommended in Eastern African countries.

4.15.2. Total bacteria count (TBC)

The results of TBC milk from Burayu, Sebetas, and Sululta towns were $5.34 \pm 0.036 \log_{10} \text{ cfu/ml}$, $6.53 \pm 0.305 \log_{10} \text{ cfu/ml}$ and $6.42 \pm 0.29 \log_{10} \text{ cfu/ml}$, respectively (Table 24). Statistical analysis shown that there were significant difference ($p < 0.05$) between Burayu and the rest two town in terms of TBC. However, there was no statistical difference ($p > 0.05$) among Sebeta and Sululta Towns.

The mean \pm SE value of milk sampled from producers, milk collectors and cafeteria were $5.34 \pm 0.189 \log_{10} \text{ cfu/ml}$, $6.15 \pm 0.22 \log_{10} \text{ cfu/ml}$, and $6.8 \pm 0.229 \log_{10} \text{ cfu/ml}$, respectively (Table 24). There was statistically significant difference ($P < 0.05$) in total bacteria count/ml of raw milk between farm and other value chain actors but there is no statistical significant difference ($P > 0.05$) between milk collectors and cafeteria. The overall mean \pm SE of TBC obtained from raw milk in the present study is $6.09 \pm 0.212 \log_{10} \text{ cfu/ml}$.

4.15.3. Yeast and molds counts (YMC)

Yeast and mold are considered as spoilage forming organisms. In the current study results revealed that, yeast and mold for milk sample from Burayu, Sebetas and Sululta towns were less than $< 0.1 \log_{10} \text{ cfu/ml}$) (Table 24). Yeast and mold laboratory result was statistically not significantly different ($P > 0.05$) between the urban study towns. The average value of yeast and mold of milk sampled from milk value chain point means milk producer /farm, milk collectors and cafeteria/restaurants were also less than $0.1 \log_{10} \text{ cfu/ml}$. There was no significant difference ($P > 0.05$) among the value chain actors.

4.15.4. Somatic cell count (SCC)

The overall mean and (\pm SE) of somatic cell count milk sampled from Burayu, Sebeta and Sululta were 5.29 ± 0.043 log₁₀ cfu/ml, 5.29 ± 0.048 log₁₀ cfu/ml and 5.38 ± 0.036 log₁₀ cfu/ml respectively. The laboratory result showed that there was non-significance difference ($P>0.05$) among the three urban study area. The mean value of somatic cell count of raw milk that collected from milk producer, milk collectors and cafeteria/restaurant were 5.36 ± 0.033 log₁₀ cfu/ml, 5.38 ± 0.048 log₁₀ cfu/ml and 5.32 ± 0.046 log₁₀ cfu/ml respectively. The statistical analysis indicated that there was no significant difference ($P>0.05$) among milk producer, milk collectors and cafeteria. The result revealed that the somatic cell count in this study area was slightly found in acceptable range.

Table 21: Microbial Counts of Raw Milk (mean \pm SE) in Study area (mean \pm SE)

Milk source	Mean \pm SE	Mean \pm SE	Mean \pm SE	Mean \pm SE
	CC(log ₁₀ cfu/ml)	TBC(log ₁₀ cfu/ml)	YM(log ₁₀ cfu/ml)	SCC(log ₁₀ cfu/ml)
Burayu	$3.31^b\pm 0.055$	$5.34^b\pm 0.036$	$<0.1\pm 0$	$5.29^a\pm 0.043$
Sebeta	$5.85^a\pm 0.467$	$6.53^a\pm 0.305$	$<0.1\pm 0$	$5.29^a\pm 0.048$
Sululta	$5.12^{ab}\pm 0.34$	$6.42^a\pm 0.29$	$<0.1\pm 0$	$5.38^a\pm 0.036$

Mean value with different subscript letters for each milk quality parameters in the rows are significantly different ($p<0.05$)

Table 22: Microbial Counts of Raw Milk (mean \pm SE) in Terms of Value Chain Actors

Milk source	Mean \pm SE	Mean \pm SE	Mean \pm SE	Mean \pm SE
	CC(log ₁₀ cfu/ml)	TBC(log ₁₀ cfu/ml)	YM(log ₁₀ cfu/ml)	SCC(log ₁₀ cfu/ml)
Farm	$3.485^b\pm 0.129$	$5.34^b\pm 0.189$	$<0.1\pm 0$	$5.36^a\pm 0.033$
Collectors	$5.73^a\pm 0.362$	$6.15^a\pm 0.22$	$<0.1\pm 0$	$5.38^a\pm 0.048$
Cafeteria	$5.07^a\pm 0.37$	$6.8^a\pm 0.229$	$<0.1\pm 0$	$5.32^a\pm 0.046$
Over all mean	4.76 ± 0.287	6.09 ± 0.212	$<0.1\pm 0$	5.32 ± 0.042

Mean value with different subscript letters for each milk quality parameters in the rows are significantly different ($p<0.05$)

4.16. Chemical Composition of Home Mixed Dairy Feed

The mean feed chemical compositions results are indicated in Table 23. Interestingly, the chemical compositions of the sample feed among the three study towns didn't significantly differ from each other ($P>0.05$).

The overall mean feed mixed at home contents of dry matter (DM) and crude protein (CP) in the current study area were 898.63 ± 1.92 and 160.22 ± 4.54 g/kg, respectively. The mean CP content of the study area similar to the minimum requirements 170g/kg or 17% of Ethiopian feed quality standard (ES6403:2019) of total CP recommended for lactating dairy cow feed. The overall mean value of organic matter (OM) and ash in home-mixed dairy feed in the study sites was 799.11 ± 2.35 and 99.51 ± 1.43 g/kg respectively. The overall mean metabolic energy (ME) value of the home-mixed concentrate feed was 2428.22 ± 45.93 kcalg /kg. This is lower than the minimum requirements 2500kcalg/kg of Ethiopian feed quality standard (ES6403:2019) metabolic energy (ME) recommended as dairy feed. The mean value of crude fat, and crude fiber, in the study urban was 39.88 ± 1.11 g/kg, and 154.15 ± 5.04 g/kg, respectively. These were highly lower than the maximum requirement 1000g/kg, and 150g/kg, (ES6403:2019) of Ethiopian feed quality standard respectively. The nutritional composition of home-mixed feed in the study area was slightly lower than the Ethiopian feed quality standard.

Table23: Chemical Composition of Home-mix Feed in Urban Dairy Farms

Nutritive value	Burayu N= 30	Sululta N=30	Sebata N=30	Overall mean N=90	P- Value
DM	898.24 ^a ± 3.34	891.14 ^a ±0.77	906.52 ^a ±1.65	898.63±1.92	0.001
OM	785.46 ^a ±3.73	805.3 ^a ±1.09	806.58 ^a ±2.24	799.11±2.35	0.002
CP	152.52 ^a ±2.98	166.3 ^a ±5.48	161.84 ^a ±5.17	160.22± 4.54	0.003
Fat	34.82 ^a ± 1.52	33.15 ^a ±0.78	51.69 ^a ±1.04	39.88± 1.11	0.001
ME kcal g/kg	2415.3 ^a ±50.64	2403.6 ^a ±47.38	2465.8 ^a ±39.8	2428.2±45.9	0.004
Starch	185.78 ^a ± 8.35	325.02 ^a ±15.79	271.3 ^a ±59.85	260.68± 27.99	0.003
Ash	112.78 ^a ±1.91	85.83 ^a ±0.96	99.9 ^a ±1.41	99.51± 1.43	0.002
Fiber	155.6 ^a ±6.26	143.56 ^a ±5.04	163.29 ^a ±3.82	154.15±5.04	0.003

Where DM=Dry matter, OM=Organic Matter, CP= Crude Protein, ME= Metabolic Energy,

4.17. Aflatoxin B1 (AFB1) Contamination Level in Dairy Feeds

Aflatoxin B1 contamination of urban dairy feeds in the study are presented in Table 24. The laboratory test result showed that the minimum level of Aflatoxin B1 contamination was 12ppb and the maximum Aflatoxin B1 amount was 46ppb (Table 24). The overall mean of AflatoxinB1in the study area, 22.42±1.87ppb and was higher than tolerance level of Ethiopia feed safety standard of aflatoxinB1of 20ppb (ES6403:2019). The mean AflatoxinB1 pollution value was significantly ($p<0.05$) higher in Sululta than Burayu and Sebata. However, it was statistically non-significance difference ($P>0.05$) between Burayu and Sebata.

Table24: Aflatoxin B1 Contamination of Dairy Feeds in the Study Area

AFB1 in ppb	Burayu N=30	Sululta N=30	Sebeta N=30	Over all N=90	P-value
Mean	21.99 ^b ±1.75	23.37 ^a ±1.95	21.9 ^b ±1.9	22.42±1.87	0.0001
Median	18.00	18.5	18	18.17	
Minimum	12	14	12	12.67	
Maximum	46	46	45	45.67	

It was observed that all the 90 feed samples collected were moderately contaminated with Aflatoxin B1 at different level (Fig. 3). It was observed that 73.3% of home mixed dairy feed contained AFB1 at a level less than or equal to 20ppb set by the Ethiopia dairy feed safety standard (ES6403:2019) implying that it is safe for feeding lactating dairy cow without significant harms. On the other hand, about 26.7% of the feed samples contained AFB1 at a level exceeding Ethiopian dairy feed safety standard (20ppb), which is not recommended or safe for feeding lactating dairy cows.

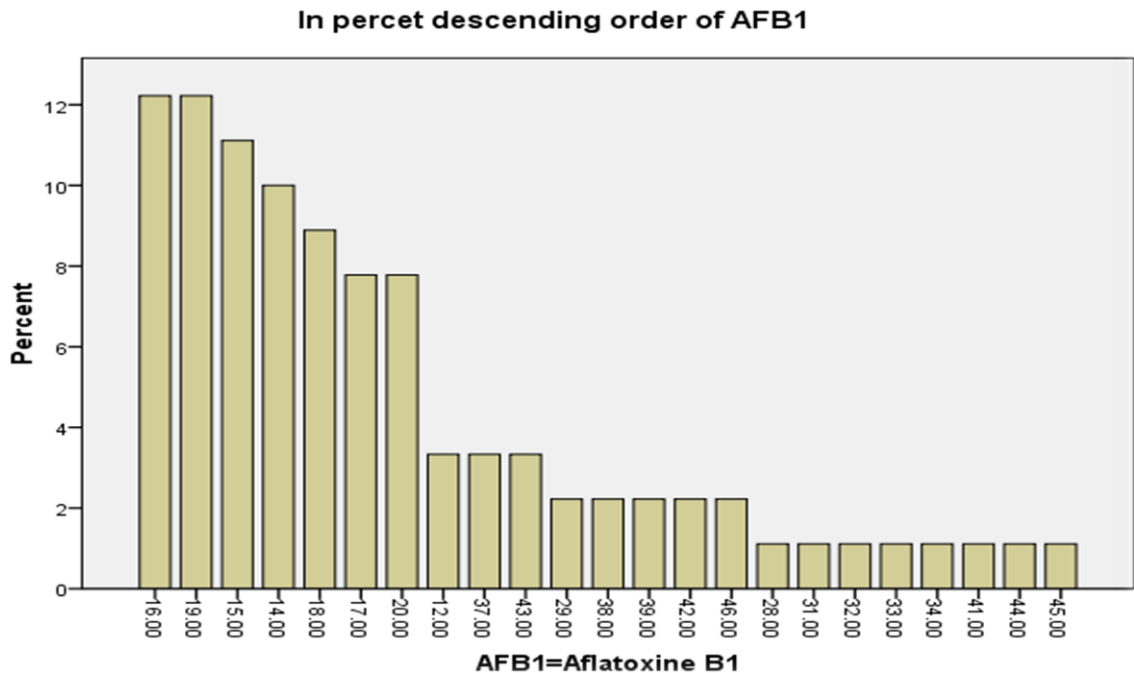


Figure 3: Contamination Level of Feed Samples with AFB1 (ppb) in the Study area

4.18. Aflatoxin M1 (AFM1) Contamination Level in Milk

The finding of this study showed that all milk samples were contaminated with Aflatoxin M1 within a median value of 0.042ppb (Table 25). Though non-significant ($P>0.05$), the highest milk AFM1 content was 0.08ppb from Sululta and Burayu towns, while the lowest milk Aflatoxin M1 was 0.02 ppb from Sebata town. In our previous results, it was found that feed samples from Sululta town was turned out to be with high Aflatoxin B1, implying that it is converted to AFM1 and secreted in the milk. The overall mean value of the study was 0.044ppb, which was moderately lower than the Ethiopian milk safety standard or regulatory limits of FAO/WHO 0.05ppb Aflatoxin M1 in milk. From this study there was non-significance difference ($P>0.05$) among the study towns.

Table25: Aflatoxin M1 Contamination of Milk in the Study Urban Area

AFM1ppb	Burayu N=30	Sululta N=30	Sebata N=30	Overall mean N=90
Mean	0.0431 ^a	0.0454 ^a	0.0431 ^a	0.044
SD	0.0154	0.017	0.0150	0.016
Medium	0.0420	0.043	0.042	0.042
Minimum	0.02	0.03	0.02	0.023
Maximum	0.08	0.08	0.07	0.0766

Out of the total samples collected, 64 samples (71.1%) of the samples contain Aflatoxin M1 at level of less than or equal to 0.05ppb of the Ethiopian milk safety standard level (ES 2009) while 26 samples or 28.9% exceed the levels of Ethiopia milk safety standard. Though lower percentage of the samples exceed Ethiopian milk safety standard, it warrants cautions and should not be overlooked and undermined due to the fact that it is pretty associated with the health of animals and human as it has carcinogenic, mutagenic, teratogenic, and immune suppressive effects.

4.19. Correlation of AFM1 in Milk and AFB1 in Feed

The parametric statistics of regression coefficient of the study is shown in Table 26 and was totally different from zero, which advocates that the regression model that there was clear association among AflatoxinM1 contamination of milk and the occurrence of Aflatoxin B1 within the feed. This means that there was a strong positive relationship among AFBM1 contamination in raw milk and AFB1 within the feed. The correlation coefficient of 0.932 between AFB1 and AFBM1 is a clear indication of conversion of AFB1 conversion into AFM1 and secreted in milk. However, some farms had discrepancies between the amount of toxin contamination in their milk and feed where there was occurrences of high Aflatoxin M1 in milk but less aflatoxinB1 in feed and vice versa. This probably associated with the probability that during milk sampling, the cows for which the samples were taken might be feed distinct types of feed that was free of AFB1 or mixing of feed was not complete where cows didn't take contaminated feed by chance.

Table 26: Linear Regression Model Showing Relationship of Aflatoxin B1 in Feed and Level of Aflatoxin M1 in Milk.

Source	Sum of Squares	Mean Square	Coefficient	95% Confidence interval	F-value	P-value
Regression	0.019	0.019	0.932	0.001-0.002	581.281	0.0001
Residual	0.003	0.00				
Total	0.012	0.019				

Predictors : (constant), AFB1=AflatoxineB1, Dependent Variable: AFM1=Aflatoxin

5. DISCUSSION

5.1. Socio-Economic Characteristics of House-hold

It is a reality that the proportion of male and female-headed dairy farms that run a dairy farm business varies from town to town and among communities with different socio-economic and socio-cultural backgrounds. This study demonstrates that the cultural taboos that offer male-headed households a sole owner of dairy farms started changing and female-headed dairy farms are overtaking the business in urban settings. Relative comparisons show that the proportion of female-headed dairy farmers was relatively higher than the proportion reported by (Belay *et al.*, 2012) in Jimma town 24% but lower than reported by (Assaminew,2014) who reported 60% female-headed dairy owners farm in Holeta town. On the other hand, the proportion of female-headed dairy farms was comparable with the value reported 47.7% by (Haile *et al.*, 2012) in Hawassa town. In either case, it is interesting to observe cultural taboos that deny females to run dairy business are started shifting implying that the long-awaited concept of gender equality started bearing fruits in urban settings.

In any country, running of effective dairy business has a direct association with the level of literacy. In the present study, most of the interviewed dairy farmers were literate and attended formal education from primary to the tertiary level. The implication is twofold. On one hand, they run effective dairy business as they record every farm transaction related to health services, inputs and outputs. On the other hand, they can easily adopt full dairy packages, extension and advisory services given by experts. In fact, comparable results have been reported by previous studies (Fekede *et al.*, 2013) who reported that 41% of the interviewed farmers attended primary education in the Addis Ababa milk shed. Therefore, it is unsurprising that the level of literacy of dairy farmers varies from town to town in the same country and from country to country depending up on the socio-economic and socio-cultural settings.

The current study revealed that majority of the dairy farmers was within active and productive age group who can effectively run cumbersome dairy business. Results of the present study are similar with report of Berhanu (2012) who reported average age of 44.1 years and family size of 5.42 in the majority of urban settings in Ethiopia. Likewise, Azage *et al.* (2013) reported age range from 39.7 to 51.9 years in Mieso and Shashamane towns of Ethiopia, respectively. The average farming experience (3.4 years) in the present study was lower than the value (9.67years) reported by (Berhanu, 2012) for the commercial urban dairy farms of Ethiopia. The overall average number of crossbred cows owned per household in the study site was greater than the figure reported for medium farms 6.43 cows in Bishoftu, Ethiopia (Mulisa *et al.*, 2011). The variations could be attributed to differences in production objectives between urban to urban farmers, and also the lack of sufficient space to accommodate large herd size in urban centers.

The study revealed that all the dairy farmers used hired labor and family member labor for the farm operation. Household members and hired labor were participating in various dairy cattle management practices. This was dependent not only on the sex and age of the family members but on the type of activities (kassu, 2016). Young son and daughter had a small involvement in all activity but next to hired worker's household wife was higher involvement in the heavy part of the activity; this is agreed with (Habtamu, 2018) who report on analysis of intensification of dairy production systems, bovine milk quality and consumption in the smallholder dairying of ada'a district of Ethiopia. More women's contribution to the dairy labor force continued to be a heavy burden on women, in addition to their daily routines of preparing food and caring for the family. The higher participation of hired labor in this study agreed with other African counties, in urban dairy farms of Dar es Salaam, Tanzania (Kivaria *et al.*, 2006), and Kisumu, Kenya (Kagira and Kanyari,2010) hired labor was used intensively in 97% and 76% of households, respectively.

In relation to dairy breed, the result indicated that all urban dairy producers were reared the crossbred dairy cows this is in line with (Habtamu, 2018) who report on the analysis of intensification of dairy production systems, bovine milk quality and consumption in the smallholder dairying of ada'a district of Ethiopia. In terms of farming experience; the

present study result was agreed with the result reported by (Staal *et al.*, 2002) that dairy farming experience is positively related to the keeping of crossbred dairy cattle. Adoption of improved dairy cow technologies is expected to be negatively associated with the size of livestock ownership (Moll *et al.*, 2007).

5.2. Feed and Feeding System

The study noted that none of the dairy farmers were used purchased formulated feed alone for feeding their cattle's and majority of them were used only feed that mixed at home but the few of urban dairy farm in the study area were used both small amount of formulated feed and large amount of feed that mixed at home. The result of present study was not line with (Fekede *et al.*, 2013) the urban and peri-urban dairy operations depend mainly on the natural pasture hay as a source of roughage feed in the central highlands of Ethiopia. But the result was compliance with (Azage *et al.*, 2013), agro-industrial by-products such as bran, middling, oil seed cakes and molasses are fed as supplement to crossbred dairy cows in urban and peri-urban areas.

In the current study result, all of the dairy farmers were used hay grass and straw as basal diet for their dairy cattle. Since there was the scarcity of formulated feed, the farmers frequently used feed that mixed at home. The common types of concentrates feed ingredients used were includes: wheat bran, noug seed cake, wheat middling, linseed cake, bean hulls and salt, this is line with (Assiminew, 2014) the dairy farmers were blend the concentrate mixture for crossbred dairy cows from wheat bran 42.60%, noug seed cake 34.20%, wheat middling 10.27% and the remaining proportions from linseed cakes bean hulls and common salts in Holeta town. Among the different ingredients used, noug seed cake and salt are the sole concentrates feed ingredients for home-mixed concentrate mixture in the study site.

The feeding methods of urban dairy farm in the study area were commonly individual feeding system and few of them were feeding in group this is agreed with (Assaminew, 2014) assessment of feed formulation and feeding practices for urban and periurban dairy cows around holeta, Ethiopia. Majority of the farmers in this study were determine the

amounts of feed provided per head per day were based on the level of milk yield only, this is agreed with the result of (Azage *et al.*, 2013) and some of the farmers were based on level of milk yield and bodyweights but few of them were only on the bodyweight of the dairy cattle rather than the level of milk yield, this may due to lack of experience for rearing dairy cow.

5.3. Water Source and Frequency of Watering

The main source of water in this study site were tap water which is comparable to the report of (Azage *et al.*, 2013) who reported the majority 71.8% of the urban dairy farming system (Hawassa, Shashemene, Yirgalem,Dilla), southern Ethiopia rely on tap water and (Assimene2014) that reported (76.4%) of the Holeta town dairy production system . Regarding frequency of watering, most of the dairy farmers watered their cattle twice a day in this study was agreed (Lemma *et al.*, 2005) who reported that almost all the respondents watered their cattle twice in a day and few of farmers were provided water in *ad libitum*. Actually for watering frequency of dairy cattle is depends on access to water sources, age structure of the herd, physiological stage of animals and season (Azage *et al.*, 2013).

5.4. Dairy Cattle Housing System

The purpose of housing dairy cattle like other farm animals is to reduce climatic stress on the animals that hinder production, reproduction and proper growth and development (Yibrah *et al.*, 2005). The uppermost numbers of stanchion housing type were observed in this study; these were higher than the finding of (Mulisa *et al.*, 2011) in Bushoftu town for the majority of medium dairy holders 71.4%. All roofs of the barn were rain proof which is higher than most of the farms in all scales of production 78.8% kept their dairy cows under cow shed roofed with corrugated sheets of materials (Mulisa *et al.*, 2011) in Bisheftu town. The general farm hygiene conditions in this study were more hygienic than Asela town where 39% dairy farms were hygienic (Hunduma, 2013). All the dairy farmers constructed a separate dairy cattle house system from the main residence and constructed within the living fences of the dairy farmers. The houses were not

constructed according to recommended dairy housing design extensions package service; however, the majority of them have enough ventilation and light. In the study, majority of the dairy house had individual pen and maternity pen. The majority of dairy house used only for dairy cattle and few of them were mixed with other livestock.

5.5. Dairy Cattle Disease

The health of dairy stock was affected by inaccessibility of veterinary service, death, disease occurrence and expensive private veterinary service. There were similar reports of veterinary-related problem in Ethiopia and elsewhere. Provision of veterinary service in Ethiopia is inadequate and underdeveloped (Ayele *et al.*, 2012; Jaleta *et al.*, 2013). Kitaw *et al.*, (2012) also reported that veterinary service was the least commercialized among inputs of dairying with provisions limited to drug vending. On the other hand, service from private veterinarians was expensive and with limited outreach. The most common sign frequently occurred in their farm were swelling the udder and closed of teat. The common bacterial diseases that occurred in the study area were mastitis disease and less frequency occurrence of brucellosis and also lameness was happening. This result is similar with the result of (Habtamu 2018) mastitis, lameness and brucellosis diseases were affected dairy cows, which are diseases associated with intensification and in Kenya clinical mastitis (66.7 %), Lameness (23 %); Lumpy skin disease (23 %) were reported as major health problems (VanLeeuwen *et al.*, 2012). According to the respondents whenever sick dairy cow were observed in their farm, major of the farmers called vet doctor and few of them were treat by themselves.

5.6. Institutional Support and Extension Service

This study revealed that the contact between extension serve agents and urban dairy producers was good and frequent. According to the respondents, most of the dairy farmers had access to extension services while few numbers them had no access to extension services. The present study was not agreed with (Berhanu, 2012) about 60.4% of farmers didn't access livestock extension services because of inadequate capacity of extension service and only about 16% of farmers received extension services such as

veterinary and crossbred cows, milk value addition and market information. Institutional supports like training, extension and veterinary services was provided by the urban agricultural offices while credit services provided by the micro finance of the urban office , However it is not satisfy needs of the farmers.

5.7. Productive and Reproductive Performances

The estimated mean daily milk yield of 13.4 ± 0.4 kg/cow/day of this study is comparable to the report of (Nigusu and Yoseph, 2014) 14.1kg /day/cow in urban and secondary town dairy production systems in Adama milk shed. However, it is higher than the finding from Hawassa City, 10.32 ± 1.5 kg/cow/day (Haile *et al.*, 2012) and Dar es Salaam, Tanzania 10.4 ± 0.7 kg/cow/day (Gillah *et al.*, 2013). The overall estimated mean yield at 1st parity, 2nd parity and 3rd parity was 10.7 ± 0.26 kg/cow/day, 13.33 ± 0.31 kg/cow/day and 16.06 ± 0.61 kg/cow/day respectively with the overall mean of peak yield at mid lactation was 18.13 ± 0.39 kg/cow/day, from this result the yield start from the first parity to third parity was increased. The lactation length in crossbred cows observed in this study is slightly shorter than the lactation length of 11.7 months reported for crossbred cows in the Central Highlands of Ethiopia (Zelalem and Ledin, 2001) and (Adebabay 2016) reported result 10.1 month in bure town. The present study result was comparable to the lactation length of dairy cows (9.29 months) at Meiso district (Kedija, 2008). The average ages at first service (AFS) reported for cross breed heifers 2.26 ± 0.05 years in this study is similar with (Kassu, 2016) reported result (2.69 ± 0.08 years) for crossbred heifers in Sidama zone.

The AFC obtained in the present study was shorter than the result reported by (Asaminew, 2007) that the average AFC was 37.6 months in Bahir Dar milk shed area and the finding of (Fisseha, 2007) with the overall mean of AFC 43.13 ± 1.7 months for holstein frisian cows in Alage. Age at first calving is closely related to generation interval and, therefore, influences response to selection. Early AFC reduces unproductive period and a higher the AFC will be the additional rearing cost of the animal (Panja and Taraphder, 2012).

The reported average number of services per conception (NSPC) of the study area were slightly similar with (Adebabay, 2009) the number of service preconception cross bred cow in bure town 3.91. The present result is greater than the number of services per conception (Gizu and Azage, 2018) reported around Mekelle, Bako research center, the overall least squares means in the Maksegnit town and Fogera cows were 2.1 ± 0.1 , 1.34 ± 0.11 2.0 ± 0.65 and 1.42 ± 0.05 , respectively. According to Mukassa - Mugerwa (1989), cows with values of NSPC greater than two, are regarded as poor, the average natural service conception has 1.18 whereas artificial insemination users (1.5 up to 2.3).

The current result of calving interval was comparable to the value reported by (Gidey, 2001) for Frisian x Fogera breed 18.6 months and (Yifat *et al.*, 2012) reported that crossbreeds have shorter calving intervals than indigenous in Tatesa cattle breeding center. But the current finding was longer than (Kiwuwa *et al.*, (1983); (Enyew *et al.*, (2000); (Obese *et al.*, 2013); Niraj *et al.*, (2014) reported about 459 days for crossbred cattle in Arsi region Ethiopia. The current calving interval value was shorter than the estimates of (Mukassa-Mugrewa *et al.*, 1989) (25 months) in cross bred cattle. Long calving interval implies that farmer's income suffers because cows spend a greater portion of their lactation at low production levels (Swai *et al.*, 2007).

The overall estimated mean days open in the study site was 161.76 ± 34.80 days. This current study is agreed with the average length of days open recently reported for crossbred dairy cows in Ethiopia was 85.6 to 197 days (Zewdie *et al.*, 2011; Belay *et al.*, 2012b; (Hunduma,2012; Niraj *et al.*, 2014) . The average days' open value in this study was slightly shorter than the report of Lemma and Kebede (2011) 176.8days from Addis Ababa and 171.18days of (Alphonsus *et al.*, 2014) from Nigeria. The reproductive performance of cattle, particularly the probability of conception, may be negatively associated with the magnitude and duration of negative energy balance in early lactation (Walsh *et al.*, 2011).

5.8. Dairy Farm Waste Management Practice

The study revealed that the majority of waste in the farms was manure, followed by roughage feed left over and dust, this result agreed with the report of (Paul *et al.*, 2009) Cattle manure management in east Africa: Review of manure quality and nutrient losses and scenarios for cattle and manure management. Manure is among the most important contributions that livestock make to intensification and sustainability (Ehui, 2000). Adoption of improved manure handling techniques is crucial in stall fed cattle (Powell and Williams, 1995; Paul *et al.*, 2009). The majority of manure in this study area was not properly disposed in dump due to lack of dump site. The most common environment concern with animal wastes was that it affects the atmospheric air with offensive odors, release of large quantities of CO₂ and ammonia which might contribute to acid rain and the greenhouse effect. For this reason the future threats of urban dairy farms in the study area were displacement and complain from the neighbors as result of improperly management of wastes. Very few numbers of farmers were used as fertilizer in their very small garden farm and nor numbers of farmers were used biogas. When the disposal of waste is not properly planned it might create social tension owing to the release of odors and contamination of water sources. Proper disposal and returning of nutrients back in the soil without pollution and spreading of diseases/pathogens, is required for efficient utilization of wastes especially on such urban dairy farm but this was less practiced in this study area.

5.9. Physical Quality Characteristics of Raw Milk

It is very fact that milk produced in Ethiopia by several dairy farms to finish shoppers isn't well regulated and such milk is also exposed to adulteration. Generally, it was found that the overall mean of added water was similar to the findings of (Dessalegn, 2017) and (Tsedey and Asrat, 2015), while the current result was higher than the results of (Dehinet *et al.*, 2013) and lower than the result of (Abdissa *et al.*, 2020). The addition of water to milk not only reduces the nutritional value of milk but also contaminated water may also pose a health risk (Pitty, 2011) and if contaminated, it poses a health risk

to consumers (Kandpal *et al.*, 2012). The remains of the rinse water in the milk container prior to milking and the addition of the wash water to the tank after the milking might have subsidized the presence of added water in milk (Wangdi *et al.*, 2016).

The milk pH gives an indication of milk hygiene and freshness; the pH value of this study was below the normal pH of fresh cow milk. According to O'Connor (1995) and FAO (2009), fresh cow milk has a pH value that ranges from 6.6 to 6.8 when milk temperature is 20°C. In the current study milk, pH-value was out of the normal fresh milk. This might be due to the increased acidity of milk by bacterial multiplication. The result of this study was comparable with the result of (Abdissa *et al.*, 2020) and (Teklemichael *et al.* 2015) who reported 6.47 ± 0.42 and 6.63 ± 0.135 , respectively while the current result not line with the finding reported by (Eshetu *et al.*, 2019).

In the current study, the milk samples collected from three towns had a titratable acidity value of greater than 0.17% which indicates that the milk samples were kept at room temperature for a longer period and under poor handling practices until they were sold and/or consumed. Hence, there was the growth of the bacteria, which lead to in lactic acid production. According to the Ethiopian Standards Agency, the titratable acidity of ordinary fresh milk is between 0.14% and 0.17%. The current study is comparable with the result of (Teshome and Tesfaye, 2015) and lowers than the finding reported by (Asaminew and Eyassu, 2011). In this study milk sampled from collectors and cafeteria high percent of titratable acidity than milk sampled from the farm, maybe due to the high bacterial growth and multiplication during transportation of the milk to the vending sites and longer storage of the milk before consumption.

The specific gravity of normal milk ranges from 1.027 to 1.035 with an average value of 1.032 at 16°C (FAO, 1999). In this finding, the specific gravity of raw milk samples obtained from collectors and cafeteria in a milk supply chain was lower than that obtained from producers and also below the acceptable limit. These variations might be due to the different sources of milk mixed together that might have been adulterated with water. A similar result was also reported by (Teklemichael *et al.*, 2015) and (Eshetu *et*

al., 2019). The specific gravity of milk can be affected by various factors. For instance, the specific gravity of milk decreases by the addition of water and addition of cream; while it is increased by the removal of fat and reduction of temperature.

According to the Ethiopia milk quality standard, the normal freezing point of milk is between -0.55°C to -0.525°C (ES2009). The current study was not within the range of normal milk freezing point, however, this finding was slightly similar to the average milk freezing points reported by (Dessaleng, 2017) of $-0.55\pm 0.03^{\circ}\text{C}$ and less than the results of $-0.941 \pm 1.40^{\circ}\text{C}$ reported by (Shimelis, 2016) with milk collected from the study conducted in Addis Ababa. For dairy farmers and consumers, the freezing point of milk can be an indicator of milk quality, especially adulteration with water. The environmental difference, breed, and management can all influence the freezing point of milk. The season, time, type of feed, and the amount of water the animal consumes can affect milk's freezing point.

5.10. Chemical Composition of Raw Milk

In this study, the result of protein content was in line with the result of $3.27\pm 0.15\%$, $3.2\pm 0.22\%$, $3.2\pm 0.22\%$, and $3.21\pm 0.06\%$, were reported by (Desalegn, 2017), (Debebe, 2010), (Mirzadeh, 2010) and (Belay and Janssens 2014), respectively. However, it is lower than the result of $3.94\pm 0.07\%$, 3.67% , 3.4% , and 3.34% reported by (Gurmessa *et al.*, 2015), (Deresse, 2008), (Haftu, 2013), and (Ayisheshim *et al.*, 2015) in Yabello District, Borana Zone, cow milk of Western Shewa, Southern Ethiopia and Western Amhara region respectively. The current result was slightly higher than the result of 3.12 ± 0.32 reported by (Dehinnet *et al.*, 2013). From this result, the protein content of milk decreased starting from the producer to the end consumer. This may be due to the adulteration of milk by the cheap material. According to the Ethiopian standards Agency, the minimum percent protein content of whole milk should be 3.2 percent (ESA, 2009). Hence, the average protein content for the current study was within the recommended standard.

In this study, the result of lactose contents was lower than the finding of $4.34\pm 0.13\%$ (Belay and Janssens, 2014) who reported the lactose content of raw milk samples collected from different urban dairy farms located in Jimma town and $5.39\pm 0.31\%$ reported by (Abdissa *et al.*, 2020). According to European Union Quality Standards for unprocessed whole milk, lactose content should not be less than 4.2% (Tamime, 2009). Therefore, the current result was below the recommended standards. This might be due to the action of lactose hydrolyzing enzymes produced by microorganisms as a result of storage temperature variation (Dessalegn, 2017). In general, the composition of milk can vary depending on the breed of the animals, management practices such as feeding management, and environmental factors that influenced the milk composition (Pandey and Voskuil, 2011).

The current result of fat contents was higher than the report of (Dessalegn, 2017) who found (3.60 ± 0.53) fat from milk value chain and Quality in Bishoftu and Akaki Towns, Oromia Regional State, Ethiopia. However, this finding was less than the report of (Teshome *et al.*, 2015) who found (4.28 ± 0.05) fat from raw cow's milk produced and marketed in Shashemene town, Southern Ethiopia. This result was comparable with the result of 3.9% raw milk reported by (Kunda *et al.*, 2015) on smallholder of dairy farmers in the Lusaka Province of Zambia. The subordinate fat content of milk may be due to high milk-producing crossbreeds' cows which reduces the fat content of the milk samples or water may be added with milk or partly skimming the milk or due to the feed, they offered. According to the Ethiopian standard agency, the minimum fat content of raw milk should not be less than 3.5% (ESA, 2009). Accordingly, the mean (\pm SE) fat content (3.96 ± 0.25) observed from the three value-chain actors milk samples was in the range of recommended standards.

The current finding of SNF content of raw milk was slightly similar with (Estifanos *et al.*, 2015), who report the average SNF 7.98 ± 0.98 of raw cow milk and (Dessalegn, 2017) who report the average SNF 7.78 ± 0.41 Milk Value Chain and Quality in Bishoftu and Akaki Towns, Oromia Regional State, Ethiopia. But less than the findings of (Fikrineh *et al.*, 2012) found the average SNF percentage of raw milk of Adama town to be 9.05 ± 0.16 and (Debebe, 2010) also reported the minimum 8.3 ± 0.36 and maximum

8.7±0.36 SNF content of raw cow's milk obtained from street-vendors and milk producers in, and around Addis Ababa. According to food and drug administration (FDA) as well as European Union (EU) quality standards, a minimum solid not fat (SNF) content of whole milk is 8.25% by (Raff, 2011). The current result was not found in the recommended range. This may be due to a variety of factors including the feed, genetics, season of the year, stage of lactation and disease.

The total solids (TS) content of this result was lower than (Eshetu *et al.*, 2019) who report average total solid (12.78%) milk production, marketing practices, and qualities along milk supply chains of Haramaya District, Ethiopia. But the current result was agreed with (Dessalegn, 2017) who report the average total solid content (11.38%) milk value chain and quality in bishoftu and akaki towns, Oromia regional state. According to the Ethiopia standard agency, the total solid contents of cow milk should not be less than 12.80% (ES, 2009). Therefore, the result of this study was less than the recommended standard. The lower total solid content found from this study may be due to adulteration of milk (addition of water to milk) and removal of fat content.

The ash content of the current study was higher than the result of 0.62±0.05 reported by (Dessalegn, 2017) and also the result of (Imran *et al.*, 2008) and (Estifanos *et al.*, 2015) who observed that the means of ash in cow's raw milk collected from different locations were 0.64±0.07 and 0.68±0.16, respectively. But an agreement with the finding of (Teshome *et al.*, 2014) who reported the ash content (0.78±0.00) for the raw cow's milk collected from produced and marketed in Shashemene town, Southern Ethiopia.

5.11. Microbial Quality Analysis of Raw Milk

Milk is a very nutritious food that serves as an excellent breeding ground for a variety of bacteria. The microbiological quality of milk and dairy products is influenced by the early factors of raw milk, processing conditions, and contamination of post-heat treatment. For this reason, additional emphasis should be placed on microbiological testing of milk and dairy products. Microbiological analysis is critical to quality and

safety assessments, compliance standards and specifications, and compliance controls. The study was specifically conducted on the amount of total coliform count, total bacteria count, yeast and mold, and somatic cell count.

The current study result of coliform counts/ml was line with the results that reported by (Asaminew and Eyassu, 2011) $4.50 \pm 0.109 \log_{10}\text{cfu} / \text{ml}$, (Tesfaye *et al.*, 2015), $4.13 \pm 0.76 \log_{10}\text{cfu} / \text{ml}$, and (Negash *et al.*, 2012) $4.40 \pm 0.06 \log_{10}\text{cfu} / \text{ml}$ of raw cow's milk. But the result was lower than the finding of (Abdissa *et al.*, 2020) $5.99 \pm 0.35 \log_{10}\text{cfu}/\text{ml}$ of raw milk, and the study result of (Amistu *et al.*, 2015) designated that a higher mean range of coliform bacterial counts of $5.42 \pm 1.735 \log_{10}\text{cfu}/\text{ml}$ to $5.78 \pm 0.985 \log_{10}\text{cfu}/\text{ml}$ for samples collected from the farmer and collectors on Sebeta site. According to east African country (EAC), the recommended level is $5.0 \times 10^4 \text{ cfu}/\text{ml}$ for the coliform count. Coliforms bacteria are fecal bacteria but also it is more common in the environment. Coliform bacteria can cause mastitis; however, mastitis cows are generally not the cause of high coliform counts in most tanks/chambers. The existence of high numbers of coliforms in milk shows that the milk has been contaminated with fecal materials and this could be recognized to insufficient pre-milking udder preparation, poor hand washing practice of milkier and use of poor sanitary and non-boiled water for cleaning of milking utensil. This is supported by (Grillet *et al.*, 2007) higher coliform counts result may be due to the contamination of the milk either from dirty equipment or from milking cows with environmental coliform mastitis. The Laboratory analyses performed that, there were medium levels of coliform count was found in these study towns.

The current study result of the total bacterial count was lower than research conducted in the country by (Tsedey and Asrat, 2015) $7.03 \pm 0.07 \log_{10} \text{CFU}/\text{ml}$ and (Fikrineh *et al.*, 2012), $7.08 \log_{10} \text{cfu}/\text{ml}$, (Zelalem, 2010), $9.10 \log \text{cfu}/\text{ml}$, (Abebe *et al.*, 2012) $9.82 \log \text{cfu}/\text{ml}$ and (Asaminew and Eyassu, 2011) $7.58 \log \text{cfu}/\text{ml}$. The total bacteria count obtained from the current result was slightly similar to the result reported by (Tamirat, 2018) $6.15 \log_{10}\text{cfu}/\text{ml}$; and also this result was in line with the minimum quality standard value of the Ethiopia standard agency $6.3 \log_{10} \text{cfu}/\text{ml}$, (ESA, 2009), which

means it found in the level of an acceptable range. The total bacterial count is a good sensible indicator for monitoring the hygienic conditions practiced throughout production, collection, and handling of raw milk.

Yeast and mold are considered spoilage-forming organisms. The yeast and mold count from the laboratory analysis of the current study result was not agreed with the result $8.13 \pm 0.31 \log_{10} \text{cfu/ml}$, $7.21 \pm 0.21 \log_{10} \text{cfu/ml}$, and $4.266 \pm 0.032 \log_{10} \text{cfu/ml}$ reported by (Abdissa Tadesse *et al.*, 2020), (Korma *et al.*, 2018) and (Debela *et al.*, 2015) respectively, that attained from milk samples from rural and urban farmers in Hawasa Woreda, Southern Ethiopia and from the producers Yabello Woreda, Borana zone, Ethiopia respectively. However the current finding of yeast and mold count slightly agreement with the result $0.6 \log_{10} \text{cfu/ml}$ reported by (Godic Torkar K. and A. Vengus 2007), the presence of yeasts, molds, and aflatoxin m1 in uncooked milk and cheese in Slovenia. The current result of yeast and mold contents of raw milk sampled was very low and save for consumption this might be due to urban milk production area was the nearest market, it is no longer time-lapse for transportation and storage.

A somatic cell count (SCC) is a cell count of somatic cellular in a fluid specimen, commonly milk. In dairying, SCC is an indicator of milk quality in particular, its low consistency containing harmful bacteria, and consequently high food safety. (Raynal-Ljutovac *et al.*, 2007) stated that an increased SCC results either from an inflammatory process due to the occurrence of an intra-mammary infection or, under non-pathological conditions, from physiological processes such as estrus or an advanced stage of lactation. The result of somatic cells in the current study agreed with the result $5.05 \log_{10} \text{cuf/ml}$ reported by (Dessalegn, 2017) and also in line with the result reported by (Mustofa, 2012) and (Kunda *et al.*, 2015). The result of this study was lower than the Findings reported by (Stulova *et al.*, 2010) and (Dehinenet *et al.*, 2013). The current finding of SCC was showed slightly above the recommended limit of Food and agricultural organization (FAO) $1 \times 10^5 \text{ sc/ml}$ or $5 \log_{10} \text{sc/ml}$. According to FAO an individual cow SCC of 1×10^5 or less indicates an 'uninfected' cow, where there were no significant production losses due to subclinical mastitis. SCC in milk rises soon after calving when colostrum is produced before the cow enters the lactation, and tends to rise towards the end of

lactation, mainly due to the effect of low concentrations of milk produced. A very low SCC is sometimes considered a sign of poor immune response, but in general, this does not have to be true; it may have been just a low level of current infection.

In all milk value chain actors, the increase in bacterial load was statistically significant. This shows a general trend of decreasing quality from farms to cafeteria, which clearly raises food safety concerns about contamination by pathogenic organisms and suitability of raw milk consumption in the milk value chain actors of study towns. This might be due to the contamination originating from the udder surface, in farm level, lack of cooling technology and transport, not properly cleaned milk containers, sanitation of water used for cleaning milking utensils and the time interval from production to marketing. This is also supported by (Hossain *et al.*, 2011) the most frequent causes of high bacterial load are poor cleaning of the milking system, milking dirty udders, maintaining not clean milking and housing environment, and failure to rapidly cool milk to less than 4°C after milking.

5.12. Chemical Composition of Home-Mixed Dairy Feed

In the present study, the overall mean value of CP was considerably greater than the value (150g/kg DM) of compound feed mixture recommended by (Delgado and Randel 2004) for cows grazing tropical grass swards. The mean Crude Protein of the present finding was less than 216.58±20.86 g/kg DM stated by (Assaminew 2014) and 260 g/kg DM reported by (Mesfin *et al.*, 2013) in the urban, as well as periurban production system of dairy cattle in Holeta and home-mixed compound feed mixture for cross bred lactating dairy cattle in the highlands of Ethiopia respectively. But it has comparable with finding reported by (Nega *et al.*, 2006) in the urban and periurban area of the Central Rift Valley, Ethiopia who report 163 g/kg DM of CP in the farmer home-mixed concentrate for cross-bred lactating dairy cattle.

The home-mixed concentrate mixture for lactating cross-bred cattle's was considerably variable and unbalanced for the CP contents; the ingredients were blended in the concentrate mixture without any standards. The mean metabolic energy (ME) content

result in this study was less than the report of (Rehrahie *et al.*, 2003); (Mesfin *et al.*, 2013); (Tekeba *et al.*, 2013) who showed closer to 2866.8 kcal/kg DM of ME. The present result was similar to 2532.34/kg DM of ME contents of the finding of (Nega *et al.*, 2006) and 2580.12kcal/kg DM of ME with the finding of (Mesfin *et al.*, 2013) in farmers' home-mixed feed to dairy cows of central rift valley and central Ethiopia, respectively.

5.13. Aflatoxin B1 Contamination Level of Home –Mixed Dairy Feed

The present study revealed that all feed samples had detectable with different levels of aflatoxins B1, this finding was agreed with the result of (Giza chew *et al.*, 2016) for AflatoxinM1 contamination of milk, and AflatoxinB1 with in dairy feeds in the Greater Addis Ababa milk shed. The current study showed that significant numbers of home mixed dairy feed aflatoxinB1contamination exceeded the maximum limit of detection (20ppb) set by the Ethiopian standard agency that regulated by the Ethiopia veterinary drug and feed administration control authority (VDFACA). Upon ingestion with the aid of ruminants, AFB1 is partly destroyed inside the rumen whereas the absorbed AFB1 unexpectedly undergoes metabolic strategies within the liver to diverse secondary metabolites.

Therefore, over 5 billion humans in developing nations global are prone to chronic exposure to aflatoxins through contaminated meals (williams *et al.*, 2004). Chance of human exposure to AFM1 contamination of milk is a major problem in Ethiopia where dairy farmers usually use distinctive combined pay attention feeds containing traditional brewery derivative, wheat bran, noug (*guizotia abyssinica*) cake, maize grains, and silage to growth manufacturing. But, these feeds are susceptible to the contamination with AFB1. In the current study result aflatoxinB1 contamination level was lower than Compound feed collected from great Addis Ababa milk shed, with an average concentration of a minimum of 7 μ g/kg(7ppb) and a maximum of 419 μ g/kg (419ppb) that reported by (Gizachew *et al.*, 2016).

In the current result, overall mean contamination of AFB1 levels were above the Ethiopia feed safety standard limit (20ppb), this result agreement with Aflatoxin M1 in raw milk and aflatoxin B1 in the feed from household cattle in Singida, Tanzania (Joan J.E M. *et al.*, 2016). The high contamination levels of home mixed dairy feed perceived during data collection at study sites can be attributed to the fact that the storage facilities feed raw materials were very poor. The majority of the farmers were not aware of the presence of aflatoxins in animal feed and its impact on animal health as well as human health. Furthermore, farmers tend to buy the raw materials of feed-in bulk during the low price season and store them for extended periods in poor storage facilities this statement line with the result reported by (Giza chew *et al.*, 2016).

Inadequate studies have been reported on aflatoxins in dairy feeds in Sub-Saharan Africa with the exception Kenya, where substantial analysis of aflatoxin contamination of maize has been carried out (Kang'ethe, M'Ibui, Randolph, and Lang'at, 2007;Ogana and Muture, 2005). In Ethiopia, young calves are especially susceptible to the harmful effects of aflatoxins before their rumen matures and they consume their mother's milk until weaning. Therefore, the economic losses due to chronic exposure of cattle to aflatoxins could be significant to the urban dairy industry in Ethiopia (Gizachew *et al.*, 2016).

The amount number of aflatoxin contamination of home mixed feed in Sululta town was significantly greater than Buyayu and Sebeta. Though all dairy farmers of the different towns used similar types of feed raw materials, differences in environmental temperature condition, moisture, and storage situations might be the cause for the variation of aflatoxin impurity between the study areas. In dairy cow, feeding of high levels of aflatoxins bases for critical toxicosis and death, while chronic ingestion of lower levels can cause liver injury, gastrointestinal dysfunction, and failure in appetite, reproductive role, growth, average daily intake, body weight, and production (Khlangwiset *et al.*, 2011).

5.14. Aflatoxin M1 Contamination Level of Raw Milk

This study revealed that all milk samples had detectable with different levels of AFM1. The present study result was similar with a previous finding that conducted on Aflatoxin contamination of milk and dairy feeds in the greater Addis Ababa milk shed, Ethiopia (Gizachew *et al.*, 2016) but the toxification levels perceived in the present study were lower than those stated by the same authors. The more number of milk samples have not exceeded the limit of 0.05 ppb set by the Ethiopia standard or WHO/FAO, however non disregarded percentage of them were exceeded the levels of tolerance. The maximum contamination of AFM1 that spotted in milk was less than the finding from urban centers in Kenya that has reported AFM1 levels up to 0.68 ppb (Kang 'ethe and Lang', 2009), and the concentration of AFM1 contamination in raw milk collected from Khartoum state in Sudan, with an average level of 2.07ppb and maximum of 6.9 ppb (Elzupir & Elhussein, 2010). While the incidence of AFM1 in the present study was slightly similar when compared to a previous study conducted on the Presence of Aflatoxin M1 in Milk, data sample Collected from Jeddah, Saudi Arabia ((Magda *et al.*, 2017) were contaminated and the quantity of AFM1 ranged from 0.09-0.65 ppb with the mean value of 0.04 ppb which is lower than the Euro-limit (0.05ppb) while 6 samples exceed the USA limit (0.5 ppb).

5.15. Correlation of AFM1 in Milk and AFB1in Dairy Feed

The recent study discovered that, there were a moderate optimistic relation among aflatoxinM1 contamination in milk, and aflatoxinB1 in the feed. The high level of aflatoxin B1 in feed correlation with high level impurity of milk with aflatoxin M1. The maximum level of aflatoxinM1 pollution in Sululta farm milk, and the analogous AFB1 levels in the feed. There were some disagreements between the contamination levels of milk and feed collected from the dairy farms. For example, the four farms in burayu had high levels of AFM1 in the milk while corresponding feed samples were only moderately polluted with AFB1. Inversely, a high amount of feed contamination was not always reflected in the milk. The motive can be that either on the time while milk samples have

been being taken, the lactating dairy cow were fed distinctive inventory of feed, or the feed became not mixed well such that the study evaluation didn't have an actual illustration of the distinctive feeds in the blend, this idea agrees with previous study Aflatoxin contamination of milk and dairy feeds in the greater Addis Ababa milk shed, Ethiopia (Gizachew *et al.*, 2016). In dairy farm animals feeding of very excessive stages of aflatoxins bases for acute toxicities and death, even as chronic intake of lower levels can cause liver damage, gastrointestinal dysfunction, and decrease in appetite, reproductive function, growth, average daily gain, bodyweight, and production (Khlanguiset *et al.*, 2011)

6. CONCLUSION AND RECOMMENDATIONS

6.1. Conclusion

The study revealed that commercial urban dairy production system was practiced by both male and females and mainly by medium age groups of the urban farmers as an income generating activity. All dairy farmers used hired labor and family member labor for the farm operation. The main purpose of rearing dairy cattle in urban areas of the study site was mainly for income generation with household consumption. All cattle breed of the study area were Local x Holstein Friesian crossbreds, the majority of dairy cattle blood level are more than 62.5%. Majority of the dairy farmers were used both formulated feed and feed that was prepared at home, and they were used feed that prepared at home in large amount than formulated feed per day. Compounds feed that mixed at home were mostly prepared from the mixture of wheat bran, noug seed cake, wheat middling, linseed cake, bean hulls, and salt. The majority of the farmers were determining the amounts of feed provided per head per day based on the milk yield of lactating cow.

The present finding revealed that, the majority of the dairy houses have good ventilation and light, also the housed were constructed separately. The water sources of study area were tap water, hole water and pond water but the main source of water was tap water when compare with hole water and pond water. The common bacterial diseases that occurred in the urban dairy farms were mastitis disease and less frequent occurrence of brucellosis was happened and among the viral disease foot and mouth disease was rarely occurred. Teat closing from mastitis was the most economically important disease affecting milk quality and quantity in the study towns. In urban dairy production practices majority of the dairy farmers had got extension service from urban agricultural office. Service like training, extension and veterinary services was provided by the urban agricultural offices and credit services were provided by the urban micro finance institute. The estimated overall mean daily milk yield was 13.4 ± 4 kg/cow/day and average age at peak yield, estimated lactation length and average age at first calving were

4.33±.08 year, 9.52±.08 months and 2.26±.05 years respectively. The overall estimated mean calving interval was 20.8±.05 months and mean days open was 161.76±34.80 days.

Manure was found to be the bulk waste in urban dairy farms and removing the bulk manure was the most difficult task. Wheel barrow, polythene and hessian sack were used to remove the waste. The major constraints of waste disposal encountered by the urban dairy farmers were lack of convenient dumping site. There were other most important constraint that had negatively affected urban dairy production. These were high price and unavailability of concentrate feed in the area, shortage of land, unavailability of heifer in time, high cost of heifer, feed quality. The study exposed that, the increasing cost of feed is a threat to the dairy farmers of the study area.

All feed and milk sample were contaminated with aflatoxin B1 and aflatoxin M1 respectively. Non ignored numbers of samples were found to have aflatoxin contamination more than the level set by Ethiopia standard authority. From the present findings it could be decided that aflatoxin M1 in milk is public health concern and hence efforts should be made to keep below the recommended levels. Such efforts need all-inclusive tactic and all the serious control points of entry aflatoxin B1 into the feed chain has to be monitored and controlled.

Results of the laboratory analysis of this study showed that, adulteration of raw milk were increasing along with the increase of the milk chain. Results from the analysis of the physiochemical properties indicated that, majority of sampled milk were not fulfilled the required quality parameters of Ethiopia standard agency/FAO/EU. Milk physic-chemical composition is an indicator of the quality. The current quality situation of the milk in the study area in terms of physico-chemical and composition is at an alarming state, so it requires urgent action to reverse the situation.

The result of current study offered that, some of the microbial qualities were poor, as mediated from the high values of coliform count (CC), total bacterial count (TBC) and somatic cell count (SCC) which were higher than the recommended values of the national/international standards safety for human consumption. These microbial loads may be due to unhygienic condition milking and milk handling during transportation, use

of plastic containers and improper cooling system. In general, the result of this study indicated that urgent measures are needed to improve quality and safety milk production at urban dairy farmer's community level through promotion of good hygienic practices and adequate sanitary measures from production to consumption. Normally, physico-chemical, microbial, aflatoxinM1, qualities and safe of cow raw milk are important from the users' health point of view as well as for further processing of milk and milk products. These study result will also induce awareness in regulatory organization as well as publics to be assembled to monitor the standard regulation of milk compositions in every dairy farm.

6.2. Recommendations

Based on the findings, the following recommendations could be drawn

- Provision of urban dairy husbandry training and extension services should be improved for the better efficiency of the commercial urban dairy cattle production. Hence, the government should encourage the urban agriculture extension agents and experts through the provision of incentives such as fill skill gap by training, educational scholarships and a better salary to motivate them to provide effective training and extension service
- The high price of feed, feed raw materials and its unavailability at required amount and quality is becoming a threat for the sector. Thus, it needs government and private investors' participation in the establishment of technological supported crop production and feed processing centres, so as to provide a feed with a standard quality and a minimum price; an adequate.
- It is best to increase the biogas digester to deal with fuel shortages as well. The residue may be used to fertilize crops. Alternatives such as charcoal making and disposing in rural areas to fertilize crop farming can also be presented as part of a sustainable solution to the use of this important resource.
- Suitable housing with appropriate sanitation of the cow's barn to reduce mastitis disease.
- Large number of AI service was doing but less conception rate, this is increasing day open cow and decreasing production and reproduction. Thus the research institute and educational organization should give training for AI technicians and fill their skill gap for purpose of increasing production and reproduction.
- Provision of credit facilities from financial institutions with lower interest rates can play a significant role the expansion and improvement of the urban dairy farming
- From the present study aflatoxinM1 existence in milk is public health concern and hence all the efforts should be made to keep the levels below it is recommended

levels 0.05ppb. This need all-inclusive tactic and all the serious control points of entry of aflatoxin B1 into the feed chain has to be monitored and controlled.

- Create awareness of Aflatoxin B1 in feed related with feed storage condition, be sure that **‘today feed is tomorrow food.’**
- The outcomes of this study direct the requisite to implement improved sanitization practices and to apply effective monitoring throughout the production to end consumers.
- Avoid microbial contamination of the milk by using good sanitary milk equipment, milking environment, timely delivery at a milk collection and storage facility.
- After milking milk should be rapidly stored in below 4° temperatures to decrease microorganism multiplication.
- Further exploration and extension service is needed to illustrate critical quality points and hazards in order to ensure that good quality dairy products are produced and consumed.
- All actors along the milk value chain should be organized and regularly trained to increase their awareness on aflatoxin B1, aflatoxin M1, general milk handling, milk safety and quality and commercialization of milk.
- From this finding the less milk quality and safety observed will require further investigation on the status of urban dairy production, Aflatoxin B1 in feed, aflatoxin M1 in milk, milk microbial load, milk physico-chemical and transportation delivery of milk from the farm up to restaurant/cafeteria.

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8. APPENDIX

**Addis Ababa University, College of Veterinary Medicine and Agriculture
Department of Animal Production Studies
PhD Program in Animal Production**

URBAN DAIRY PRODUCTION PRACTICES AND ANALYSIS OF FEED AND MILK QUALITY AND SAFETY ACROSS VARIED VALUE CHAINS ACTORS IN OROMIA SPECIAL ZONE SURROUNDING FINFINNE, ETHIOPIA

Appendix A: Questioners

Name of the dairy farmer -----

Sub city-----

Woreda ----- kebele.....

Date of interview---/---/-----

A. Socio-economic characteristics

1. Sex of the respondent 1. Male 2. Female
2. Age of the respondent _____
3. Family size_____
4. Educational level of the respondent
 1. No formal education
 2. Primary education
 3. Secondary education
 4. Tertiary education
5. Marital status
 1. Married
 2. Unmarried
 3. Widows
6. Owners occupation
 1. Business & Dairy farm
 2. Civil worker & Dairy farm

3. Retired
 - 4 Dairy farmer only,
 5. House wife & Dairy farmer
7. Main sources of income
 1. Dairy production
 2. Salary
 3. Other Business
 4. Pension
 8. Sideline business
 1. Small business
 2. Civil servants
 3. None
 9. Experience in Dairy farming? _____ .
 1. Zero to one year 2. One to 3 years
 3. Three to 5 years
 4. More than 5 years
 10. When did you start Dairy rearing? _____ ?
 11. For what purpose do you raise dairy? -----
 1. Income generation
 2. For income and home consumption
 3. Home consumption
 4. Others, specify _____
 12. State the number or members of your family who care of Dairy _____ ?
 1. 1 person 2, 2-3 persons 3, More than 4 persons
 13. What is the name of dairy breeds you raise? _____
 14. The blood level of dairy breed you raise _____
 15. Where is your source of foundation stock? _____
 16. By which age classes you have started the dairy farm?
 1. Heifer
 2. after one parity

3, after 2nd parity

4, after 3rd parity

17. How many numbers of you have dairy cattle in your farm?

1. Lactation _____

2. Dry _____

3 Heifer _____

4 Pregnancy _____

18. Do you keep records? 1) Yes 2) No

19. Household labor allocation

Activities	Husband	wife	Young daughters	Young sons	Others, specify
Feeding					
Milk milking					
milk selling					
Input purchasing					
Cleaning					
Other activities,					

B. Housing

1. Type of house used for cattle?

1/ Free stall

2/ Lose type of housing

3/ Stanchion

4/ Other (Specify

2. What type of standing in housing system do you practice for your dairy rearing?

A Head to head housing system B. Teal to teal housing system

2. If you are using Head to head housing system, what are the main problems you faced in Head to head system?

3. If you are using teal to teal housing system, what are the main problems you faced in using this system?

4. Housing condition?

1. Share the same house with other livestock
2. Separate house entirely constructed for dairy cattle

5. Did you construct dairy cattle house based on recommended extension packages?

1. Yes 2 No

6. If no for Q.5, specify the reasons

1. _____ 3. _____
2. _____ 4. _____

7. How frequently do you clean? _____ How many times in day _____?

9. Do you provide individual pen in the dairy house? 1. Yes 2. No

10. Is there maternity pen in dairy house? 1. Yes 2. No

11 If no for Q.10, specify the reasons

12. Is it provides enough ventilation and light? 1. Yes 2. No

13. If no for Q.12, specify the reasons

C. Feeding and watering

1. What type of feed you provide for your dairy cattle?
 1. Purchased formulated feed
 2. Mixed at home
 3. Both
 4. Others, specify _____
2. When do you feed your cattle?
 1. Morning and evening
 2. Morning and afternoon
 3. Milking time only
 4. Free access
3. How do you feed your cattle?
 1. Put feed in Feeder individual pen
 2. Put feed in Feeder in group
 3. Others, specify _____
4. Where is the source of feed for your dairy cattle?
 1. Private feed manufacturer
 2. Governmental
 3. Purchasing the ingredients and mixing at home
 4. Others specify _____
5. What are the main problems in preparation of formulated feed by you?
 1. Lack of knowledge on how to prepare
 2. Cost of ingredients
 3. Unavailability of ingredients
 4. Others, specify _____
6. What are the main problems of purchased formulated dairy cattle feed?
 1. Low quality
 2. Price of feed
 3. Unavailability
 4. Others specify _____
7. How much amount of feed you provide per head per day? _____ kg/head/day or how

much kg of feed you provide for your herds per day_____.

8. Based on what you determine amount of feed for your animals?

1. Based on their body weight
2. Based on their milk production
3. Based on their body weight and milk production

9. Do you provide green feed to your Cattle? A. yes B .no

10. If yes for Q.9, How?

- 1 By cut and carry system
2. By grazing

11. Do you provide hay for your Cattle? A yes B no

12. If yes for Q.11, where is the source?

13. What is the source of water?

1. Hole water
2. River
3. Tap water
4. Pond water
5. If others (specify)_____.

14. How frequently do you provide water?

1. Free access
2. Morning only
3. Morning and evening only
4. Morning, afternoon and evening
5. If other (specify) _____

D. Disease and bio security measures

- 1. Do you experience serious disease outbreaks? 1. Yes 2.No
- 2. Describe the common diseases you have experienced in your farm.

Name of disease	Symptoms	Favorable seasons	Local Treatment/modern treatment

- 3. What do you do when animals fall to sick?
 - 1. Do you separate into isolation pen?
 - 2. Do you use milk of those animals?
 - 3. Do you milking in common parlor?
- 4. Do you practice annual vaccination of your cattle? 1. Yes 2. No
- 5. Is there mastitis disease in your farm? 1. Yes 2. No
- 6. Do you use anti-ectoparasites? 1. Yes 2. No
- 7. Do you practice deworming? 1. Yes 2. No
- 8. Do you have dedicated boots for the dairy house? 1. Yes 2. No
- 9. Are foot dips available at the entry of each dairy farm? 1. Yes 2. No
- 10. Do you have a Programme for parasite control? 1. Yes 2. No

E. Culling and mortality

- 1. Do you purposely cull your animal at any time? 1. Yes 2. No
- 2. What factors determine which dairy cattle you will cull?
 - 1. Poor productivity
 - 2. Old age
 - 3. Sickness

4. Other, specify-----

3. At what age of the cattle do you decide to cull and sell it? _____

F. Milk production performance

1. Production performance

Variables	
Milk yield at 1 st parity	
Milk yield at 2 nd parity	
Milk yield at 3 rd parity	
Milk yield at early lactation	
Milk yield at pick lactation	
Milk yield at late lactation	
Age at first parity	
Age at pick lactation	
Milk yield /day/ head	
Average milk yield in farm	
Number of lactation animals in farm	
No of mastitis animals in farm	
No of teat blocked/animals	
Length of lactation	
Calving interval	
No of pregnant animals	
No of culled from the farm	

E. Institutional support and extension services

1. Do you have access to extension services? 1. Yes 2. No

2. How frequently do you see the extension agent or the urban agricultural officers?

1. Once in a week
2. Once in two weeks
3. Once in a month
4. Not Seen

3. Have you ever discussed your dairy production and related problems with urban and Urban agricultural officers? 1. Yes 2. No
4. If you say No for Q.3, what are the reasons?
 1. Have no heard of them
 2. Cannot easily reach them
 3. There is no need
 4. If others (specify) _____
4. Is there any institutional support to your dairy farming? 1. Yes 2. No
5. If yes for question 4,
What kind of benefits obtained from the institution?
 1. Veterinary service
 2. Input supply
 3. Training
 4. Credit service
6. Have you ever got any training on dairy production? 1. Yes 2. No
7. If yes, for Q. 6. When?
 1. Before starting the business
 2. After the business started
8. If yes, for how long you took the training?
 1. Few days
 2. Few weeks
 3. One month
 4. Greater than 1 month
9. Training provided by
 1. Urban agriculture offices
 2. NGO\
 3. Other, specify _____

F. WASTE MANGEMT PRACTICES

1. What are the common wastes in your farm?

- 1. Manure 2. Feed leftover
- 2. Dust
- 3. Manure, feed leftover, dust
- 4. Other specify_____

2. What type of floor you used in your cattle house?

- 1. Cemented
- 2. Non-cemented
- 3. Others, specify_____

3. Household labor allocation in removing poultry waste

Activities	Husband	Wife	Young daughter	Young sons	Other, specify
Dairy cattle west removal					

4. How frequently you remove the manure?

- 1. Every day
- 2. Two times per day
- 3. Every week
- 4. Three times per week
- 5. Others, specify_____

5. How do you transport the manure of your farm?

- 1. Using hand
- 2. Wheel barrow
- 3. Others, specify_____

6. What kind of disposal methods you used to remove manure/litter?

- 1. Giving it to other farmers
- 2. Used it to fertilize their own garden farm
- 3. Disposed it in the dumping site

4. Marketing for use as a fertilizer

5. Others, specify_____

7. Are you using biogas? 1 yea 2 No

8. What are the major challenges of dairy waste disposal in your farm? List and rank them accordingly.

List	Rank(1-5)
1	
2	
3	
4	
5	
6	

9. What should be done for proper dairy waste management practice?

G. Constraints and opportunities

1. Do you face constraints in practicing urban dairy production? 1 Yes 2 No
2. If yes for Q 1. What are the main constraints? List and rank according to their importance

No	List the constraints	Rank (1-5)
1		
2		
3		
4		
5		
6		

3. If yes for Q 1, do you have problem in getting the land? 1. Yes 2. No
4. Do you have sufficient area of land to implement your activity? 1. Yes 2. No
5. Threats to urban dairy farming
 1. Displacement from residence
 2. Diseases 3. Increase in price of feed
 4. Compliant from neighbor's
 5. Big dairy farms market interference
 6. Others,

specify_____.

6. Do you intend to expand dairy production? 1. Yes 2. No
7. If yes, to what size? _____
8. What are your barriers to future expansion of dairy production?
 1. Lack of capital
 2. High price of feed

3. Shortage of land

4. Others, specify_____.

9. is there any regulation concerning the raising of dairy in your residential area? 1. Yes
2.No

10. If yes for Q 9, what type of regulations is this?

11. Have you get enough amount of feed supply? 1 yes 2. No

12. Have you get required amount of feed fed ingredients? 1 yes 2. No

13. What do you think the government should do to improve dairy keeping, particularly
in urban areas?

H. Record keeping

H1. Production records

1. Do you make production records of your farm? 1. Yes 2. No

2. If yes for Q1 on what basis you collected the records?

1. Daily basis

2. Weekly basis

3. Monthly basis

3. If yes for Q1. Why you keep the production record? Give reason

-

4. Do you record the number of milk produced per day? 1. Yes 2. no

5. Do you record the amount of feed given per day? 1. Yes 2. No

6. Do you record the type of drugs/vaccines given? 1. Yes 2. No

7. Do you record the number of calve born per day? 1. Yes 2. no

8. Do you record the number of calve mortality? 1. Yes 2. No

Appendix B: ANOVA Table of Feed Quality and aflatoxinB1 contamination of Feed
And Aflatoxin M1 Contamination of Milk.

	Mean	EM	SD	Variance
DM	898.6322	1.42122	13.48284	181.787
OM	799.1144	1.79966	17.07304	291.489
CP	133.2972	1.94304	18.43333	339.788
CF(fat)	39.8856	1.10923	10.52312	110.736
ME	1893.1160	37.79243	358.53045	128544.086
Starch	260.6833	21.46582	203.64269	41470.343
Ash	99.5178	1.44040	13.66482	186.727
Fiber	154.1544	3.05935	29.02351	842.364
Moisture	113.3333	10.00992	94.96247	9017.871
AFB1	22.4000	1.07006	10.15144	103.052
AFM1	0.0439	0.00166	0.01576	0.0000

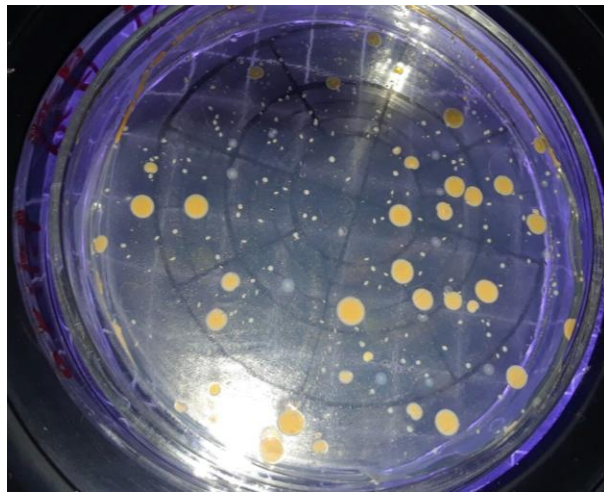
Appendix C: ANOVA Table of Physico-chemical characteristics of milk

Urban	Observation	Variable	Mean	Std.dv	Std. Error
Burayu	30	Titratable acidity	0.189666	0.0124522	0.0022735
	30	Fat	4.3300000	0.9283616	0.1694949
	30	protein	3.4482000	0.1962527	0.0358307
	30	SNF	8.0066667	0.4245999	0.0775210
	30	Specific gravity	1.0292667	0.0012015	0.000219369
	30	Added water	0.5769000	1.2191416	0.2225838
	30	Freezing point	-0.5603333	0.0190251	0.0034735
	30	Total solid	12.3366667	0.9941253	0.1815016
	30	Ash	0.7300000	0.0836660	0.0152753
	30	PH	6.4100000	0.1863441	0.0340216
	30	Lactose	3.8284667	0.4715143	0.0860863
Sebeta	30	Titratable acidity	0.1756667	0.0159056	0.0029040
	30	Fat	4.1060000	0.6386818	0.1166068
	30	protein	3.3186667	0.3346510	0.0610986
	30	SNF	7.7767333	0.6421731	0.1172442
	30	Specific gravity	1.0375000	0.0477253	0.0087134
	30	Added water	4.3106667	4.7898103	0.8744957
	30	Freezing point	-0.5526667	0.0315062	0.0057522
	30	Total solid	11.8827333	1.0668610	0.1947813
	30	Ash	0.7400000	0.0621455	0.0113462
	30	PH	6.2766667	0.1304722	0.0238209
	30	Lactose	3.7180667	0.4892983	0.0893332
Sululta	30	Titratable acidity	0.1873333	0.0332113	0.0060635
	30	Fat	3.4530000	1.5024214	0.2743034
	30	protein	2.8470000	0.3528226	0.0644163
	30	SNF	6.9913333	0.7350427	0.1341998
	30	Specific gravity	1.0260000	0.0064434	0.0011764
	30	Added water	10.0220000	8.1043579	1.4796465
	30	Freezing point	-0.4286667	0.2694533	0.0491952
	30	Total solid	10.4443333	1.9807360	0.3616313
	30	Ash	0.6966667	0.0850287	0.0155241
	30	PH	6.2433333	0.1040004	0.0189878
	30	Lactose	3.4476667	0.6038308	0.1102439

Appendix C: ANOVA Table of Milk Microbial Load Value Chain Actors in the Study Urban Area.

Urban	Source	Variable	Mean	Std.dv	Std. Error
Burayu	Farm	CC(log10cfu/ml)	3.7450000	0.0814112	0.0257445
		TBC(log10cfu/ml)	5.4530000	0.1935085	0.0611928
		YM(log10cfu/ml)	1.000	00	00
		SCC(log10cfu/ml)	5.2530000	0.1228414	0.0388458
	Collectors	CC(log10cfu/ml)	3.6160000	0.2076964	0.0656794
		TBC(log10cfu/ml)	5.3430000	0.0676675	0.0213983
		YM(log10cfu/ml)	1.00	00	00
		SCC(log10cfu/ml)	5.3620000	0.1342303	0.0424474
	Kaferia	CC(log10cfu/ml)	2.5910000	0.2354405	0.0744528
		TBC(log10cfu/ml)	5.2390000	0.0854335	0.0270165
		YM(log10cfu/ml)	1.000	00	000
		SCC(log10cfu/ml)	5.2740000	0.1550054	0.0490170
Sebeta	Farm	FCC(log10cfu/ml)	3.9330000	0.4456718	0.1409338
		TBC(log10cfu/ml)	5.7700000	0.9059924	0.2865000
		YM(log10cfu/ml)	1.00	00	000
		SCC(log10cfu/ml)	5.2190000	0.1252952	0.0396218
	Collectors	CC(log10cfu/ml)	7.1670000	2.1554688	0.6816191
		TBC(log10cfu/ml)	6.3940000	1.1231424	0.3551688
		YM(log10cfu/ml)	1.00	00	00
		SCC(log10cfu/ml)	5.3400000	0.1569147	0.0496208
	Kaferia	CC(log10cfu/ml)	6.4670000	1.8418653	0.5824489
		TBC(log10cfu/ml)	7.4320000	0.8906402	0.2816452
		YM(log10cfu/ml)	1.00	00	00
		SCC(log10cfu/ml)	5.3270000	0.1751222	0.0553785
Sululta	Farm	FCC(log10cfu/ml)	2.7800000	0.7079705	0.2238799
		TBC(log10cfu/ml)	4.8170000	0.7004768	0.2215102
		YM(log10cfu/ml)	1.00	00	00
		SCC(log10cfu/ml)	5.3150000	0.0632895	0.0200139
	Collectors	CC(log10cfu/ml)	6.4200000	1.0750917	0.3399739
		TBC(log10cfu/ml)	6.7150000	0.9045594	0.2860468
		YM(log10cfu/ml)	1.00	00	00
		SCC(log10cfu/ml)	5.4390000	0.1718171	0.0543333
	Kaferia	CC(log10cfu/ml)	6.1600000	1.4950957	0.4727908
		TBC(log10cfu/ml)	7.7400000	1.2138003	0.3838373
		YM(log10cfu/ml)	1.00	00	00
		SCC(log10cfu/ml)	5.3810000	0.1118978	0.0353852

Appendix D1: Image of Coliform bacteria in raw milk in the study area



Appendix D2: Image of somatic cell count in raw milk in the study area

