ADDIS ABABA UNIVERSITY

COLLEGE OF VETERINARY MEDICINE AND AGRICULTURE

VALUE CHAIN AND QUALITY OF MILK IN SULULTA AND WELMERA WEREDAS, OROMIA SPECIAL ZONE SURROUNDING ADDIS ABABA, OROMIA, ETHIOPIA

BY

MUSTEFA ABU KUFFA

JUNE, 2012

DEBRE ZEIT, ETHIOPIA

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A thesis submitted to the School of Graduate Studies of Addis Ababa University in partial fulfillment of the requirements for the Degree of Master of Science in Tropical Animal Health and Production

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LISTS OF ABBREVIATIONS

AI	Artificial Insemination
CSA	Central Statistical Authority
^0C	Degree Celsius
DDE	Dairy Development Enterprise
ECSA	Ethiopia Central Statistical Authority
FAO	Food and Agricultural Organization of the United Nations
FAOSTAT	Food and Agricultural Organization of the United Nations Statistics
GDP	Gross Domestic Product
ILCA	International Livestock Center for Africa
IPS	International Project Service
Km	Kilometer
Lit.	Liter
m.a. s.l	Meter above sea level
mm	Millimeter
RMA	Rapid Marketing Appraisal
SDDP	Smallholders Dairy Development Programme
SLRDHO	Sululta Livestock Resource, Development and Health Office
SPSS	Statistical Package for Social Sciences
TCP	Technical Cooperation Programme
TLU	Tropical Livestock Unit
UHT	Ultra Heat Technology
USD	Unit stats of American Dollar
WFP	World Food Programme
WLRDHO	Welmera Livestock Resource, Development and Health Office

ABSTRACT

Milk value chain and quality of milk were assessed in selected areas of Oromia special zone surrounding Addis Ababa from September 2011to April 2012. A total of 180 randomly selected market-oriented smallholder dairy farmers were involved in a cross-sectional study that was carried out by way of questionnaire survey, rapid market appraisal, farm inspection and group discussion. The overall mean family size of respondents in this study was 5.63 ± 1.926 persons with average livestock holding per household of 23.93 ± 11.755 animals. Cattle were the predominant species representing 84.3% of the total TLU. The average number of lactating cows owned by the respondent farmers was 1.76 ± 0.920 local and 2.79 ± 3.445 cross bred animals. Average daily milk yield of crossbred and local milking cows were 9.11 ± 2.902 and 1.889 ± 0.6707 liters respectively. Overall mean lactation lengths of crossbred and local milking cows were 9.7 ± 0.46 and 6.26 ± 0.6624 months. Sixty milk samples were collected and the analysis of microbiological and physiochemical were carried out. The overall mean chemical compositions of milk for fat (%), protein (%) and solids not fat (%) contents were 3.5693 ± 0.10892, 2.9646 ± 0.04621 and 6.9632 ± 0.12175 in bulk Tank milk samples. The overall mean microbiological count of log (TBC cfu/ml), log (CC cfu/ml) and log (SCC/ml) of raw milk was 8.2285 ± 0.10041, 3.3363 ± 0.10010 and 5.1622 ± 0.07382, respectively. The proportion of raw milk used for household consumption was relatively small (5%). The major part (86%) of milk produced by smallholders is destined to market. The main outlets for raw milk identified were cooperatives (55.6%), processors (20.0%), vendor (20.0%), directly to consumer (2.8%) and hotels/restaurants (1.7%). Price variations (cited by 87% of the respondents), lack of fair market (72.2%), lack of demand during fasting (49.4%), lack of preserving facilities, and absence of quality based payment and no/less say in deciding milk price by producers were the major problems of raw milk marketing.

Key words: - Coliform, Milk, physicochemical, Total bacteria.

1. INTRODUCTION

Ethiopia has a huge potential to be one of the key countries in dairy production for various reasons (Pratt *et al.,* 2008). These include a large population of milk cows in the country estimated at 9.9 million (CSA, 2008), a conducive and relatively disease free agro-ecology, particularly the mixed crop–livestock systems in the highlands that can support crossbred and pure dairy breeds of cows (Ahmed *et al*. ,2003), a huge potential for production of high quality feeds under rain fed and irrigated conditions, existence of a relatively large human population with a long tradition of consumption of milk and milk products and hence a potentially large domestic market (Holloway *et al*., 2000).

According to FAOSTAT (2007), among the 20 major food and agricultural commodities ranked by value in 2005, whole fresh cow milk is ranked third. Milk production in the same year was estimated at 1.5 million tones which is equivalent to USD 398.9 million (FAOSTAT, 2007). Dairy production, among the sector of livestock production systems, is a critical issue in Ethiopia where livestock and its products are important sources of food and income, and dairying has not been fully exploited and promoted in the country. The estimated human population of Ethiopia in 2006 was 79.4 million (The Economic Intelligence Unit, 2007), with an overall density of 67 persons per km^2 (Edmond, 2007). The population is comprised of 61.369 million rural (84%) and 11.675 million urban (16%), and the overall annual population growth is estimated at 2.78% (ECSA, 2005).

Dairy production as a biologically efficient system that converts large quantities of roughage, the most abundant feed in the tropics, to milk, the most nutritious food. The dairy industry also occupies a special position among the other livestock sectors due to four interrelated features (Perera, 1999). The first factor is related to the specific properties of milk in that it is a bulky and heavy commodity, which is produced on a daily basis. Secondly, the socio-economic position of the majority of the farmers involved is small-scale producers, with a weak and vulnerable position on the market. Thirdly, dairy cooperatives hold a strong position in milk marketing and processing. The fourth and final feature is the fact that milk is a very valuable but an extremely expensive raw material to make a wide range of products. Among the interrelated features of dairy industry, one of the necessary conditions for increased milk production is the provision of assured market outlets that are sufficiently remunerative to producers.

A number of fundamental constraints underlie these outcomes, including traditional technologies, limited supply of inputs (feed, breeding stock, artificial insemination and water), poor or non-existent extension service, high disease prevalence, poor marketing infrastructure, lack of marketing support services and market information, limited credit services, absence of effective producers' organizations at the grass roots levels, and natural resources degradation (Berhanu *et al*., 2006). In addition, policy decision on milk and milk product marketing are taken in the absence of vital information on how they affect dairy producers, traders, exporters, and consumers. Similarly, current knowledge on dairy product market structure, performance and prices is poor for designing policies and institutions to overcome the perceived problems in the marketing system (Ayele *et al.,* 2003).

Traditional farmers sell their raw milk informally due to absence of organized marketing network that has made the produced milk unable to reach the consumer. Further losses incurred are quality losses by storing in unclean storage utensil, which is prone to high microbial contamination. Losses in spillage and contamination occur where handling during and after milking are traditional and care is not satisfactory. Additionally the trade in the sub-sector is constrained by various structural, production, information exchange, and promotional problems, as well as financial constraints.

1.1. Objectives

1.1.1. General objective

To assess value chain and quality of milk in selected areas of Oromia special zone surrounding Addis Ababa.

1.1.2. Specific objectives

1. To assess the value chain of raw milk through identifying marketing actors in the study area.
2. To determine the quality of milk at smallholder level in the study area.
3. To identify key milk marketing constraints in the study area.

2. REVIEW OF LITERATURE

2.1. Husbandry practice

2.1.1. Feeding of dairy animal

The major feed resource for ruminants in the tropics and sub tropics encompasses natural pasture, crop residues and agro- industrial by products. Besides forage legumes and concerned forage complement the total ruminant feed in most of the region (Falvey and Chantalakhana, 1999).

Conventional forage crops are not common among smallholder farmers. Only large private and state farms produce a limited amount of cultivated forage (Zinash *et al*., 1996). According to Getnet (1999), grasses (oats and Napier grass), herbaceous legumes (vetch, alfalfa, and native clovers), browse trees and fodder beet are grown by farmers in Selale and Sheno areas of Ethiopia. Browse trees are mainly grown along the fence lines and in the backyard nevertheless their utilization, as livestock feed was restricted. This is because the available forage quantity was small and farmers were not well acquainted with the proper utilization of these forage crops. Some farmers in their back yards grow fodder beets as a dry season supplement for dairy cows. Crossbred cows managed under smallholder farm management condition have low body weight during the rainy season but showed a tendency of gaining and improvement during dry season in the Selale highland of Ethiopia because of the low dry matter intake during the rainy season (Solomon, 1996). Oats are an excellent feed for dairy cattle and should be used in the ration depending on its availability (Etgen and Reaves, 1978).

Hay is the commonly used feed stuff in central highlands of Ethiopia. However, the composition and nutritive value of hay collected from various agro-ecological zones of Ethiopia are characterized by low crude protein, high neutral detergent fiber and low invitro organic matter digestibility (Seyoum and Zinash, 1989). Crop residue is becoming important source of feed in smallholder dairy production systems. Crop residues are characterized by low metabolize energy (less than 0.5 MJ/kg DM), and low crude protein content (less than 60gm/kg DM) (Seyoum and Zinash, 1989); but high cell wall constituents.

2.1.2. Artificial inseminations

Selection for higher milk yield through culling of inferior cows and selection of young bulls on dam‘s yield and body conformation is the origin of animal breeding (Falvey and Chantalakhana, 1999). Selection of crossbred cattle is suitable for smallholder dairy production system. Results from cross breeding research program aimed at comparing different combinations of indigenous zebu and exotic breeds identified that Friesian, Simmental and Jersey crosses with exotic inheritance of 50-62.5% are appropriate for smallholder dairy production in Ethiopia (Tesfaye *et al*., 2004).

Among the mating methods, AI is the one that has so far made the greatest impact on animal genetic improvement. The use of AI has contributed much more in both the control of disease and genetic improvement. AI is currently in use in only few areas in Ethiopia. Smallholder dairy farms prefer AI to natural mating, but the unavailability of the AI services regularly forces them to use natural mating (Mekonnen *et al*., 2006).

2.1.3. Veterinary service)

Market oriented smallholder dairy farms, in general, have access to veterinary services due to the income they get from the sell of milk that allows them to cover veterinary costs. Seifert (1991) also reported that smallholders get better animal health care services than the rural areas. Smallholder dairy farms vaccinate their animals against major disease like anthrax and blackleg (Mekonnen *et al*., 2006).

Most animals have a certain amount of internal parasites. Severe worm infestation, however, causes a severe drop in milk production and growth. In hot and humid areas it is almost essential to de-worm livestock regularly (Sastry and Thomas, 1981).

2.1.4. Housing

It is very important to provide appropriate conditions for rearing dairy cows in the tropics by reducing the extreme effects of climate such as heat and moisture. Good housing and layout of the farm can reduce stress. Environmental control improves milk production by reducing stress and disease hazards, also making management easier. In conjunction with a good herd health management program, housing can be a main determinant of productivity (Falvey and Chantalakhana,1999). Traditional livestock husbandry practices across the Ethiopian highlands are more or less similar to each other. Livestock are kept in a ―corral” during the night. During the daytime, they are herded on communal pasture, private grazing lands or in stubble depending on the season (Getachew *et al.,* 1993). Improved types of housing constructed from locally available and cheap materials are used mainly by urban and peri-urban smallholder dairy farmer

2.2. Milk production system in Ethiopia

Livestock are raised in all of the production systems of Ethiopia by pastoralists, agro-pastoralists, and crop/livestock farmers (Ahmed *et al.,* 2003). Milk production system can be broadly categorized in to three systems, based on marketing situations, such as urban, peri-urban and rural milk production system (Tsehay, 2002). The main source of milk production in Ethiopia is from the cow, but small quantities of milk obtained from goat and camel is also used in some regions particularly in pastoralist areas (IPS, 2000).

2.2.1. Urban milk production system

This system is developed in major cities and regional towns, which have a high demand for milk, and they are a largest source of milk producer. A total of about 5167 small-medium and large-scale dairy exist in and around Addis Ababa. Total milk production from these dairy farmers‘ amounts to 34.649 million liters per annum of this total 73% is sold, 10 % is left for household consumption, 9.4% goes to calves and 7.6 % is processed, mainly in to butter and cottage cheese (Azage and Alemu, 1998). In this system milk is a means of additional cash income. Most of the improved dairy stock in Ethiopia is used for this production system. One of the largest sources of milk in Addis Ababa/regional towns is that from intra-urban milk producers. The producers deliver milk to consumers or consumers may collect it at the producers‘ gate. Studies indicate that in terms of volume, 71% of intra-urban producers sell milk directly to consumers (Tsehay, 2001).

2.1.2. Peri-urban milk production

This system includes smallholder and commercial dairy farmers near Addis Ababa and other regional towns (Ahmed *et al.,* 2003). Most of the improved dairy stock is used for this type of dairy production. Currently small holder farmers‘ milk marketing units, the DDE (Dairy Development Enterprise), Mama agro-industry (Sebeta Agro-Industry), and private dairy farmers in and around Addis Ababa are supplying milk as shown in the Table 1(to Addis Ababa) to the city market (Tsehay, 2002). Generally, the primary objective of this milk production system is to sale milk as a means of additional cash income (Tsehay, 2002). This production system is now expanding in the highlands among mixed crop–livestock farmers, such as those found in Selale and Holetta, and serves as the major milk supplier to the urban market (Gebre Wold *et al*., 2000).

Table 1.Annual Milk Supply to Addis Ababa

Supply Sources	Amount in litres
Addis Ababa urban dairy farmers	45,243,000
DDE (now renamed as LAME Dairy)	4,500,000
Sebeta Agro-Industry (Mama)	8,760,000
Individual Milk Collectors	4,000,000
Other suppliers	2,000,000
Total	65,503,000

Source: Teferra A. (2006)

2.1.3. Rural milk production system

This dairy system is part of the subsistence farming system. According to Staal and Shaprio (1996), it is the predominant production system accounting for over 97% of national milk production. This system includes pastoralists, agro-pastoralists, and crop-livestock producers. Largely, the system is based on low producing indigenous breeds of zebu cattle. Pastoralism is the major system of milk production in lowlands. However, because of the low rainfall, shortage of feed and water availability, milk production is low and highly influenced by season (IPS, 2000; Tsehay, 2002). The system is not market oriented and most of the milk produced in it is retained for home consumption (Ahmed *et al.,* 2003) or household processing.

The level of milk surplus is determined by the demand for milk by the household and its neighbours, the potential to produce milk in terms of herd size and production season, and access to a nearby market (Getachew, 2003). The surplus is mainly processed using traditional technologies and the processed milk products such as butter, ghee, cottage cheese and sour milk are usually marketed through the informal market after the households satisfy their needs (Tsehay, 2001). The majority of these farms maintain small herds, and hence the volume of dairy products they handle at a time is very small.

2.3. Milk processing

In areas where the climate is hot and humid, the raw milk is spoiled easily during storage. Therefore, the smallholder with non-access to the modern preservative and cooling mechanism should seek products with a better shelf life by converting milk in to a more stable product like yoghurt, cottage cheese butter and ghee or by treating it with traditional preservatives (Getachew, 2003). Traditionally there are different types of plants used for smoking and cleaning of milking, storing, processing and marketing utensils in different parts of the country. In semi-arid pastoral system of Ethiopia, the most commonly used smoking plants are *Acacia nilotica*, *Cordia glarfa*, and *Cordia ovalis*. In Eastern Showa zone of Oromia region, about 53.3% of the women in Lume district used ―Guftee” (*Sida cuneifolia)* and ―Hiddii hooiotaa” (*Cucumis prophetarus*) leaves to clean the milk vessels and processing, while about 47 % and 40 % of the women in Adami Tulu and Arsi Negelle, respectively used ―Kosorata” (*Ocimum hardiense*). ―Ejersa” (*Olea Africana)* is the most frequently used plant for smoking milk vessels followed by *Juniperous procera* and *Ocium hardienes* (Lemma *et al.,* 2005)

Modern milk processing technologies in Ethiopia are emerged in the development of dairy sector. These technologies distributed around different parts of the country with different potential capacity. Currently the potential capacity of the DDE/LAME milk processing plant (60 ton/day) is not fully utilized. Data from ten years performance (1991 to 2000) indicate an annual processing average of 4,703.8 ton. Maximum utilization of the processing capacity of the plant was reported in 1981/82 with 52.8% while the lowest was in 1992/93 with 9.9% utilization. Over the periods 1981/82 to 1995/96 average intake was 33.5%. Sources of milk for processing were 44.1% from own production, 44.7% from farms other than its own and the rest 11.2% from powdered milk utilization. Powdered milk utilization was for years 1991 to 1997, the highest utilization being from 1991 and 1992 (Getachew F. and Gashaw G., 2001).

Other than DDE/Lame a number of small-scale and a few medium and large scale private dairies are operating around Addis Ababa and other urban areas. These small-scale processing enterprises use their own milk from the peri-urban farms for processing. The major commercial processors are Sebeta/ Agro-industry in Addis Ababa milk shed area and Dire dairy Ltd. in Dire Dawa. Sebeta Agro-industry with a brand name of ‗Mama‘ milk is pasteurizing milk and manufacturing dairy products from its farm and collects milk in Sebeta, Sululta-Fiche and Debrezeit milk shed areas. The capacity of the dairy is 30 ton per day and it is reported that current processing throughput is on average 8 tons per day (personal communication). It has milk-chilling centers in three sites along its collection routes and within Addis Ababa. Dire dairy Ltd. known as ‗Hamdael‘ is operational in Dire Dawa Region with a homogenizing plant for whole milk and uses milk from its own farm only. Dinsho Agro-industry, through its affiliated Din System PLC, had temporarily started a milk processing activity in Sebeta area, which was not widely commercialized. To date Dinsho dairy plant is not functional.

Table 2. Major dairy processing plants and their production capacities

No	Name of the processing enterprise	Year of establishment	Brand	Daily production capacity in liters: No of working shifts	Daily production capacity in liters: Total production per day	Current attained average capacity
1	Lame dairy processing	2008	Shola	1	30000	20000
2	Sebeta Agro-industry	1998	Mama	1	40000	29000
3	MB plc	2003	Family	2	10000	5000
4	ADA Dairy cooperatives		Ad‘a	2	15000	7500
5	Genesis Farm	2001	Genesis			
6	Lema dairy	2004	Lema	2	10000	3000
7	Bora	2008	Bora	1	2500	1000

Source: Getnet H. (2009)

2.4. Milk marketing in Ethiopia

Marketing milk stimulates production, raise dairy farmers' income and living standards and create employment in rural areas. Provision of improved and sustainable milk marketing arrangements in villages is therefore important in the aspiration for advancement of the sector. The Ethiopian milk marketing system is not well developed. This is reflected where only 5 percent of milk produced in rural areas is marketed as liquid milk. This has resulted in difficulties of marketing of fresh milk where infrastructure especially transportation facilities are extremely limited and market channels have not been developed. In the absence of an organized rural fresh milk market, marketing in any volume is restricted to the urban and peri-urban areas (Getachew, 2003). As is common in other African countries (e.g., Kenya and Uganda), dairy products in Ethiopia are channeled to consumers through both formal and informal dairy marketing systems (Mohammed *et al*., 2004).

2.4.1. Formal and informal milk marketing

Until 1991, the formal market of cold chain, pasteurized milk was exclusively dominated by the DDE (Dairy development Enterprises)/Lame which supplied 12 percent of the total fresh milk in the Addis Ababa area (Holloway *et al*., 2000). The DDE/Lame remains the only government enterprise involved in processing and marketing dairy products. The survey result conducted by Mohammed *et al*. (2004) revealed that in addition to DDE, several private milk-processing plants have been established in Addis Ababa, two of which Sebeta Agro Industry and Dinsho dairy industries have already started marketing their products. Although their share of the market is still small compared to DDE.s, the entry of private firms in the formal milk market is a significant development indicating the profitability and potential of private investment in dairy in Ethiopia and that the policy environment is facilitating such entry.

Formal milk markets are particularly limited to peri-urban areas and Addis Ababa. The formal market appears to be expanding during the last decade with the private sector entering the dairy processing industry in Addis Ababa, Dire Dawa and Dessie towns.

The Lame Dairy (formerly DDE), collects milk for processing from different sources, including large commercial farms and milk collection centers that receive milk from smallholder producers. The enterprise operates 25 milk collection centers located around Addis Ababa, of which 13 located around Selale, 5 around Holetta and 7 around Debre Brehane. Ten private milk processing plants have entered the milk marketing and processing, increasing the amount of milk channeled via the formal markets. Sebeta Agro Industry established the first UHT dairy processing facility in the country. The new production lines will produce 500ml carton pouches (Tetra Fino Aseptic) and 250ml portion packages (Tetra Brik Aseptic). The DDE, now LAME, produces pasteurized milk in 500ml plastic pouches. The introduction of UHT dairy products on the market is a great step forward to offset the seasonality in milk production and consumption. Share of milk sold in the formal market is insignificant in Ethiopia, less than 2%, compared to 15% share in Kenya and 5% in Uganda (Muriuki and Thorpe, 2001).

UHT products are aseptically processed and packaged, which gives them a shelf life of 6-12 months without the need for cooling during storage and transportation. The formal milk marketing systems are dominated by a government enterprise called the Dairy Development Enterprise (DDE), which has established numerous collection centers that buy milk at a uniform government controlled price that requires no minimum delivery. In 1992-1993, the DDE supplied 12 percent of total fresh milk sales in Addis Ababa (Holloway *et al*., 2000). The DDE is concerned primarily with liquid milk marketing although it does make some cheese and yoghurt in its Addis Ababa processing plant. At present, the formal market consists of Shoal Dairy Development Enterprise/Lame and Mama Dairy Agro Industry at Sebeta (Getachew, 2003).

In the informal market, milk may pass from producers to consumers directly or it may pass through two or more market agents. The informal system is characterized by no licensing requirement to operate, low cost of operations, high producer price compared to formal market and no regulation of operations. In Ethiopia, 95% of the national milk is marketed through informal channels and is unprocessed. The traditional processing and marketing of dairy products, especially traditional soured butter, dominate the Ethiopian dairy sector. Only 5% of the milk produced is marketed as liquid milk due to underdevelopment of infrastructures in rural areas. Hence, the informal (traditional) market has remained dominant in Ethiopia. Production is non-market oriented and most of the milk produced is retained for home consumption (Tsehay, 2001).

In recent years, promotional efforts have focused on dairy marketing. Milk marketing cooperatives have been established by the SDDP (Smallholders Dairy Development Program) with the support of Finnish International Development Association. These groups buy milk from both members and non-members, process it and sell products to traders and local consumers. The units also process milk into cream, skim milk, sour milk, butter and cottage cheese. The number of these milk cooperatives reached to 32 in total, 2 established by FAO/TCP (Technical Cooperation Programme) and World Food Programme (WFP) while 30 by SDDP (Tsehay, 2001). Setting up a new dairy cooperative would clearly reduce the travel time to group, and the actual number of households that would benefit depends on local population densities. It is also important to keep newly emerging milk groups small and geographically limited to ensure proximity and avoid large groups that would tend to increase average travel times (Holloway *et al.*, 2000).

Another study showed that the creation of new market outlets for fluid milk brought major improvement in the production, marketing and consumption behavior of small dairy households. The new marketing outlets may also promote involvement in more intensive dairying (Nicholson *et al.*, 2000). Furthermore, cooperatives, by providing bulking and bargaining services, increase easy access to market and help producers avoid hazard of being encumbered with a perishable product. In short, participatory cooperatives are very helpful in overcoming access barriers to asset, services and markets within which smallholders wish to produce high value items.

2.4.2. Marketing channels

Marketing channels are routes through which products pass as they are moved from the farm to the consumer. In any marketing system, various actors participate in marketing of commodities and process of transactions made. These include itinerate /mobile traders, semi-whole sellers, retailers, cooperatives and consumers. Itinerate/mobile traders purchase commodities from nearby market points and sell at business site or residences. Whereas, retailers are market intermediaries such as supermarkets, small and large –scale retailers who perform the function of retailing. Semi-whole sellers are important commodity market intermediaries who perform the function of both retailing and whole selling depending on the market conditions. Cooperatives are common form of collective group of producers. They are milk outlets that are potential catalysts in markets by providing bulking and bargaining services, increase outlet market access and help farmers avoid the hazards of being encumbered with a perishable product with no rural demand. In short, participatory cooperatives are very helpful in overcoming access barriers to assets, information, services, and indeed, to the markets within which smallholders wish to produce high value items (Holloway *et al*., 2000).

Cooperative marketing is based on the premise that a group of producers can achieve better results by combining their efforts and resources than operating separately. The final/destination link in any commodity marketing chain is consumer. Terms related to marketing outlets, marketing channels, and marketing chains are important to describe milk marketing systems (Sintayehu *et al.,* 2008). Marketing outlet is the final market place to deliver the milk product, where it may pass through various channels. A network (combination) of market channels gives rise to the market chain.

Marketing survey in Hawassa, Shashemane and Yergalem depicted that milk producers sold milk through different principal marketing channels (Woldemichael, 2008). These included:

- Producer-consumer (P-C) channel- involves direct sales to individual consumers accounting for 21%, 4.7% and 23.7% of total milk marketed per day in Hawassa, Shashemane and Yergalem, respectively.
- Producer → Retailer → Consumer: The channel represents average of 43% of milk marketed per day in the milk shed. This channel represents for 16%, 38% and 76.6% of total milk marketed per day in Hawassa, Shashemane and Yergalem, respectively.
- Producer → Semi-whole seller → Retailer →Consumer: This channel was identified to be operational only in Hawassa where milk semi-whole sellers undertake both retailing and wholesaling activities.
- Producer → Cooperative → Retailer →Consumer: This channel account for 2.2% and 46.9% of total milk marketed per day in Hawassa and Shashemane, respectively.
- Producer → Cooperative →Consumer: This channel was exceptional for Shashemane and Hawassa where milk cooperatives are found and accounts for 0.81% and 10.67% of total milk marketed per day in Hawassa and Shashemane, respectively.

2.4.3. Value chain; definition and importance

The value chain describes the full range of activities which are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumer, and final disposal after use (Kaplinsky, 2001). For at least twenty years now, there have been systematic attempts in English-, German-, and French-speaking schools of thoughts, to describe and analyze the vertical integration and disintegration of production and distribution processes. A great many terms were used in this connection, in part with identical and in part with varying meanings.

Value chain analysis addresses the nature and determinants of competitiveness, and makes a particular contribution in raising the sights from the individual enterprise to the group of interconnected enterprises. By focusing on all links (actors, enterprises, processes) in the chain and on all activities in each link, value chain analysis helps to identify which activities are subject to increasing returns, and which are subject to declining returns.

Global Commodity Chains (GCC): the term "Global Commodity Chain (GCC)" was introduced in the mid 1990s (Gereffi, 2001). Gereffi is focusing on the power relations in the coordination of globally dispersed, but linked, production systems. He has shown that generally commodity chains are characterized by a leading party or parties that are determining the overall character of the chain. Gereffi differentiates between "producer-driven" and "buyer-driven" global commodity chains. Capital and technologyintensive industries such as automobiles, aircrafts or computers are typical examples for
"producer-driven" global commodity chains, while labor-intensive industries such as consumer electronics or food production are examples for "buyer- driven"-chains. For the latter the specifications are supplied by the large retailers or marketers that order the goods. The four core elements of the GCC approach are the international dimension, power or governance, coordination and organizational learning. The main hypothesis of the GCC is linking up with the most significant "lead-firms" in an industry. Lead firms are distinguished from subordinated companies in terms of access to major resources (e.g. product design, brand names or consumer demand).

World Economic Triangle: A concept pointing out that the combination of strong local linkages within global commodity chains might bring upgrading prospects for regions in developing countries; and thus is an approach for showing the importance of linking vertical (chains) and horizontal (clusters) integrations. Other authors (Humphrey *et al.*, 2001) are pointing out that the combination of strong local linkages within global commodity chains might bring upgrading prospects for regions in developing countries. The concept of the "world economic triangle", where actors, governance and regulation systems are determining the scopes of action open to regions in the global commodity chains. He determined six critical aspects in any economic triangle; these are Actor constellations, Interests, Power structures, Situational mindsets, Action orientation and Trust.

2.5. Physicochemical property of milk

Chemical composition of milk is variable and influenced by intrinsic factors like breed, species, stage of lactation, external factors like environmental stress, changes in feeding, etc. Milk composition and production are the interaction of many elements within the cow and heir external environments (O'Connor, 1994). However, it is generally accepted that the dairyman can alter many of these factors to achieve milk production and increase profit. The major factors affecting milk composition are; Breed and species, feeding regime, stage of lactation, age of lactions and interval between milking.

2.6. Bacteriological quality tests

Sanitary methods of handling milk must be strictly adhered to rigidly in order to provide safe milk for human consumption. Furthermore, since milk is a good growth medium, even a small number of non pathogens can multiply considerably if the milk is not kept refrigerated. Because the consumer has no way of knowing whether or not the milk delivered to the home or purchased in the store is contaminated, a number of standard tests are carried out periodically on milk in that area. From the results of these tests, milk is classified into grades designated as A, B, and C (Volk and Wheeler, 1980). Tests commonly employed to determine the quality of milk include Standard plate count and Coliform count.

2.6.1. Standard plate count (SPC)

The standard plate count of raw milk gives an indication of the total number of aerobic bacteria present in the milk at the time of pick up. Obviously, very clean milk will have lower bacterial counts than milk collected or handled under unsanitary conditions. The standard plate count is a basis for grading milk (Volk and Wheeler, 1980).As Kurawijilla *et al.* (1992*)* reviewed bacterial count graded in to very good, good, fair and poor when not exceeding 200,000, 200,000-1,000,000, 1,000,000-5,000,000 and greater than 5,000,000 respectively. Milk samples are plated on standard plate count agar media and then incubated for 48 hrs at 32 ^{0}C to encourage bacterial growth. Single bacteria or clusters grow to become visible colonies that are then counted. All plate counts are expressed as the number of colony forming units (cfu) per milliliter (Murphy, 1996).

This method is used mainly to estimate the bacterial population of raw milk prior to heat treatment. It has a limited value in that it doesn't indicate the quality of microbial populations in terms of pathogens and non pathogens (Teka, 1997). The standard plate count is generally accepted as the most accurate and informative method of testing bacteriological quality of milk (Kurwijilla *et al*., 1992; Bekele and Bayileyegn2000). Plate count standards have been developed to ensure satisfactory production hygiene and that the product is safe. The plate count method has been conducted as a valuable adjunct to guide sanitarians in correcting sanitation failures and improving milk quality (IDF, 1990).

2.6.2. Coliform count

The coliform group of bacteria comprises all aerobic and facultative anaerobic, grams negative, non spore-forming rods that are able to ferment lactose with production of acid and gas at 30^{0}C within 24 hours. Coliforms comprise the genera *Escherichia, Enterobacter, Citrobactor and Kelbsiella.* In proportion to the number present, existence of any of these types in dairy products is indicator of unsanitary conditions or practices during production, processing or storage. Bekele and Bayileyegn (2000) reported that dairy hygiene is given less serious attention in Ethiopia. They also reported that exogenous sources of milk contamination with bacteria are very common.

2.7. Somatic cell count (SCC)

Somatic cells are composed of white blood cells (WBC) and occasionally sloughed epithelial cells. Cells found in normal cattle milk from uninfected glands include neutrophils (1.1%), macrophages (66.68%), lymphocytes (10-27%) and epithelial cells (0-7%) (Larsen, 2000).When bacteria invade and colonize the mammary gland, the macrophages respond by initiating the inflammatory response that attracts polymorphonuclear cells (PMN) in to the milk to engulf and destroy bacteria. More than 90% of SCC in infected glands is composed of neutrophils. The cells can be counted by a direct microscopic method on stained milk smears. The most commonly used automated device for rapid determination of SCC in milk samples is the fossomatic milk cell counter. This instrument stains cells with a fluorescent dye and then counts the number of fluorescing particles (Schalm *et al*., 1971).

Monitoring udder health status is an important principle of mastitis control. A regular quantitative assessment of udder health status is available through the use of SCC data. The practical use of SCC data to determine cow infection status requires the selection of a threshold level (Radostitis *et al.,* 1994b). Dohoo and Meek (1982), however, stressed that somatic cell counts are general indicators of udder health which are subject to many factors including age, stage of lactation, season, stress and management. The basic patterns of change over lactation remain the same in health or mastitic cows (Auldist *et al*., 1995). However, Harmon (1994) argued that marked increases in SCC are a result of cells being attracted to the mammary tissue because of direct mediators produced during a local infection; events that do not affect udder healthy are unlikely to have a direct or dramatic effect on SCC. According to him little evidence exists other than normal diurnal variation any factor did not have a major influence on SCC in the absence of intra-mammary infection. At present a threshold of 100,000 cells/ml can be assumed an internationally accepted definition of udder health (Hamann, 2003). Less than 200, 000 cells/ml for cow and less than 130,000 cells/ml for bulk tank milk were reported by Larsen (2000).

2.8. Common challenges and constraints of dairy production and marketing in Ethiopia

Challenges and problems for dairying vary from one production system to another and/or from one location to another. The structure and performance of livestock and its products marketing both for domestic consumption and for export is generally perceived poor in Ethiopia. Underdevelopment and lack of market-oriented production, lack of adequate information on livestock resources, inadequate permanent trade routes and other facilities like feeds, water, holding grounds, lack or non-provision of transport, ineffectiveness and inadequate infrastructural and institutional set-ups, prevalence of diseases, illegal trade and inadequate market information (internal and external) are generally mentioned as some of the major reasons for the poor performance of this sector (Belachew and Jemberu 2003; Yacob as cited in Ayele *et al.,* 2003). In the debate of poverty reduction or small-scale vs. industrial production and in spite of a general consensus on the appropriateness of general recommendations, there seem to be a lack of vision regarding the future structure and roles of the present small-scale producers. Many donors seem ready to protect and preserve the smallholders, but few have a vision of the process requiring ‗transforming small-scale subsistence producers into commercial producers supplying a modern, demanding food market' (Kristensen *et al*., 2004).

In Ethiopia milk marketing system is not well developed (Ahmed *et al.,* 2003) especially, market access in pastoral production system is a critical factor (Tsehay, 2002). This has resulted in difficulties of marketing fresh milk where infrastructures are extremely limited and market channel has not been developed. In the absence of organization of rural fresh milk market, marketing in any volume is restricted to peri-urban areas. Milk being perishable and demand being high for urban consumption, efficiency in collection and transportation of this bulk from widely scattered rural sources, requires a well-defined method of preservation and distribution. This would impact on the amount that would be available for consumption through losses in quality (Ahmed *et al.,* 2003).

Dairy product marketing is limited by the distance of the market from producers, lack of transport facility, and seasonal variation in the volume of milk production which leads to seasonal fluctuation in prices. The scattered nature of the production units, the poor communication system, the low rate of urbanization and its concomitant low infrastructure to road facilities may also not warrant the establishment of processing plants (IPS, 2000).

A pastoral community depends mainly on milk and milk products for its survival and therefore, these items are not perceived to be for commercial purposes. Thus it‘s only the households who are in a walking distance from the urban centers who sell milk and milk products to urban consumers (IPS, 2000). In few cases, however, small assemblers go to water points and buy directly from the pastoralist and sell to the next urban areas. They use donkey as a means of transport to carry milk from the water points to the urban center. In general, in pastoral and agro-pastoral area of Somalia region, milk is the main diet to households and also it is affected by season of the year, and even during the rainy season this production system is affected by the absence of transport facilities to markets (IPS, 2000)

3. MATERIALS AND METHODS

3.1 The study areas

The study was conducted in two districts of the Oromia special zone surrounding Addis Ababa. The districts, namely Sululta and Welmera, were selected purposively based on their potential for dairy production that was favored by market access to the capital city, Addis Ababa.

3.1.1. Sululta District

Sululta District is among one of the six districts found in Oromia special zone surrounding Addis Ababa, Oromia Regional State. It lies between $39^0$30‘ N Latitude and 38^0 30' and 39^0 00 E longitude. It is located 40 km north west of Addis Ababa. The topography of Suluta is undulated with altitude ranging between 1600 and 3318m.a. s. l. The pattern of rainfall in the area is a bi-modal and ranges from 834 to 1440 mm. The short rainy season is between February and March while the long rainy season is between June and September. The site is also characterized by very mild sub-tropical weather with average temperature of 13-28^0C. Human population of the district is about 144,510 of which 51% are females. Over 90% of the community members of the district are dependent on subsistence agriculture and the farming system of the district is characterized by mixed crop-livestock production system. According to the Sululta Livestock Resource Development and Health office, the total cattle population of the district for the year 2011 was 210,211 heads.

3.1.2. Welmera District

Welmera District is located 28 km west of Addis Ababa at $09^0$02 North latitude and $38^0$34 East longitudes with its altitude ranging from 2060-3380m.a.sl.The district is classified into two agro-climatic zones namely —Dega” 41% and —Woyna Dega” 59% with an average temperature of 21^{0}C and annual rain fall of 900-1100mm in a bimodal pattern. The short rain occurs from March to April and long rain from July to October. According to Welmera Livestock Resource, Development and Health office the total cattle population of the district for the year 2011 was 175,846 heads.

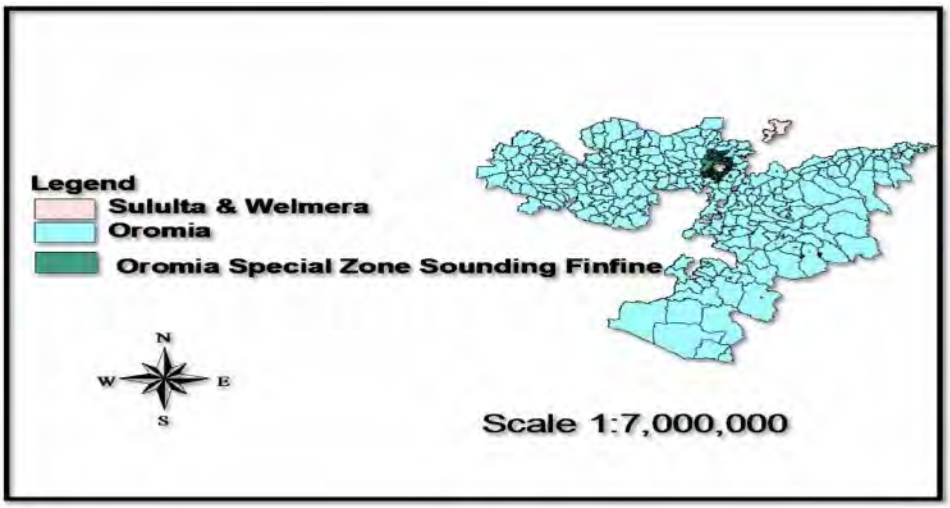

Figure 1 Map of the Oromia National Regional State showing the study site

3.2. Study population

Smallholder farmers in Sululta and Welmera Districts owning crossbred and indigenous cattle for milk production constituted the study population.

3.3. Study design

A cross-sectional study by way of questionnaire survey, rapid market appraisal, farm inspection, group discussion, interviewing key respondents and laboratory analysis of raw milk samples was carried out from September 2011 to April 2012. Marketing actors and smallholder dairy farmers in the selected study area were study participants.

3.4. Sample size determinations

The sample size was determined by using mathematical model of Arshame(2007). The sample size, N, can then be expressed as largest integer less than or equal to $0.25/SE^2$.

$$N=0.25/SE^2$$

Where Confidence level of 95% and Confidence interval of 5%, were considered.
Based on the above formula the computed sample size was 180 (one hundred eighty).

3.5. Sampling procedure

To select a representative sample, the potential of the two districts were identified. Sululta district has 23 peasant associations (PAs), of which eight have potential in dairy production. From the list of these eight PAs, three were selected randomly. These included Moye-Gajo, Chancho-Buba, and Warrarsso-Malima PAs. Then ninety households owning dairy cattle were selected randomly from three PA‘s (thirty from each PA). Welmera District has also 24 PAs, of which six have potential in dairy production. From the list of these six three , namely Gelgelikuyu, Bekeka na kore-oddo and Gebarobi PAs were selected. Then ninety households owning dairy cattle were selected randomly from the three PA‘s.

3.6. Data collection

3.6.1. Questionnaire survey

The questionnaire that was structured and closed type for its major part was pre-tested before its full administration. The questionnaire was focusing on demographic characteristics of the study participants, husbandry practices, milk production, processing, and marketing and utilization situations. Furthermore, marketing constraints of raw milk was investigated (Annex2).

3.6.2. Rapid Market Appraisal (RMA)

Rapid Market Appraisal (RMA) using checklists and observation was implemented to understand how a product or commodity flows to reach the end users.

3.6.3. Farm inspection

Farms were inspected once at the same time with the questionnaire survey. Activities observed during the farm visit encompassed kinds of utensils used, milking practices, milk handling and storage conditions.

3.6.4. Group discussions

Group discussions at three different PA'S of Sululta and three PA'S of Welmera were undertaken, in order to understand the overall community situations and get insight about milk marketing, milk handling, limitations and strength milk marketing. Groups were composed of 10 to 12 members constituted by different age and social groups. Discussion participants were identified in consultation with the wereda development agents. A sample checklist, which served as a guide and consisting of the main points for the group discussion was prepared.

3.6.5. Interviewing key respondents

Chairmen of PA'S, representatives of the sub PA'S and extension workers were interviewed. The agricultural office workers at PA'S levels were also participants in the process.

3.6.6. Collection of raw milk samples

Raw milk samples were collected at farm and milk collections centers by following strict aseptic procedures. Physicochemical test of raw milk was performed and the presence of bacteriological agents was assessed; standard plate count, coliform and somatic cell count tests were done. Before sampling the milk was thoroughly mixed after which 25 ml of milk was transferred into sterile sampling bottles. The milk sample bottles were capped, labeled with a permanent marker and stored in an ice packed cool box and transported to the Ethiopian Meat and Dairy Technology Institute , Debre-zeit where the different analysis were conducted.

3.7. Bacteriological quality tests

Tests employed to determine the quality of milk were Standard plate count, Coliform count, and Somatic cell count. Detailed description of the steps followed in each of the methodologies is presented in the following sections.

3.7.1. Standard plate count (SPC)

The standard plate count of raw milk samples was performed by putting one ml of milk sample into a sterile test tube having 9 ml peptone water. After mixing, the sample was serially diluted up to 1: 10^{-7} and duplicate samples of 1 ml of diluted milk samples were streaked on 15-20 ml standard plate count agar media and then incubated for 48 hours at 37^{0}C to encourage bacterial growth. Finally, colony counts were made using colony counter. Single bacteria species or clusters grow to become visible colonies that were then counted. All plate counts were expressed as the number of colony forming units (cfu) per milliliter. Results from plates, which contained 10 to 300 colonies per plate were recorded. If plates from two consultative decimal dilutions yield colony counts of 10 to 300, the counts for each dilution were computed by the following formula (APHA, 1992).

$$N = \frac{\sum \text{colonies}}{[(1 * n1) + (0.1 * n2)] * d}$$

Where: N = number of colonies per milliliter of milk,

∑C = sum of colonies on plates counted,

n_1= number of plates on lower dilution counted,

n_2 = number of plates in next higher dilution counted and

d = dilution from which the first counts are obtained.

3.7.4. Coliform count (CC)

One ml of milk sample was added into sterile test tube having 9 ml peptone water. After mixing, the sample was serially diluted up to 1: 10^{-4} and duplicate samples (1 ml) were pour plated using 15-20 ml Violet Red Bile Agar solution (VRBA). After thoroughly mixing, the plated sample was allowed to solidify and laying over by Violet Red bile Agar solution (VRBA) then incubated at 37ºC for 24 hours. Finally, colony counts were made using colony counter. Typical dark red colonies were considered as coliform colonies.

3.7.5. Somatic cell count (SCC)

For counting somatic cells, the microscopic method was used. Milk film preparation, staining and counting were done according to the standards set by International Dairy Federation (IDF, 1995). To obtain a uniform distribution of cells, milk samples were mixed by moving up side down gently 25 times and letting it to stand for 2 minutes to permit air bubbles and foam disappear. Microscopic slides were degreased with alcohol before milk film preparation. A 0.01ml of milk was taken with a 50µl micropipette calibrated at 10 and spread evenly over one cm^2 area on a microscopic slide and allowed to dry at room temperature on a leveled table. One cm^2 area was delineated by a template prepared from a cap board. Dried films were fixed with ethanol for 15 minutes. Stained with toludine blue for 5 minutes and washed with tap water gently and allowed to dry in a dust free area. Stained slides were stored in slide box until counted. Using oil immersion objective those cell nuclei clearly recognizable and those at the periphery with more than 50% of the cell body in view were counted. Twenty fields were counted from given sampled milk. The number of cells per ml of milk was calculated by multiplying the average number of cells per field with Magnifications filed (Laboratory manual).

$$\text{Somatic cell per ml of milk} = \frac{\sum SCOperfield * 10{,}000}{0.0346 * 20}$$

Where $\sum SCOperfield$= the summations somatic cell counted per each field

0.0346= oil immersion calibrated

20= Total number of field counted

3.7.2. Physicochemical test

The chemical compositions of milk (fat, protein, and solid not fat) and physical characteristics (density and freezing point), of the milk samples were determined by Ekomilk analyzer (Bulgaria), according to manufacturer's instructions. Milk samples were mixed gently 4-5 times to avoid any air enclosure in the milk. Then 25 ml samples were taken in the sample-tube and put in the sample- holder one at a time with the analyzer in the recess position. Then when the starting button activated, the analyzer sucks the milk, makes the measurements, and returns the milk in the sample-tube and the digital indicator (IED display) shows the specified results

3.7. Data analysis

The data collected from the study area were entered into Micro-soft-Excel spreadsheet for managing the data and analyzed using SPSS version 17. Descriptive statistics like means, standard deviation and frequency distribution were used to describe the farming system characteristics in the study area. One-way ANOVA statistical analysis was used for comparison of the performance variation. The correlation statistical analysis was used to study the interaction between the farming system characteristics and the interaction between physicochemical and microbiology of raw milk sample.

4. RESULTS

4.1. Demographic characteristics of smallholders

In the study areas, over 67.2% of the study participant households were male headed and 32.8% female headed. Their Experience of raising cattle for milk production varied considerably, less than 2 , between 2 – 5 , between 5-10 and more than 10 years were 22.8%, 26.7%, 35.6% and 15.0%, respectively (Table 1). Among the respondent farmers the majority (73.9%) were ageing between 30 and 50 years. The highest proportion of them (78.9%) was married and 96.7% of the smallholder farmers were engaged in own farm work. Nearly 78.9% of the respondents had basic education and above (Table 3).

Table 3. Demographic characteristics of smallholder dairy farmers (N=180) in study areas.

Variable			Frequency	Percent
Farm owners	Sex	Female	59	32.8
		Male	121	67.2
	Age	<30 years	19	10.6
		30-50years	133	73.9
		>50years	28	15.6
Marital status	Married		142	78.9
	Divorced		11	6.1
	widowed/er		27	15.0
Family size	Male	1-2 family members	67	37.9
		3-4 family members	92	52.0
		>5 family members	18	10.2
	Female	1-2 family members	85	47.2
		3-4 family members	78	43.3
		>5 family members	17	9.4
Farm owner Educational		Illiterate	38	21.1
		Basic Education	51	28.3
		Primary Education	72	40.0
		Secondary Education	19	10.6
Farm owner occupation		own farm work	174	96.7
		Business/trade	6	3.3
Experience of raising cattle for milk production		Less than 2 years	41	22.8
		B/n 2 – 5 years	48	26.7
		5-10 years	64	35.6
		More than 10 years	27	15.0

The overall mean family size for all respondents was 5.63 ± 1.926 persons. The family size ranged from 2 to 12 people. Fifty two percent of the family members were male and the rest (48%) were female. The overall average livestock holding per household was 23.93± 11.755.The average family and herd size of the two districts namely Sululta and Wolmera pointed out by the respondents (Table 4).

Table 4. Average family size and herd in smallholder dairy farms in the study district.

Variables	Sululta(N=90)	Wolmera(N=90)	Overall(N=180)
	Mean ±S. D	Mean ±S. D	Mean ±S. D
Family size	5.49±1.819	5.77±2.028	5.63±1.926
Male	2.88±1.211	3.04±1.469	2.96±1.346
Female	2.68±1.198	2.76±1.248	2.72±1.220
Livestock	25.22±12.382	22.63±11.009	23.93±11.755
Cattle	14.69±11.619	11.37±3.905	13.03±8.802
Lactating cows	4.57±4.316	3.38±1.427	3.97±3.260
Local cows	2.18±0.384	2.08±.278	2.13±0.336
Cross bred cow	4.28±0.450	4.32±.470	4.30±0.459
Sheep	5.92±4.238	6.66±4.490	6.26±4.356
Equines	1.80±0.924	2.16±1.256	1.97±1.105

S.D=standard deviations N=number of respondents

4.2. Cattle composition

Table 5 shows the size and composition of cattle owned by the smallholders in the study areas. All the surveyed smallholders owned on average 13.03 ± 8.802 (12.29 TLU) cattle. The average number of Lactating cows owned by the respondent farmers was 1.76±0.920 local or 1.76 TLU and 2.79±3.445 cross bred animals or 4.185 TLU (Annex 1 conversion factors). Cattle were the predominant species representing 84.3% of the total TLU. The smallholders prefer to have crossbred cows because of their greater milk production, even though they require high management and susceptible to disease than local breeds.

Table 5. Cattle herd size and composition in TLU in smallholder farms.

Variables	Sululta(N=90)		Wolmera(N=90)		Overall(N=180)	
	Mean ±S. D	TLU	Mean ±S. D	TLU	Mean ±S. D	TLU
Cattle	14.69±11.619	13.006	11.37±3.903	11.391	13.03±8.802	12.29
L.M. cows	1.68±0837	1.68	1.83±0.993	1.83	1.76±0.920	1.76
C.M. cows	3.30±4.511	4.95	2.21±1.252	3.315	2.79±3.445	4.185
Calves	3.23±3.083	0.646	2.76±1.126	0.552	3.01±2.357	0.602
Heifers	2.78±3.131	1.668	2.16±1.094	1.296	2.47±2.359	1.482
Bulls	1.56±0.940	1.872	1.39±0.549	1.668	1.48±0.777	1.776
Oxen	2.19±0.518	2.19	2.73±1.166	2.73	2.48±0.956	2.48

S.D =standard deviation TLU= tropical livestock units N= number of respondents 1TLU=250kg of live weight of livestock, L.M. cows=local milking cows C.M. cows= crossbred milking cows

4.3. Husbandry Practices

4.3.1. Feeding

Major feed stuffs in the study area that were/are used as basal diet for dairy animals. Large majority (74.4%) of the smallholders graze their animals outdoors. Conserved feed (hay / silage) (96.1%) and Crop residue (67.8%) were also widely used in stall feeding in few cases and /or as additional basal diet to grazing. From the group discussion with the participants also indicated that, major feeds in the area were pasture, crop residue, hay, and supplemental feeds such as improved forage, concentrate and brewery byproducts. The informant farmers pointed out that crossbred cows graze on pasture over 6 hours per day and supplemented with hay, crop residue and brewery by-products. The lactating cows were supplemented (90%) with a small quantity of concentrate. Access to most of the grazing lands was controlled during the long rainy season for individual grazing and haymaking. Only few farmers developed improved forage for their dairy cattle in the study area. Vetch, oat, Alfa-alfa and tree legumes were used in the study areas. Free grazing on pasture land was the major system indicated by the respondent farmers. Study participants also indicated problems of aaccessibility, affordability and price instability of feeds as important problems related to feeding of their animals.

4.3.2. Health care

Through group discussions with the participants of the study areas it was pointed out that the service delivered from the government veterinary service was not to the level of the expectation of the smallholders. To keep the health of their livestock especially dairy cattle, smallholders were/are forced to depend on private service providers.

4.3.3. Breeding

From the group discussions and farm visits of the study areas, it was found that the preferred breeding methods by smallholders were use of crossbred bull and AI. The preference of the households was more of for the AI. Artificial inseminations service was given at a cost of 4.00birr per insemination that was judged as affordable by the smallholders.

4.3.4. Housing

Table 6 shows the housing conditions of dairy cattle in the study farms. In the study area the majority (85.0%) were using traditional barns for their dairy cattle. Only 10.6% of the respondent households kept their dairy cattle in improved barns and 4.4% of respondent households kept their dairy caws in open air without any enclosure. The barns were constructed from locally available materials. Eighty five percent of the roofing material was grass and the remaining of the households used corrugated iron. The material used for wall construction was wood througho ut the households. In only small proportion (8.3%) of the households cattle were kept on concrete cement floor. In 34.4% of the households the floor was soil and in 57.2% stone layer. There was no problem of ventilation in all housing conditions and disposals of waste materials were done once a day, twice a day or more frequently.

Table 6. Dairy cattle housing conditions of small holder farmers.

Factors and category	Frequency	Percent
Type of housing for dairy cows		
Open without enclosure	8	4.4
Traditional barn	153	85.0
Improved barn	19	10.6
Floor type		
Paved(concrete cement)	15	8.3
Stone face	103	57.2
Soil	62	34.4
Frequency of dispose waste material		
Frequently	32	17.8
Once a day	109	60.6
Twice a day	39	21.7

4.3.5 .Milking and milk handling practices

Ninety four percent of the respondents of the study area were using plastic pail for milking and milk handling. Nearly 6% were using Stainless steel pail. Difficulties of using these utensils were difficult for cleaning (1.1%), accessibility in local markets (5%) and no problem of using these utensils (93.9%) were indicated by the respondents of the study area. Through group discussions with the participant of the study areas it was pointed out that all the respondents practice washing the utensils used for milking and milk handling. Commonly they were washing the milking utensils with warm water by using soap and finally allow drying till milking. In the study area cows are hand milked and calves are allowed to suckle their dams prior to as well as after milking. About 100%t of the respondents in Sululta and Wolemera area pointed out that they milk their cows two times a day at morning and evening. They milked their cows at barn, where the animals are sheltered. As illustrates on Table 7, all respondents were washing their hands and vessels before milking.

Seventy two percent of respondents were also washing udder before milking. Nearly 19% of the smallholders were using individual towels for cleaning udder of milking cows in 52.2% of the cases collective towels were used while in the rest (28.9%) no towel use was practiced.

Table 7. Observed milking practices in the study areas (N=180)

Variable	Frequency Yes	Percent	Frequency NO	Percent
Wash milkier hands and vessels	180	100.0		
Wash udder before milking	129	71.7	51	28.3
Wash udder before and after milking			180	100.0
Use of individual towels	34	18.9	145	80.6
Use of collective towels	94	52.2	86	47.8
No towel	52	28.9	128	71.1

4.3.6. Milk production and use aspects

Mean of Lactation length of crossbred and local milking cows were 9.72 ± 0.45 and 6.353 ± 0.7681 in Sululta, 9.68 ± 0.47 and 6.167 ± 0.5567 in Wolmera district respectively and overall mean of lactation length of crossbred and local milking cows were 9.7 ± 0.46 and 6.26 ± 0.6624 months respectively. Average daily milk yield of cross bred and local cows in Sululta were 9.56 ± 3.010 and 1.809 ± 0.4574Liter/day respectively. Moreover, crossbred and local cows in Wolmera areas were 8.60 ± 2.703 and 1.96± 0.8193 liters/day respectively. Overall mean summery of daily milk yield at the study areas of crossbred milking cows (9.11 ± 2.902) and local milking cows (1.889 ± 0.6707) liters as shows on table 8.

Table 8. Average lactation length and daily milk yield of local and cross bred milking cow of small holder farmers.

Variables	Sululta(N=90) Mean ± S.D	Wolmera(N=90) Mean ± S.D	Overall(N=180) Mean ± S. D
Lactation length of local cattle in month	6.353± 0.7681	6.167 ± 0.5567	6.26 ± 0.6624
Lactation length of cross bred cows in month	9.72 ± 0.45	9.68 ± 0.47	9.7 ± 0.46
Average daily milk yield of local cows(/liter/day)	1.809± 0.4574	1.96± 0.8193	1.889 ± 0.6707
Average daily milk yield of cross bred cows(/lit/day)	9.56 ± 3.010	8.60 ± 2.703	9.11 ± 2.902

S.D= standard deviations, N=number of respondents

Overall mean of milk producing, Processing, consuming and selling per day per household was 26.88±4.76, 1.23±1.603, 1.29±1.176 and 23.32±5.22 liters respectively (Table 9). The proportion of raw milk used for household consumption was relatively small. As figure 1 illustrates, the major part of milk produced by smallholders is destined to market. Smallholders also process milk to butter and cheese. Milk was soured for 2-3 days before processing it in to butter and cheese. The one way of ANOVA analysis showed significance difference at ($P<0.01$) and ($P<0.05$) among the District from which the milk sample for milk produced and milk sold per day/liter.

Table 9.Milk production and partition in to different use categories at smallholder farm level.

Category/area of study		Mean ± S. D	95% CI	Df	F	P
Milk produced at farm/lit/day	Sululta	28.01±3.135	27.35-28.67	1	10.762	0.001**
	Wolmera	25.74±5.756	24.54-26.95	178		
	Overall	26.88±4.76	26.18-27.58	179		
Milk processed/lit/day	Sululta	1.29±1.493	0.98-1.6	1	0.215	0.643
	Wolmera	1.18±1.713	0.82-1.54	178		
	Overall	1.23±1.603	1.00-1.47	179		
Milk consumed at home/lit/day	Sululta	1.43±1.272	1.17-1.7	1	2.534	0.113
	Wolmera	1.16±1.059	0.93-1.38	178		
	Overall	1.29±1.176	1.12-1.47	179		
Milk sold/lit/day	Sululta	24.11±4.67	23.13-25.09	1	4.245	0.041*
	Wolmera	22.52±5.631	21.34-23.7	178		
	Overall	23.32±5.22	22.55-24.08	179		

**P-value is significant at 0.01 levels S.D= standard deviation and CI = confidence interval df= degree of freedom F=F ratios P= P value

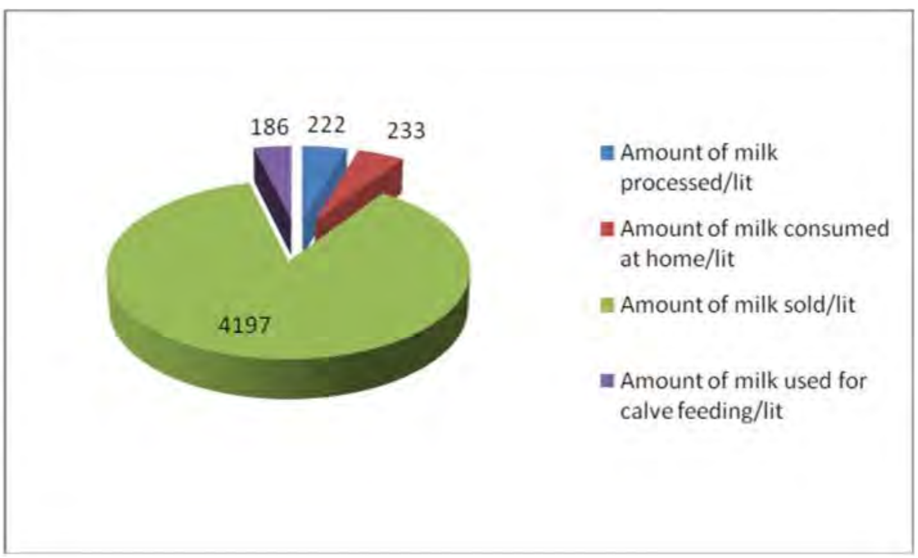

Figure 2. Milk processing, consumptions sold and milk used for calves feeding

4.4. Milk marketing

Table 10 shows distance between production and market place. Nearly 54.9% of the households were nearby to the market center for their raw milk marketing while about 4% of the households travel more than 10 km.

Table 10. Distance of market centre for milk in smallholder dairy farmer of study areas
(N=175 households).

Distance of marketing place	Frequency	Percent
Less than 1 km (nearby)	96	54.9
Between 1 – 5 km (proximity)	70	40.0
Between 5 – 10 km (intermediate)	2	1.1
More than 10 km(far)	7	4.0

4.4.1. Milk sales outlet

The main outlets for raw milk identified as shows in (Table11) were Cooperatives, Processors, Vendor, Directly to Consumer and Hotels/restaurants 55.6%, 20.0%, 20.0%, 2.8% and 1.7% respectively.

Table 11 .Marketing channel of small holder farmer of the study area

Milk out let	Frequency	Percent
Cooperatives	100	55.6
Hotels/restaurants	3	1.7
Vendor	36	20.0
Processors	36	20.0
Directly to Consumer,	5	2.8

4.4.2. Rapid market appraisal

Rapid Market appraisal (RMA) on milk value chain in selected area of Oromia special zone surrounding Addis Ababa with special emphasis to Sululta and Welmara district was conducted. Group discussions with participants especially actors (Producers, collectors and consumers) of milk marketing was conducted mainly to describe functions and capacity of networking actors enrolled in milk marketing. Subsequently, milk value chains were analyzed and mapped (Fig. 2)

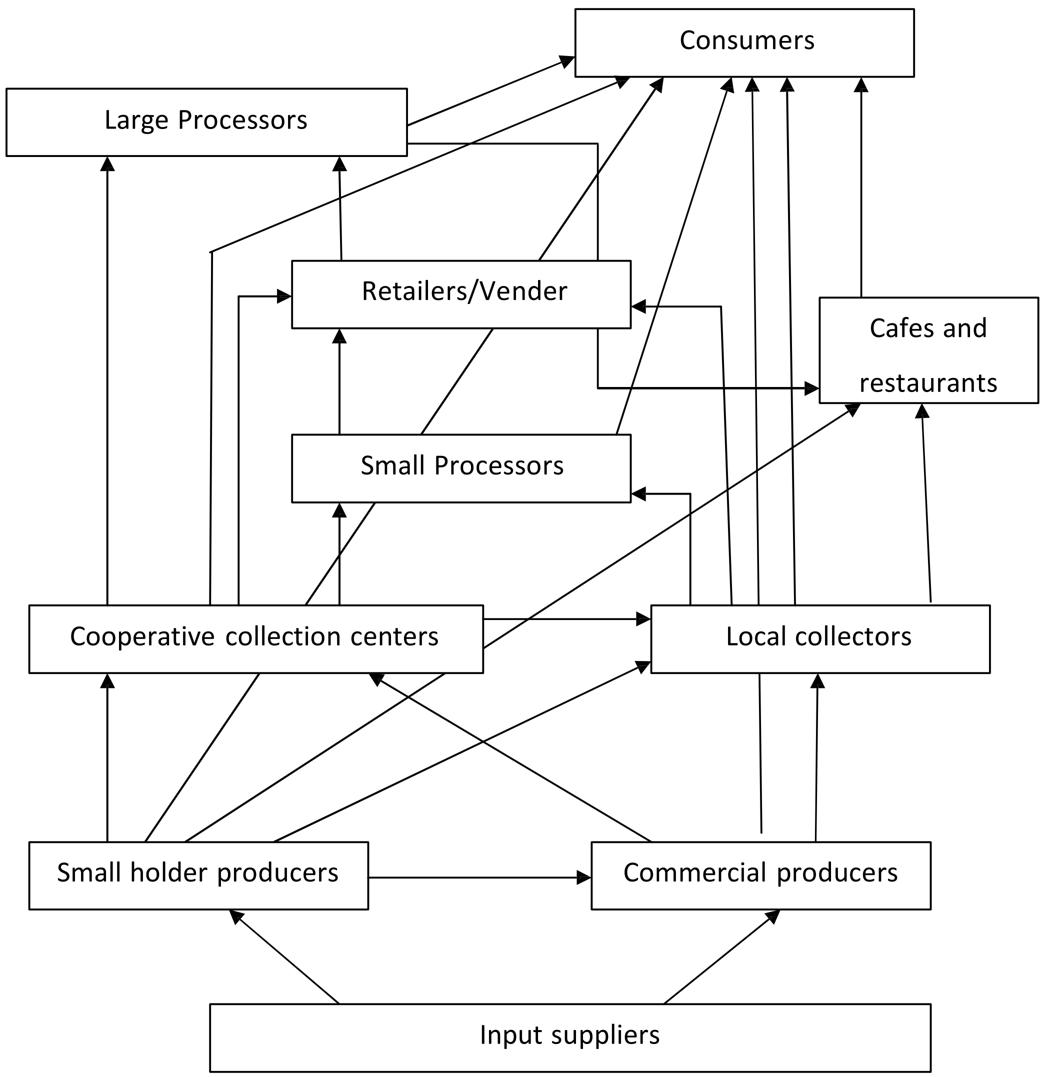

Figure 3. Map of milk value chain

4.5. Raw Milk marketing constraints

Table 12 illustrates raw milk marketing constraints at specific study area. The respondent farmers indicated that, price variations (87.2%), lack of fair market (72.2%) and lack of demand (49.4%) during fastening were the major problem of raw milk marketing in descending order of importance.

Table 12.Descriptions of marketing problems of small holder at the study area

Constraints	Frequency Yes	Percent	Frequency No	Percent
price variations	157	87.2	23	12.8
Lack of fair market	130	72.2	50	27.8
Lack of demand during fastening	89	49.4	91	50.6

As shows on table 13 milk price decided by producer, processor and collector were 6.1%, 25%, and 68.9%respecively as ascending order. Additionally through group discussion almost the entire group member pointed out they have less /no power to decided milk price at the study area.

Table 13 Power of decisions in milk price

Decisions of milk price	Frequency	Percent
Producer	11	6.1
Processor	45	25
Collector	124	68.9

Quality based payment was also another raw milk marketing constraints of the study area. They indicated quality based payment was enhanced quality of milk supplied to processors at the same time as encouraging them to produce more and quality milk. Through group discussions of respondents in the sturdy areas pointed out they possessed less preserving facilities for surplus milk produced and demand especially during fasting were great influence on raw milk marketing. Additionally, they showed that less adopted technologies for enhancing shelf life of raw milk in the study areas.

4.6. Factors influencing milk production, consumption and marketing

Milk production was positively and significantly correlated with experience of raising cattle for milk productions, raw milk sold ($P<0.01$) and significantly correlated with distance of milk marketing ($P<0.05$). Milk sold was positively and significantly correlated with experience of raising cattle, milk productions and distance of milk sold ($P<0.01$). Milk consumption was negatively and significantly correlated with cattle herd size ($P<0.01$) (Table 14).

Table 14. Correlations among different characteristics of small holder dairy farmers

Variable	Family size	ERCMP	Cattle	MPF/day	MS/day	MC/day	DMP
Family size	1						
ERCMP	.149*	1					
Cattle	.124	.012	1				
MPF/day	.121	.375**	-.119	1			
MS/day	.085	.342**	-.146	.908**	1		
MC/day	-.006	-.160	-0.613**	.103	.091	1	
DMP	-.155*	.232**	.235	.175*	.284**	-.080	1

*correlation is significant at the 0.05 level and **highly significant at the0.01 level ERCMP=experience of raising cattle for milk productions, MPF= milk produced at farm, MS= milk sold, MC= milk consumed and DMP= distance of marketing place.

4.7. Physicochemical and microbiological quality of milk

The average chemical compositions of milk for fat (%), protein (%) and solids not fat (%) content were 3.6043 ± 0.12200, 2.9749 ± 0.05147 and 6.9992 ± 0.13452 in raw milk samples mixture from producer respectively. Additionally, the mean of milk chemical compositions for fat (%), protein (%) and solids not fat (%) content were 3.3243 ± 0.15814, 2.8929 ± 0.08510 and 6.7114 ± 0.24844 in raw milk samples mixture from collector respectively. The average physical properties of milk sample indicates on (Table 15) with density, freezing point 1.02721 ± 0.000477 and -0.47143 ± 0.00774 in raw milk sample from producer; 1.02623 ± 0.000874 and -0.45788 ± 0.016510 in raw milk sample from collector respectively.

Table 15.Physicochemical properties of milk at farm and collection points in study area.

Variables and category		N	Mean ± Std. Error	95% CI
Fat (%)	Producer	49	3.6043 ± 0.12200	3.3590 - 3.8496
	Collector	7	3.3243 ± 0.15814	2.9373 - 3.7112
	Overall	56	3.5693 ± 0.10892	3.3510 - 3.7876
Protein (%)	Producer	49	2.9749 ± 0.05147	2.8714 - 3.0784
	Collector	7	2.8929 ± 0.08510	2.6846 - 3.1011
	Overall	56	2.9646 ± 0.04621	2.8720 - 3.0572
SNF (%)	Producer	49	6.9992 ± 0.13452	6.7287 - 7.2696
	Collector	7	6.7114 ± 0.24844	6.1035 - 7.3193
	Overall	56	6.9632 ± 0.12175	6.7192 - 7.2072
Density	Producer	49	1.02721 ± 0.000477	1.02625 - 1.02817
	Collector	7	1.02623 ± 0.000874	1.02410 - 1.02837
	Overall	56	1.02709 ± 0.000432	1.02622 - 1.02795
Added water (%)	Producer	40	14.4087 ± 1.45661	11.4625 - 17.3550
	Collector	7	14.2700 ± 3.05519	6.7942 - 21.7458
	Overall	47	14.3881 ± 1.30856	11.7541 - 17.0221
Freezing point	Producer	49	-0.47143 ± 0.00774	-0.4870- (-0.4559)
	Collector	7	-0.45788 ± 0.016510	-0.4983 - (-0.4175)
	Overall	56	-0.46974 ± 0.007066	-0.4839 - (-0.4556)

S.E = Standard error, C.I = confidence interval N= number of sample

The overall Average of microbiological count of log (TBC cfu/ml), log (CC cfu/ml) and log (SCC/ml) of raw milk was 8.2577 ± 0.10499, 3.3210 ± 0.11295and 5.0806 ± 0.08484 for milk sample from the producer; 8.2577 ± 0.10499, 3.3400 ± 0.10352 and 5.1205 ± 0.07533 for milk sample from collector respectively (Table 16).

Table 16. Microbiological quality of milk at farm and collection points in study area.

Variables and category		N	Mean ± Std. Error	95% CI
log(CC/cfu/ml	Producer	49	3.3210 ± 0.11295	3.0939 - 3.5480
	Collector	8	3.4569 ± 0.26971	2.8191 - 4.0946
	Overall	57	3.3400 ± 0.10352	3.1327 - 3.5474
log(TBC/cfu/ml)	Producer	44	8.2572 ± 0.11195	8.0314 - 8.4830
	Collector	8	8.2601 ± 0.31391	7.5179 - 9.0024
	Overall	52	8.2577 ± 0.10499	8.0469 - 8.4684
log(SCC)	Producer	47	5.0806 ± 0.08484	4.9098 - 5.2513
	Collector	8	5.3548 ± 0.11766	5.0766 - 5.6331
	Overall	55	5.1205 ± 0.07533	4.9694 - 5.2715

Log=logarithm in base ten (normal logarithm), CC=coli form count, SCC=somatic cell count, TBC= total bacterial count, cfu=colony forming unit per ml of milk sample, S.E = standard error, C.I = confidence interval

The overall mean of chemical compositions of milk for fat (%), protein (%) and solids not fat (%) contents were 3.5693 ±0.10892, 2.9646 ±0.04621 and 6.9632 ±0.12175 in raw milk sample mixture from the two districts respectively. Additionally the overall mean of physical properties of milk sample indicates on (Table 17) with density, freezing point 1.02665 ±0.00061 and -0.47088 ±0.0070 in raw milk sample from the two districts. The ANOVA showed significance difference ($P< 0.05$) due to the source area of raw milk samples for fat, protein and freezing point. Moreover, ANOVA showed highly significance difference at ($P<0.01$) due to the source area of raw milk samples for solid not fat

Table 17. Physicochemical properties of milk for the two districts.

Variable		N	Mean ±Std. Error	95% CI	Df	F	P
Fat (%)	Sululta	27	3.3185 ±0.13027	3.0507 - 3.5863	1	5.32	0.025*
	Wolmera	29	3.8028 ±0.16215	3.4706 - 4.1349	54		
	Overall	56	3.5693 ±0.10892	3.3510 - 3.7876	55		
Protein (%)	Sululta	27	2.8485 ±0.05218	2.7413 - 2.9558	1	6.46	0.014*
	Wolmera	29	3.0728 ±0.06985	2.9297 - 3.2158	54		
	Overall	56	2.9646 ±0.04621	2.8720 - 3.0572	55		
SNF (%)	Sululta	27	6.6307 ±0.14321	6.3364 - 6.9251	1	7.80	0.007**
	Wolmera	29	7.2728 ±0.17720	6.9098 - 7.6357	54		
	Overall	56	6.9632 ±0.12175	6.7192 - 7.2072	55		
Density	Sululta	27	1.02593 ±0.00051	1.02488 - 1.02698	1	1.27	0.266
	Wolmera	30	1.02730 ±0.00105	1.02514 - 1.02945	55		
	Overall	57	1.02665 ±0.00061	1.02544 - 1.02787	56		
Added water	Sululta	26	15.4562 ±1.80236	11.7441 - 19.1682	1	0.82	0.37
	Wolmera	21	13.0657 ±1.90496	9.0920 - 17.0394	45		
	Overall	47	14.3881 ±1.30856	11.7541 -17.0221	46		
Freezing point	Sululta	27	-0.45456±0.00987	-0.47485-(-0.43428)	1	5.21	0.026*
	Wolmera	30	-0.48557±0.00934	-0.50468 -(-0.46647)	55		
	Overall	57	-0.47088 ±0.0070	-0.48498- (-0.45679)	56		

** is highly significant at the (P< 0.01) and* is significant at the (P< 0.05) level.

S.E = standard error, C.I = confidence interval, Df= degree of freedom p= p value

The overall mean of microbiological count of log (TBC cfu/ml), log (CC cfu/ml) and log (SCC/ml) of raw milk was 8.2285 ±0.10041, 3.3363 ±0.10010 and 5.1622 ±0.07382 for milk sample from the two districts respectively (Table 18). The ANOVA showed significance difference at (P<0.01) due to the source area for log (TBC cfu/ml)

Table 18. Microbiological quality of milk for the two districts of study area

Variable	N	Mean ±Std. Error	95% CI	Df	F	P
log(CC/cfu/ml.						
Sululta	30	3.3925 ±0.14411	3.0978 - 3.6873	1	.302	0.585
Wolmera	31	3.2819 ±0.14074	2.9944 - 3.5693	59		
Overall	61	3.3363 ±0.10010	3.1361 - 3.5365	60		
log(TBC/cfu/ml)						
Sululta	27	7.9548 ±0.12902	7.6896 - 8.2200	1	7.774	0.007**
Wolmera	29	8.4834 ±0.13799	8.2008 - 8.7661	54		
Overall	56	8.2285 ±0.10041	8.0273- 8.4298	55		
log(SCC)						
Sululta	28	5.2643 ±0.10299	5.0530 - 5.4757	1	1.753	0.191
Wolmera	31	5.0699 ±0.10406	4.8573 - 5.2824	57		
Overall	59	5.1622 ±0.07382	5.0144 - 5.3099	58		

** is highly significant at the (P< 0.01).

Log=logarithm in base ten (normal logarithm), CC=coli form count, SCC=somatic cell count, TBC= total bacterial count, cfu=colony forming unit per ml of milk sample, S.E = standard error, C.I = confidence interval

4.8. Relationship among and between physicochemical and microbiological test of Milk

Milk protein was positively and significantly correlated with fat, solid not fat and density of milk (P<0.01) and significantly correlated with each other (P<0.01). Milk protein was negatively and significantly correlated with added water and freezing point. Fat, solid not fat (SNF) and density of milk were also negatively and significantly correlated with added water and freezing point (P<0.01) (Table 19).

Table19.Correlations among different characteristics of physicochemical and microbiological test of milk from selected area of small holder dairy farmers

Milk	Fat (%)	Prot. %)	SNF	Density	AW	Fp	log(CC .	log(TBc	log(SC)
Fat (%)	1								
Prot.(%)	.671**	1							
SNF	.624**	.977**	**1**						
Density	.565**	.969**	.997**	1					
AW	-.562**	-.951**	-.984**	-.976**	1				
Fp	-.634**	-.918**	-.942**	-.529**	1.000**	1			
log(CC)	-.148	-.062	-.068	-.141	.089	.053	1		
log(TBC)	.138	.075	.070	.030	-.066	-.081	-.075	1	
log(SCC)	.068	.075	.074	.001	-.228	-.127	-.097	.005	1

**. Correlation is significant at the (P< 0.01) level.

SNF= solid not fat, AW= added water, Fp= freezing point, log (CC) = logarithms of Coli form count, log (TBC) =logarithms of total bacterial count and log (SCC) = logarithms of somatic cell count.

5. DISCUSSION

The overall mean family size obtained in the present study for all respondents was 5.69 ± 1.87 person's less than those reported by Tolera (2007) for Girar Jarso (5.77 persons) and by Abera (2008), 6.12 persons per house hold at kuyu wored. The family size ranged from 2 to 12 persons at the study area which is comparable with the report of Kelay (2002) that family size ranged from 1 to 13 persons in Addis Ababa. About 78.9% of the households were basic educations and above in this study. This value is by far higher than the report of Sisay (2006) for Gondar area (38.5%).This is mainly indicate that the education coverage between the study areas were different.

The cattle herd size of the study area was 12.27 TLU. The work of Abdinasir (2000) indicated that the cattle herd size at Bilalo and Lemmu areas are 8.57 TLU and 10.38 TLU respectively .In the present study area the cattle herd was dominated by crossbreds that results in larger TLU cattle herd size as compared with Bilalo and Lemmu of Arsi area.

The first function in the chain refers to husbandry practice, the main goods and services the farmers need in order to raise animals for milking purpose. These include feed, housing, veterinary services and Artificial inseminations (AI).

Major feed resources identified in this study were native pasture, crop residues, agro-industrial by-products, few fodder crops (oats and vetch mixture). These feed resources were also reported as major feed resources by Zinash *et al*. (1996).

In this study the preferred breeding methods by smallholders were use of crossbred bull and AI. The preference of the households was more of for the AI. This results comparable with the report of Abdinasir (2000) who found AI being used by the majority of the farmers at Bilalo located relatively closer to Asela, where there is a well developed infrastructure for AI services.

The present study also showed that milk production was positively and significantly correlated with experience of raising cattle for milk productions, raw milk sold ($p<0.01$) and significantly correlated with distance of milk marketing ($p<0.05$). Whereas the family sizes were not correlated with cattle herd size. On contrast finding reported by Abbinasir(2000) and Kelay(2002) indicated that family size and cattle herd size were positively and significantly correlated. This variations may be due to hired labor was means of overcoming family labor resource.

The average milk yield of cross bred cows in the study area was 9.11 ± 2.902 litres per day, which was comparable with average milk yield of 10 litres reported by (Yoseph, 1999; Azage *et al*., 2000; Mekonnen *et al.,* 2006). Moreover, the average milk yield of local cows was 1.889 ± 0.6707 which was comparable with reported by Zewdu (2004) indicated that the overall average daily milk yield of local cows in the first and second lactations in North Gonder Zone was 1.69 and 1.86 liters, respectively.

The overall average lactation length of local and crossbred cows was 6.26 ± 0.6624 and 9.7 ± 0.46 months, respectively in the study area. The lactation length of the indigenous cows observed in this study is comparable with the national average of 7 months (CSA, 2005). The lactation length in crossbred cows observed in this study is shorter than the lactation length of 11.7 months reported for crossbred cows in the central highlands of Ethiopia (Zelalem and Ledin, 2001a). The variation in lactation length in the present study may be credited to feed shortage and poor genetic potential of the sample population.

Overall mean of milk producing, Processing, consuming and selling per day per household was 26.88±4.76, 1.23±1.603, 1.29±1.176 and 23.32±5.22 liters liters respectively. Eighty six point seven seven percent (86.77%) of the milk produced in the area was sold by the producer through different channels. Amount of milk processed, consumed and used for calves was 4.6%, 4.8% and 3.84% respectively. This study is inconsistent with study conducted around Addis Ababa indicated that from total milk production 73% is sold, 10% is left for household consumption, 9.4% goes to calves and 7.6% is processed into butter (Azage and Alemu, 1998).

Marketing channels are routes through which products pass as they are moved from the farm to the consumer. From this study the main outlets for raw milk identified were cooperatives, processors, vendor, directly to consumer and hotels/restaurants. These are consistent with the result in any marketing system various actors participate in marketing of commodities and process of transactions made. These include itinerate /mobile traders, semi-whole sellers, retailers, cooperatives and consumers as reported by (Holloway *et al*., 2000). Collectors collect the milk from the small holder and commercial dairy producers, they sale it to retailers, hotels, restaurants and processors. There exist two types of collectors in the milk value chain. Cooperative collection centers are a formal collectors organized by the bureau of agriculture in their respective districts. They have members of small holder dairy producers which supply daily produce of milk in order to supply to the larger processors in Addis Ababa markets. In addition to collecting from cooperative and individual collectors, larger processors are also collect milk from smallholder farmers giving them additional cents over a liter of milk than other collectors. This condition had negative effect on cooperative collection centers and mutual agreement and win-win approach should be followed among all the actors involving milk supply chain.

There are two groups of dairy processors, small scale and large scale processors, which are grouped according to their processing capacities. Small scale processors are those who are limited to small scale niche market and few processed products. They are directly buying raw milks from unions, cooperatives and individual collectors. Similarly, large scale processors also source the milk they process from smallholder farms, cooperative collection centers and individual collectors. Although they produce pasteurized milk, butter, cheese and other dairy products, they are operating below their capacities and suffering import competition of similar products with better quality. The quality and safety issues are a concern of the consumers for they are directly related to public health. Processors therefore should focus on producing superior quality products with optimum market prices so that they can compete and exist in the business.

Among constraints of milk marketing, price variations, Lack of fair market and Lack of demand during fastening were the most indicated ones. The current study agreed with the report by Baltenweck and Staal (2000) for Kenyan highlands inaccessibility of fresh milk marketing. Through group discussion almost the entire group member pointed out they have less /no power to decided milk price at the study area. Quality based payment was also another raw milk marketing constraints of the study area. They indicated quality based payment was enhanced quality of milk supplied to processors at the same time as encouraging them to produce more and quality milk. Finally, milk marketing constraints were possessing less preserving facilities for surplus milk produced and demand especially during fasting were great influence on raw milk marketing.

Through group discussions with the participant of the study areas it was pointed out that all the respondents practice washing the utensils used for milking and milk handling. Commonly they were washing the milking utensils with warm water by using soap and finally allow drying till milking. In the study area cows were hand milked and calves are allowed to suckle their dams prior to as well as after milking. About 100 percent of the respondents in Sululta and Wolemera area pointed out that they milk their cows two times a day at morning and evening. They milked their milking cows at barn, where the animals are sheltered. All respondents of the study area were washing their hands and vessels before milking. Seventy two percent of respondents were also washing udder before milking. Nearly 19% of the smallholders were using individual towels for cleaning udder of milking cows in 52.2% collective towels were used while in the rest (28.9%) no towel use practiced. It was reported by Galton *et al*. (1986) that pre-milking udder preparations play an important part in the contamination of milk during milking. Most of the dairy owners did not use towel and a few dairy owners used a single towel for all cows commonly to dry the udders. The reuse of towel for cleaning and sanitizing may result in recontamination of the udder**.** Since drying was not or in sufficiently practiced, contamination level of milk was becoming higher.

The overall mean fat percentage(3.5693 ±0.10892) of whole milk collected from the smallholder farmers in the current study is less than the fat content of whole milk collected from smallholder farmers reported by Alganesh(2002)for eastern Wollega(6.05%) and also slightly less than reported by Asaminew(2007) for Bahir Dar Zuria(4.14%) .The variation in fat percentage observed in the present study may probably due to variation in stage of lactation, feeding regime and parity. The overall mean protein (2.9646 ±0.04621) content from bulk milk obtained in the current study is lower than those reported by O'Connor (1994) for local cows' milk and also lower than Zelalm and Ledin (2001b) for whole milk in the central highlands of Ethiopia (3.1%). The average SNF (6.9632 ±0.12175) content of milk obtained in the current study is slightly lower than reported by Alganesh (2002) for eastern Wollega (8.22%).

The overall mean total bacterial count of cows' milk produced in the study area was 8.2285$\log_{10}$cfu/ml. The total bacterial count obtained in this study is generally high as compared to the acceptable level of 1×10^5 bacteria per ml of raw milk (O'Connor, 1994). The current study is consistent with Fekadu (1994) reported that the minimum and maximum total bacterial count of raw cows' milk produced in southern region to be 6 to 8.8 $\log_{10}$cfu/ml. Commonly, lack of knowledge about clean milk production and use of unclean milking equipment would be some of the factors which contributed to the poor hygienic quality of milk produced in the study area.

The overall mean coliform count of milk produced in the area was 3.3363$\log_{10}$cfu/ml. The coliform count of cows' milk obtained in the current study is smaller than with reported by Fekadu (1994) for districts of southern region (3.8 $\log_{10}$ cfu/ml). The current result is also inconsistent with the reported by Zelalem and Bernard (2006) for cows' milk collected from different producers in the central highland of Ethiopia (6.57$\log_{10}$cfu/ml). The higher coliform count obtained in this study may be due to the initial contamination of the milk samples either from the cows, the milkers, milk containers and the milking environment. The overall mean of somatic cell count in log (SCC/ml) of raw milk was 5.1622 ±0.07382 for milk sample from the two districts.

6. CONCLUSIONS AND RECOMMENDATIONS

Dairy production became a crucial element of the farming activities and income generating for household in ―Sululta" and ―Wolmera" distract of Oromia special zone surrounding Addis Abeba. Major feed stuffs in the study area that were used as basal diet for dairy animals; grazing, conserved feed (hay / silage and crop residue were widely used. The lactating cows were supplemented with a small quantity of concentrate. Access to most of the grazing lands was controlled during the long rainy season for individual grazing and haymaking. Few farmers developed improved forage for their dairy cattle in the study area. Vetch, oat, Alfa alfa and tree legumes were used.

The proportion of raw milk used for household consumption was relatively small and the major part of milk produced by smallholders is destined to market. Smallholders also process milk to butter and cheese. Milk was soured for 2-3 days before processing it in to butter and cheese. The main outlets for raw milk identified were cooperatives, processors, vendor, directly to consumer and Hotels/restaurants. Price variations, lack of fair market, lack of demand during fastening, lack of quality based payment and lack of preserving facilities were the major problem of raw milk marketing in the study areas.

Commonly and widely used utensils for milking and milk handling in study areas were plastic pail. Few smallholders were using stainless steel pail for milking and milk handling. The results in the study showed small holder were washing their hands and vessels before milking. Washing udder before milking and using individual or collective towels for cleaning udder of milking cows were practiced. Hygienic conditions of milking and storage processes, transferring of milk into different containers and sieves, unclean milk equipments were basic determinants of milk quality. Majority of raw milk samples from producer and collector bulk milk sample had higher TAPC and coliform counts, which was higher than the international acceptable limits.

Based on the enquiry of the present study the following recommendations are forwarded:

- Improving the existing feed resource through encouraging private sectors to be involved in animal feed production should be sought;
- Smallholders should be provided/supported with extension and training opportunities for hygienic conditions of milking, storing and processing;
- Quality based pricing in the milk value chain could contribute as incentive to producers for production of quality mil;
- Smallholders should be provided/supported with credit facility and market information;
- Regulatory mechanisms should be established and enforced to deter milk and milk products adulteration.

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8. APPENDICES

Appendix 1.Conversion Factors used to estimate Tropical Livestock Unit (TLU)

Types of animal (species)	Indigenous breed		Crossbred	
	Live weight (kg)	TLU	Live weight (kg)	TLU
Cow	250	1.0	380	1.5
Heifers	125	0.5	150	0.6
Oxen/Young bull	250	1.0	300	1.2
Calve	50	0.2	50	0.2
Sheep & Goats	22	0.1	-	-
Horse & Mule	200	0.8	-	-
Donkey	90	0.4	-	-

Source: Variko, T. (1991)

Appendix 2: Questionnaire sample

Name of Enumerator: ________________

Telephone: ___________________________ Region: ___________________

Zone: __________________________Wereda: _______________________/District:

Kebele:_____________ sub village /Goti: _____________ Date __ __/__ __/2004 Time started ______Time ended ______

General information	Categorical
Relationship to head of household	1) Household head 2)Spouse 3) Son 4) Daughter 5)Daughter-in-law 6)son-in-law 7)grand child 8) Niece 9)Nephew 10) House help 11) Grandparent 12) Other (specify)________

Sex	1. Female 2. Male
Age(years)	
Family size including house hold	1. Male _______ 2) Female___________
Level of education	1. Illiterate 2. Basic education 3. Primary school 4. Secondary school 5. Technical education 6. higher education
Primary activity	1) Unemployed 2)Own farm work 3) Salaried Employment 4) Business / trade 5) Labour 6) Retired with pension 7)retired without pension 8)Pupil student 9)Civil service employee 10) Professional / Private employment 11) Other (specify)
Marital status	1) Married 2)Single 3)Divorced 4) Living together 5)Widow /Widower
District	

Household Demographic information

1. Home rearing and sales of livestock (other than dairy animals and dairy products)

Livestock	No. kept current (count)	Number of livestock sold or given away in last one year	Price or value per unit of last livestock sold or given away	Number of livestock bought in last one year	Price or value per unit of livestock bought
Calves					
Heifers					
Cows					
Bulls					

Oxen					
Donkeys					
Horses					
Mules					
Sheep					
Goat					
Chicken					

2. Milk productions

Milk production issues		
How many milking cows do you have?	Local. ______________ Crossbred ________________	
Do you have other business than dairy production? A) Yes B) No	If yes, please select/describe a) full time employee b. crop and other agricultural products producer c)trader d)others(specify) ____ ____	
What is your milking cows' average daily milk yield (liter)?	Local ____________ Cross ____________	
What is the lactation length of your local cattle?	a)4 months b) 6 months c) 8 months d) 10 months e. Others (specify)	
What is the lactation length of your crossbred cattle?	4 months b) 6 months c) 8 months d) 10 months e) Others (specify)	
What amount (liter) of milk is produced at your farm?	Processed _________ c. Sold _____________ Consumed at home _____d. Other use (specify) _______	
Do you sell all the milk at your farm or transport it to market place?	i) Sell at farm	ii.Transport

If transport, how far (km) is the market place from your farm?	a. Less than 1 km b) 1 – 5 km c) 5 – 10 km d) more than 10 km		
At which market do you sell your milk?	a. .Supermarkets f. Vendor b. Cooperatives g. Processors c. Hotels/restaurants h. Shops e. Neighbors i. Distant markets in bigger towns e. Local nearby markets j. Directly to Consumer, k. Others (specify)		
Which ones are your ideal markets to sell your dairy products in order of your preference?	a. Farm gate ____________ d. Collector ____________ b. To cooperative______ e. To collection center_______ c. To larger processers__________ f. Others (specify) ________		
Who are your customers? List please.	a. Neighbors c. Cafes and restaurants b. Collection centers d. Large processors e. Others (specify)		
What are your reasons for selling milk?	a. Earn income d. There is high Demand b. Only job available e. Hobby c. Availability of resources f. Others (Specify)		
How long have you been in the business of raising cattle for milk production?	a. Less than 2 years c. B/n 2 – 5 years b. B/n 5 – 10 years d. More than 10 years		
What is the source of the basal diet for your dairy animals?	a. Grazing c. Conserved feed (hay / silage) b. Crop residue d. Others (specify)		
Do you supplement your dairy animals? Yes No (If Yes, please write amount (kg) per cow in the space provided)		Milking herd	Non milking herd
	Bran		
	Cakes		
	Brewery by products		
	Premix		
	Salt		

	Others		
What equipment do you use for milking and milk handling?	a. Plastic pail b. Aluminum pail c. Grass weaved container d. Calabash	e. Stainless steel pail f. Clay pot g. Wooden container h. Others (specify) _______	
What Problems/ difficulties do you face in using those equipments?	a. Difficult for cleaning b. Fragile	c. Difficult for handling d. Not accessible in local markets e. Others (specify)	
Milking hygienic practice	1.Wash milker hands and milk vessels 2. Wash udder before milking 3. Wash udder before and after milking 4. No hygiene 5. Use of collective towel	Use of individual towel With bare hand	
Are there seasonal variations in milk production?	a) Yes b) No		
If yes, in which months is milk production highest and lowest?		High production	Low production
	Month		
Give reasons for the variation in seasonal production	Reasons for High production		Reasons for Low production
	1. Surplus feed 2. Good climate 3. Surplus water 4. Good health 5. Good market for input 6. Others / specify		1. Feed shortage 2. Unfavorable climate 3. Water shortage 4. Health problem 5. Lack of market 6. Others / specify
Who decide price of milk?	1. Producer 2. Processer 3. Collector 4. Consumer 5. Others (specify)		

25. Do you observe some quality and hygiene measure on your farm and milk production processes**?**	a. Yes, b) No If Yes, Describe the measures 1. Surrounding cleanliness 2. Workers' hygiene 3. Workers health 4. Container cleanliness 5. Workers' way of dressing 6. Others (specify) If No, describe why not - ________________________
Are your customers concerned about the quality of milk and its products you sold?	a) Yes b) No If YES, What is their main concern about….? 1. Nutritional content (wholesomeness) 2. Hygiene, 3 Safeness 4. Microbial load 5. Contamination 6. adulteration If No, describe why not ________________________
Are your customers willing to pay more for better quality?	Yes No
What Marketing problems for your milk do you face?	1. Price variation 2 Lack of fair market 3. Lack of demand 4. Others (specify)
What Type of housing for Dairy Cows do you use?	1.Open without enclosure 3. Traditional barn 2. Improved barn 4. In family house
What materials did you use for the construction of the milking shade floor?	1. Concrete 2. Cement 3. Wood 4. Others, specify __________

How often do you dispose off waste materials from the barn/ milking house?	1. Frequently 2. Once a day 3. Twice a day 4. Once a week
How do you dispose your farm wastes?	1. Collect and store in one place 2. Collect, store and sell 3. Use manure as fuel and fertilizer 4. Others (specify)
Is there a proper waste disposal system used in the milking house/barn	1. Yes 2.No
If the response to question no.30 is yes, what proper system do you use?	1. Disposal system with screen for excluding solid wastes 2. Ordinary disposal system with no solid waste excluder 3. Waste disposal system with a provision for processing waste before disposing
Odour state in this barn is:	1. Offensive 2. Unbearable 3. Odorless
Dairy cattle disease/parasite found in the area	1. Internal parasite 2. External parasite 3.Mastitis 4. Anthrax Others (specify)

9. SIGNED DECLARATION SHEET

I, the undersigned, declare that this thesis is my original work and has not been presented for a degree in any University and that all sources of material used for the thesis have been duly acknowledged.

Name: Mustefa Abu

Signature: ______________

Date of submission: June 2012.

This thesis has been submitted for examination with our approval as University advisors:

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