Dairy production, processing and marketing systems of Shashemene–Dilla area, South Ethiopia

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Abstract

Two hundred forty dairy producers, both rural and urban producers in the four major towns representing the Shashemene–Dilla area in southern Ethiopia, were selected using a multi-stage sampling techniques, with the objective of characterizing dairy production, processing/handling, marketing systems as well as to prioritize constraints and opportunities for dairy development in the area. To characterize dairy marketing systems in the study area, a Rapid Market Appraisal (RMA) technique was employed. Dairy marketing systems were studied with the help of topical guidelines. Dairy producers were interviewed using a pre-tested and structured formal questionnaire. Two major dairy production systems, namely the urban and mixed crop–livestock systems were identified, and again classified into two categories based on the major crops grown as a cereal crop producing and *enset*–coffee producing areas. The average family size of urban and rural dairy producers was 7.19 ± 0.26 and 7.58 ± 0.23 persons, respectively. Dairy contributed about half of the income of urban producers but it made up only 1.6% of the total income of families in the mixed crop–livestock production system. Average farm size of households in the mixed system was 1.14 ± 0.99 ha, while more than 97% of the urban producers use their own residence compound for dairying, which is only 200–400 square meters. Average herd size per household in the cereal based mixed system (3.8 ± 0.42) was higher than in the *enset*–coffee based systems (2.3 ± 0.36). Out of the total herds of urban producers, 32% of cattle were local cows while 19% were crossbred. Husbandry practices like feeding, watering, housing, breeding, milking, calf rearing, waste management, and record keeping were also different between the two productions systems. An estimated total of 9,645,020 litres of milk was produced annually from 4463 small and medium farms in the four towns. The majority of producers (61.7%) in the mixed crop–livestock system process milk at home, while the majority of urban producers (79.2%) produced milk for sale. An informal dairy marketing system was the only marketing system in the area. Different market channels and market outlets were identified for different dairy commodities, butter being the one having the longest channel. Prices of dairy commodities were influenced by different factors like season, access to market/distance from towns, fasting and non-fasting days, festivals and holidays, level of supply vs. purchasing ability of the urban dwellers, and quality of dairy products. Constraints for dairy development in the area included: availability and costs of feeds, shortage of farm land, discouraging marketing system, waste disposal problems, genotype improvement problem, poor extension and animal health services, and knowledge gap regarding improved dairy production systems. The rapid urbanization, subsequent increase in human population and standard of living of the urban dwellers especially the regional town Awassa as well as the rest three zonal towns can be considered as a good

prospect for the development of dairy in the area. Dairying in the studied areas can be improved by solving major problems of smallholder dairy producers through services related to feed supply, access to land, good marketing systems, allocating place for waste handling and management and through provisions of veterinary, artificial insemination (AI), credit, extension, and training services at reasonable time and cost. Moreover, as market is the deriving force to the production and productivity of dairying, encouraging private investors to establish dairy processing plants in the area may be an option as a permanent market outlet for both rural and urban dairy producers through an organized milk collection schemes.

1 Introduction

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). Ethiopia has a diverse population, with more than 70 distinct ethnic and linguistic groups (Edmond 2007).

The Ethiopian economy is highly dependent on agriculture, which in the 2004/05 fiscal year, contributed about 48% of the GDP, followed by 39% from the service sector, and 13% from the industrial sector. The agriculture sector provides employment for about 80% of the population (The Economic Intelligence Unit 2007). The livestock subsector plays a vital role as source of food, income, services and foreign exchange to the Ethiopian economy, and contributes to 12 and 33% of the total and agricultural GDP, respectively, and accounts for 12–15% of the total export earnings, second in order of importance (Ayele et al. 2003). 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 tonnes 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. Despite its huge numbers, the livestock subsector in Ethiopia is low in production in general, and compared to its potential, the direct contribution it makes to the national economy is limited.

For years or decades Ethiopia ranked first in cattle population in Africa, but the dairy industry is not developed even as compared to east African countries like Kenya, Uganda and Tanzania. Regarding dairy production, the national milk production remains among the lowest in the world, even by African standards (Zegeye 2003). Although many efforts were made towards dairy development and various research projects have been undertaken in some parts of the country, the outcome and impact have not been satisfactory. Most development and research projects in dairying were conducted within and/or around Addis Ababa milkshed.[1]

1. A milkshed in Indian context is defined as 'an area geographically demarcated by the registering authority for the collection of milk or milk product by the holder of a registration certificate' (http://www.blonnet.com/2002/03/02/stories/2002030200471400.htm).

Current development in the country is characterized by rapid population growth in the country in general and regional towns (like Awassa) in particular. The demand for dairy products is increasing as ever.

de Leeuw et al. (1996) defined 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.

One of the necessary conditions for increased milk production is the provision of assured marketing outlets that are sufficiently remunerative to producers. Experience of countries like India, Uganda and Kenya reveals marketing outlet is a key initiator of milk production to smallholders (Matthewman 1993). Even in the long run, surplus milk can be processed into different dairy products for export, which brings foreign exchange. Planners should consider the relative efficiency of alternative milk marketing systems in terms of costs and marketing margins, product hygiene and quality, range and stability of services offered and stability of producers and consumer prices. To do so, policy makers, development organizations and private investors are in need of information of different aspects of the production system of the specific area, potentials and constraints of production and marketing conditions/systems.

Several organizations including international and national agricultural research centres, the World Bank, Ministry of Agriculture, and non-governmental organizations (NGOs) have developed and promoted the use of improved dairy technologies to help increase farm productivity and smallholder income in Ethiopia (Freeman et al. 1995; Freeman et al. 1998). Different dairy development projects have also been launched at different times and at different parts of the present study area. Dairy Rehabilitation and Development Project (DRDP), Smallholder Dairy Development Project (SDDP), which was started in April 1995 (Ojala 1998), Sidama Development Project (SDP), National Livestock Development Program (NLDP) and 'Pilot package' are some to be mentioned. Despite these efforts to run in the direction with above-mentioned scenarios, there are no studies on the impact of all these projects and the current potential they created to 'improve', if any, market-oriented production of the sector. Above all, dairy production in southern

Ethiopia is constrained by several factors that can be classified as: (a) technical or biological and (b) socio-economic and institutional factors (Fekadu 1994). Therefore, it is justifiable to generate scientific information on the current production potential and market success of this dairy production system in the study area.

The total human population in the Southern Nations, Nationalities, and Peoples Regional State (SNNPRS) accounted for 15,321,000 in the year 2007 (SNNPRS–RSA 2006).

There is a need, therefore, to differentiate and describe in detail the different types of dairy production and marketing systems that exist within the agriculture sector so that research, recommendations and technical assistances are tailored to the specific needs of the farmers in each production systems. In contrary to this, there is limited knowledge of the dairy production, processing and marketing systems in the study area. With this background and understanding, this study was conducted with the following objectives.

General objective

- To support dairy development in the region through careful collection and documentation of information on the current practices, challenges and opportunities of dairy production, processing and marketing systems in the Shashemene–Dilla area

Specific objectives

- To characterize dairy production systems of Shashemene–Dilla area and to prioritize problems, challenges, and opportunities of milk production.
- To describe the dairy marketing systems and to identify constraints and opportunities for dairy marketing in the area.
- To explore ways of dairy processing and milk handling.

2 Literature review

2.1 Historical events of dairy development in Ethiopia

According to Ahmed et al. (2003), in the first half of the 20th century, dairying in Ethiopia was mostly traditional. Modern dairying started in the early 1950s when Ethiopia received the first batch of dairy cattle from United Nations Relief and Rehabilitation Administration (UNRRA). With the introduction of these cattle in the country, commercial liquid milk production started on large farms in Addis Ababa and Asmara (Ketema 2000). Government intervened through the introduction of high-yielding dairy cattle in the highlands in and around major urban areas. The government also established modern milk processing and marketing facilities to complement these input-oriented production effort.

In 1960, UNICEF established a public sector pilot processing plant at Shola on the outskirt of Addis Ababa in order to enhance growth of the dairy sector. The plant started by processing milk produced by large farms. The plant significantly expanded in a short period and started collecting milk from smallholder producers in addition to large farms. This led to further expansion of large dairy farms. During the second half of the 1960s, dairy production in the Addis Ababa area began to develop rapidly as a result of the expansion in large private dairy farms and the participation of smallholder producers with indigenous cattle facilitated by establishment of milk collection centres (Ahmed et al. 2003). Subsequently, different dairy development projects were launched in different parts of the country. The distribution of exotic dairy cattle, particularly the Holstein Friesian, in different parts of the country, especially around the major urban areas, also contributed to the further development of dairying in Ethiopia.

2.2 Overview of dairy production systems in Ethiopia

As defined by Sere and Steinfield (1995), livestock production systems are considered a subset of the farming systems, including cases in which livestock contribute more than 10% to total farm output in value terms or where intermediate contributions such as animal traction or manure represent more than 10% of the total value of purchased inputs. There are different classification criteria for livestock production systems in general and dairy production systems in particular. For example, based on criteria such as integration with crops, relation to land, agro-ecological zones, intensity of production and type of product, the world livestock production systems are classified into 11 systems (Sere and Steinfield 1995). Of these livestock production systems, mixed farm rain fed temperate and tropical highlands (MRT system) is by far the largest. Globally, it represents

41% of the arable land, 21% of the cattle population, and 37% of dairy cattle (Sere and Steinfield 1995).

Dairying is practised almost all over Ethiopia involving a vast number of small or medium or large-sized, subsistence or market-oriented farms. Based on climate, land holdings and integration with crop production as criterion, dairy production systems are recognized in Ethiopia; namely the rural dairy system which is part of the subsistence farming system and includes pastoralists, agro-pastoralists, and mixed crop–livestock producers; the peri-urban; and urban dairy systems (Azage and Alemu 1998; Ketema 2000; Tsehay 2001; Yoseph et al. 2003; Zegeye 2003; Dereje et al. 2005). The first system (pastoralism, agropastoralism and highland mixed smallholder production system) contributes to 98%, while the peri-urban and urban dairy farms produce only 2% of the total milk production of the country (Ketema 2000).

The rural system is non-market oriented and most of the milk produced in this system is retained for home consumption. The level of milk surplus is determined by the demand for milk by the household and its neighbours, the potential to produce milk in terms of herd size and production season, and access to a nearby market. The surplus is mainly processed using traditional technologies and the processed milk products such as butter, ghee, *ayib* and sour milk are usually marketed through the informal market after the households satisfy their needs (Tsehay 2001). Pastoralists raise about 30% of the indigenous livestock population which serve as the major milk production system for an estimated 10% of the country's human population living in the lowland areas. Milk production in this system is characterized by low yield and seasonal availability (Zegeye 2003).

The highland smallholder milk production is found in the central part of Ethiopia where dairying is nearly always part of the subsistence, smallholder mixed crop and livestock farming. Local animals raised in this system generally have low performance with average age at first calving of 53 months, average calving intervals of 25 months and average lactation yield of 524 litres (Zegeye 2003).

Peri-urban milk production is developed in areas where the population density is high and agricultural land is shrinking due to urbanization around big cities like Addis Ababa. It possesses animal types ranging from 50% crosses to high grade Friesian in small to medium-sized farms. The peri-urban milk system includes smallholder and commercial dairy farmers in the proximity of Addis Ababa and other regional towns. This sector owns most of the country's improved dairy stock (Tsehay 2001). The main source of feed is both home produced or purchased hay; and the primary objective is to get additional cash income from milk sale. 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).

Urban dairy farming is a system involving highly specialized, state or businessmen owned farms, which are mainly concentrated in major cities of the country. They have no access to grazing land. Currently, a number of smallholder and commercial dairy farms are emerging mainly in the urban and peri-urban areas of the capital (Felleke and Geda 2001; Azage 2003) and most regional towns and districts (Ike 2002; Nigussie 2006). Smallholder rural dairy farms are also increasing in number in areas where there is market access. According to Azage and Alemu (1998), the urban milk system in Addis Ababa consists of 5167 small, medium and large dairy farms producing 34.65 million litres of milk annually. Of the total urban milk production, 73% is sold, 10% is left for household consumption, 9.4% goes to calves and 7.6% is processed into butter and *ayib* (cheese). In terms of marketing, 71% of the producers sell milk directly to consumers (Tsehay 2001).

2.3 Traditional milk handling and processing practices in Ethiopia

Cows are the main source of milk, and it is cows' milk that is the focus of processing in Ethiopia (Layne et al. 1990). Dairy processing in Ethiopia is generally based on *ergo* (fermented milk in Ethiopia), without any defined starter culture, with natural starter culture. Raw milk is either kept at ambient temperature or kept in a warm place to ferment prior to processing (Mogessie 2002).

Dairy processing in the country is basically limited to smallholder level and hygienic qualities of products are generally poor (Zelalem and Faye 2006). According to Zelalem and Faye (2006), about 52% of smallholder producers and 58% of large-scale producers used common towel to clean the udder or they did not at all. Above all they do not use clean water to clean the udder and other milk utensils. Of the interviewed small-scale producers, 45% did not treat milk before consumption, and organoleptic properties of dairy products are the commonly used quality tests.

In a study conducted in the Borena region of Ethiopia, butter was found to be an important source of energy as food for humans, and is used for cooking and as a cosmetic. The storage stability of butter, while not comparable to ghee, is still in the order of four to six weeks. This gives butter a distinct advantage over fresh milk in terms of more temporal flexibility for household use and marketing (Layne et al. 1990).

Efficiency of traditional butter production was measured for 28 instances in which soured milk was churned by women in 20 households of Borena region. Prior to churning, the milk had a temperature of 20.0 ± 0.42°C and an acidity of 1.06 ± 0.03%. The milk was churned for 40.0 ± 2.5 minutes and afterwards the temperature of the buttermilk was 23.7 ± 0.32°C. The sour milk contained about 46.8 g of fat, compared with 7 g of fat in the buttermilk after churning. Thus some 85% of the butterfat was extracted by churning. Butter yield was 66.9 ± 5.6 g but moisture content of the butter was not determined (Layne et al. 1990).

2.4 Dairy marketing systems in Ethiopia

In the African context, markets for agricultural products would normally refer to market-places (open spaces where commodities are traded). Conceptually, however, a market can be visualized as a process in which ownership of goods is transferred from sellers to buyers who may be final consumers or intermediaries. Therefore, markets involve sales, locations, sellers, buyers and transactions (Debrah and Berhanu 1991).

2.4.1 Formal vs. informal dairy marketing

The term 'informal' is often used to describe marketing systems in which governments do not intervene substantially in marketing. Such marketing systems are also referred to as parallel markets. The term 'formal' is thus used to describe government (official) marketing systems (Debrah 1990). Dependable system has not been developed to market milk and milk products in Ethiopia (Zegeye 2003). Fresh milk is distributed through the informal and formal marketing systems. In both rural and urban parts of the country, milk is distributed from producers through the informal (traditional) means. This informal market involves direct delivery of fresh milk by producers to consumers in the immediate neighbourhood or to any interested individuals in nearby towns (Debrah and Berhanu 1991).

Initial intervention to promote formal dairy marketing started with the establishment of a 300 dairy farm and a small milk processing plant under the UN Relief and Rehabilitation Program in 1947 in the premises of the now Dairy Development Enterprise (DDE) (Sintayehu 2003). The same report stated that in 1959 UNICEF helped establish a processing plant with a processing capacity of 10 thousand litres per day with milk collection and purchasing centres around Addis Ababa. The radius of milk collection was later expanded to 70 km around the capital. Capacity of the processing plant was increased to 30 thousand litres in 1969. In 1979 the DDA (Dairy Development Agency)

was transformed to the DDE when processing capacity was increased to 60 thousand litres/day and the radius of collection expanded to 150 km with donor assistance.

The only organized and formal milk marketing and distribution system comes from the two milk-processing plants which are both located in the capital Addis Ababa (Zegeye 2003).[1] As reported by many authors, farmers' milk marketing groups and dairy cooperatives play a key role for milk marketing outlets, which as a result encourages farmers to produce more (Zegeye 2003).

2.4.1.1 Role of farmers' milk marketing groups

According to Tsehay (1998), a milk-marketing group can be defined as a group of smallholder farmers who individually produce at least one litre of saleable milk and are willing to form a group with the objective of collectively processing and marketing milk.

To facilitate milk marketing by smallholders with crossbred cows, SDDP catalysed the formation of producer 'milk groups' (also called 'milk units' or 'mini-dairies') to process milk into butter, local cottage-type cheese (*ayib*), and yoghurt-like sour milk (*ergo*), primarily in the northern Shewa zone, north of Addis Ababa. Two similar producer groups were formed south of Assela (Arsi zone) with assistance from the Ministry of Agriculture, and another group was formed in Bakelo near Debre Birhan. This last site is in the Amhara region, whereas the other four are in the Oromia region (Nicholson et al. 1998).

2.4.1.2 Role of dairy cooperatives in facilitating marketing

Berhane and Workneh (2003), in their review, indicated the very useful involvement of the government of India at every step of the development for expansion of dairy cooperatives in the country for the successes of dairying and suggested that the Anand pattern of dairy development (India) can be emulated at least around the major milksheds in Ethiopia, for instance around Nazareth, Dire Dawa, Harar, Bahir Dar, Gondar, Awassa (one of the present study areas), Jimma and Assela. As demonstrated in India, dairy marketing cooperatives could provide farmers with continuous milk outlets, and easy access to essential inputs such as artificial insemination (AI), veterinary services and formulated feeds. Dairy cooperatives are supposed to help to trigger a series of positive developments in the subsector; hence strengthening the existing group marketing activities and formation of new cooperatives in different parts of the country (Berhane and Workneh 2003).

1. Although they are not studied and presented in literatures, nowadays, some dairy processing plants are established in different parts of the country (for example in Bahir Dar, Debre Zeit and Dire Dawa areas).

The history of the dairy cooperative system in India began in 1946 with the establishment of the Anand Milk Union Ltd (AMUL). In 1970, Operation Flood commenced with the objective of establishing a cooperative structure on the Anand pattern (Matthewman 1993). In 1980, some 12 thousand village cooperative milk producers' societies had been established in 27 selected milkshed districts. This was expanded by 1984 to 28,174 village producers in 155 milkshed districts linked to markets in 147 towns. The case of Uganda (followed the same milk collection schemes through cooperatives with this regard) is also a good example from east Africa (Matthewman 1993). Cooperative selling institutions are potential catalysts for mitigating costs, stimulate smallholders' entry into the market, and promote growth in rural communities (Holloway et al. 2000). Case studies from Kenya and Ethiopia illustrate the role of dairy cooperatives in reducing transaction costs (Staal et al. 1997). A good example to be mentioned in Ethiopia is Ada'a-Liben *Woreda* Dairy Association (Azage 2003) which presently renders milk to processing plants in Addis Ababa.

2.4.2 Dairy marketing channels and outlets

Terms related to marketing outlets, marketing channels, and marketing chains are important to describe dairy marketing systems. Marketing outlet is the final market place to deliver the dairy product, where it may pass through different channels. A network (combination) of market channels gives rise to the market chain.

A study of the milk marketing system in Kenya has shown that there are at least eight different marketing channels, with the number of intermediaries ranging from 1 to 4 (FAO 1996). A study in Addis Ababa milkshed revealed that dairy producers sold milk through different principal market channels (Debrah 1990; Mbogoh 1990), which included:

- Producer–consumer (P–C) channel: direct sales to individual consumers, which accounted for 71% of the total channels (Mbogoh 1990);
- Producer–catering institution–consumer (P–CI–C) channel: catering institutions includes// itinerant traders, small private shops and kiosks, coffee and tea sales, hotels, and supermarkets; and
- Producer–government institution–consumer (P–GI–C) channel: sales to government institutions such as the armed forces, schools and hospitals.

The main outlets for cooking butter for rural producers near Addis Ababa were:

(i) restaurants in Addis Ababa and surrounding areas that serve local foods,
(ii) itinerant traders, and
(iii) individual consumers or butter wholesalers in Addis Ababa.

Sales to restaurants accounted for 36% of total sales, while those to itinerant traders accounted for 33% and sales to individuals and those to wholesalers in Addis Ababa accounted for 31% of sales (Debrah 1990).

2.5 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 1998; 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). According to the same report, small-scale farmers can be empowered through:

- Promoting farmer organization, provision of training etc.
- Developing infrastructure, roads, markets etc.
- Providing incentives and promoting vertical integration with supply and processing and marketing sectors
- Improving access to information and to agricultural and veterinary services
- Promoting participatory methods in research and technology development
- Supporting pro-poor research and advisory services that are smallholder oriented.

In order to have such recommendations, therefore, knowledge of the specific characteristics of dairy production and marketing systems is vital to be able to target recommendations to specific production systems.

3 Materials and methods

3.1 Description of the study area

This study was conducted in the area stretching from Shashemene to Dilla, which is one of the high potential areas for milk production in southern Ethiopia. It is located on the Addis Ababa–Moyale highway, between 250 and 375 km south of the capital Addis Ababa. Major towns selected for the study are Shashemene, Awassa, Yirgalem and Dilla, each of these areas has different agricultural and other social practices. Among others, there are three major local languages spoken, which are defined by geographic location and ethnic groups in the study *woredas,* namely, Gedio language in Dilla area, Sidama language in Dale and Awassa areas, and Afan Oromo language in Shashemene area. Amharic, the federal working language, is commonly spoken in all the towns. Descriptions of each area are given below:

Shashemene is found in Oromia Regional State, West Arsi Zone, and located 250 km south of the capital Addis Ababa, and 25 km north of Awassa, the regional capital of SNNPRS. The area lies within the Rift Valley, with altitudes ranging from 1700 to 2600 metres above sea level (masl). It receives an annual rainfall of 700–950 mm, and has an annual temperature range of 12–27°C (SWARDO 2006). Major crops grown around Shashemene area are cereals such as teff, barley, wheat, maize, sorghum, and root crops like potato and sweet potato and vegetables such as cabbage, spinach and onion as cash crops. Annual crops are predominant and rain-fed agriculture is mainly practised using draught power. Total human population of this area is 285,176. The *kebeles* in the *woreda* are categorized as *Kolla* (50%), *Woinadega* (29%) and *Dega* (21%). Out of the total area of 76,888 ha, crop land accounts for 48,975 ha, and the rest 7440, 5160, and 1320 ha are forest land, grazing land and land for other purposes, respectively. The urban settlement accounts for 1733 ha (SWARDO 2006). The cattle population in the *woreda* is 184,549.

Awassa, the regional capital of Southern Nations, Nationalities and People's Regional State (SNNPRS), is found 275 km south of the capital Addis Ababa along Addis Ababa–Moyale highway. It has an altitude of 1750 masl, and is located at 6°83′ to 7°17′ N and 38°24′ to 38°72′ E (AWARDO 2006). It has an annual average rainfall of 955 mm with mean annual temperature of 20°C (SNNPRS–RSA 2006). Unlike most *woredas* of the Sidama Zone, major crops grown in the area are not cash crops but rather food crops like cereals and *enset*. Total urban and rural population of Awassa *woreda* is 123,494 and 375,041, totalling 498,534 (SNNPRS–RSA 2006). The cattle population in the *woreda* is 261,365.

Dale, presently divided into three new *woredas*, is situated 40 km south of Awassa. It is located at 6°44′ to 6°84′ N and 37°92′ to 38°60′ E with an altitude range of 1001–2500 masl (average 1624 masl). This *woreda* has diverse agro-ecological zones, and receives an annual mean average rainfall of 1170 mm (SEDPSZ 2004). The average annual temperature is 19°C. Even though Haptic Luvisols and Chromic Luvisols are the predominant soil types, Humic Nitisols, Eutic Vertisols, and Eutric Vertisols were also documented (IPMS 2005). Because of its diverse agro-ecological zones, there are different agricultural practices in this area. Relative to other areas, it is characterized by food crops like *enset* and maize and diversified cash crops like coffee, fruits (such as banana, avocado, guava), haricot bean and root crops like potato and sweet potato (DaWARDO 2006). Total population of this area is 428,648 where 41,270 are settled in the urban centres and 387,378 in the rural areas (SNNPRS–RSA 2006). The cattle population in the *woreda* is 215,924.

Dilla is another area considered in this study. It is located 90 km south of the SNNPRS regional town Awassa. It is located at 6°22′ to 6°42′ N and 38°21′ to 38°41′ E and at an altitude range of 1300–2500 masl. It receives an annual rainfall of 849.8 mm and the annual average minimum and maximum temperatures of 12.5°C and 28.0°C, respectively. Most (82.13%) of this area is covered with perennial cash and food crops, 8.54% with annual crops and 3.96, 2.57 and 2.13% land is covered with bush, grazing land and other types. This area is commonly known for its cash crops like coffee and fruits and food crops like *enset*, maize, sorghum, teff, and barley. Shortage of land is the peculiar nature of this area, resulting in diversified cropping practices within small plot of land. Chromic and Orthic Luvisols are the dominant soil types. Total population of this area is 267,867, where 66,200 live in urban towns including Dilla and Wonago, and 201,667 live in rural area. The cattle population in Dilla is 16,516 heads (DiWARDO 2006).

3.2 Sources and methods of data collection

3.2.1 Dairy production and processing systems

In order to characterize the dairy production systems in the area, farmers/producers were interviewed using a structured questionnaire which was pre-tested, and translated into Amharic language. Enumerators (diploma holders in Animal Science), were recruited and trained before actual data collection commenced.

Multi-stage sampling procedure was followed at four stages. In the first stage, a primary sampling unit represented by two broad categories of producers (Rural and Urban) was selected within each study *woreda*. In the second stage, *kebeles*, in the case of rural producers, and groups of urban *kebeles* in the case of urban producers, were identified

after a livestock census was conducted at each town. In the third stage, individual households having dairy cows of any breed and size were identified and listed. In the fourth stage, individual dairy cow owner households were randomly selected from the list for an interview.

Since there was no formal marketing and/or milk collection scheme in the rural producers in the area, two rural *kebeles* were randomly selected within 3 to 10 km radius of each *woreda*. This radius was assumed to be an ideal distance for dairy marketing in their respective neighbouring towns.

Prior to data collection, dairy cow owners were identified from each of the rural *kebeles* by the data collectors from the respective administrative *kebeles* from which households were randomly selected from the list. Since there was no reliable and up-to-date information on the livestock holdings of each town, a census was conducted from October to November 2007, with special reference to dairy cattle owners at Shashemene, Awassa, Yirgalem and Dilla towns. This census result was also used to estimate the total amount of milk produced from the four towns considered. The lactation length and daily milk off-take of both zebu and their crosses were obtained from producers; hence the total amount of milk produced in a year was calculated.

The total number of households interviewed was 240 comprising 60 households from each *woreda* where 30 were from rural and the other 30 were from urban *kebeles* of each of the four *woredas*. In addition to the main survey employed, participatory rural appraisal (PRA), as group discussion, was employed with the help of topical guidelines for some qualitative dairy production parameters (Bayemi et al. 2005). This provided additional information to characterize the dairy production systems in the area. Personal observations at the time of visits and supervisions were also made to fill the gap that might have not been described during the survey particularly to describe some of the routine dairy activities practised by producers.

3.2.2 Dairy marketing system

Marketing of the possible marketable dairy commodities like whole milk, butter, yoghurt (*ergo*), cheese and sour buttermilk (arera) were studied as the second activity. Rapid market appraisal (RMA) (Holtzeman 1986; Menegay and Molina 1988; Miles 2000) was employed in order to collect relevant data from the respective key informants at different stages (milk producers, dairy traders and consumers). Separate semi-structured informal interview guideline (checklists) was used for each group of key observers. Prior to conducting the RMA on the different marketing agents, census was conducted to count

the number of permanent butter traders and *ergo* sellers at each of the four towns, i.e Shashemene, Awassa, Yirgalem and Dilla.

3.3 Statistical analysis

Data collected for the characterization of dairy production and handling systems were analysed using appropriate statistical software–Statistical Procedures for Social Sciences (SPSS 2001) and Statistical Analysis System (SAS 1997). Survey results were reported using descriptive and inferential statistics. Statistical analysis such as correlations, and mean comparisons were made for some variables of interest. Mean comparisons were made using Duncan's multiple range tests. Levels of significance considered were at alpha of $P < 0.01$, $P < 0.05$ and $P < 0.001$.

Data related with pricing, collected for the characterization of dairy marketing system, were analysed using descriptive statistics of SPSS, and the data collected with RMA were reported with flow charts and summarized discussions.

4 Results and discussion

4.1 Dairy production and handling systems

4.1.1 Production systems identified

Two major dairy cattle production systems were identified; namely the mixed crop–livestock production system in the rural (suburb) areas and the urban dairy cattle production system, which was found within cities or towns. Although a third production system was identified, the pastoral production system, its characteristics was not studied at present as this production system is outside the radius (3–10 km) of the present work. Each of these two production systems were further subdivided into subsystems based on the type of major crops produced in the area as cereal based and *enset*–coffee based dairy cattle production systems. Based on criteria that included land and resource use, Sere and Steinfield (1995) also characterized the cattle production systems into different production systems. Therefore the present study was mainly focused on detail characterization of these two systems as presented in the following sections.

4.1.1.1 Mixed crop–livestock dairy system

Mixed crop–livestock agricultural system was identified in the rural parts of the studied areas, and it is a system of which outputs or products and/or by-products of crop and livestock are the resource input for one another. The vegetation types and crop farming practices have some implications on the livestock production in general and dairy production systems in particular. Above all, the predominant feed types provided to cattle are different in the different production systems. Even the primary purpose of keeping cattle in one area is different from other areas. Based on the above mentioned criteria, the crop–livestock production system in the investigated areas is categorized into cereal crop based and *enset*–coffee based subsystems. Adugna and Said (1992) in Wolaita; Agajie et al. (2002) and Tessema et al. (2003) in the mid highlands of Ethiopia, and Talew (2006) in Yirgachefe also found the mixed crop–livestock production systems in the country that have some common characteristics in terms of resource use with the one identified in the studied areas.

Cereal crop based dairy subsystem

This subsystem was identified in the rural areas of Shashemene and part of Awassa. Cereal crops predominantly produced in the adjoining rural areas of these two towns are maize, teff, sorghum, wheat and barley. Crop farming in this area is mainly practised using oxen draught power and oxen are given due attention than other cattle types. Farmland size and

communal grazing area, particularly in Shashemene area are relatively better. Bull calves are more preferred than heifer calves. This prioritization is similar to Dilla area, but in Dilla area these bull calves are not raised for ploughing purpose, they are fattened for beef production. In most rural parts of Awassa and Dale areas, heifer calves are more preferred than bull calves. Milk production is from animals kept for multipurpose use, and feed production and utilization is limited to communal grazing land and crop residues. Dairy products are produced and used as source of income to buy farm inputs and family needs and cattle are an asset securing farmers at the time of emergency.

Enset and coffee based dairy subsystem

*Ense*t and coffee based dairy cattle production system is the other subsystem under the mixed crop–livestock production system identified in the area. This system mainly defines the cattle production system in the rural parts of Dale and Dilla areas. This production system is characterized with perennial cash and food crop production and farmers are primarily engaged in the production of cash crops rather than rearing livestock. Because of small farm size holdings in these areas, it is common to see highly diversified cropping practices within a single farmland. *Enset*, coffee, fruits (like banana, avocado, mango, and pineapple), 'Boynna' (yam), cassava, 'Godere' (Taro), 'chat', and annual crops like maize and sorghum are common cash and food crops grown in the area. Crop farming in this system is mainly practised with hand tools, seldom with draught oxen.

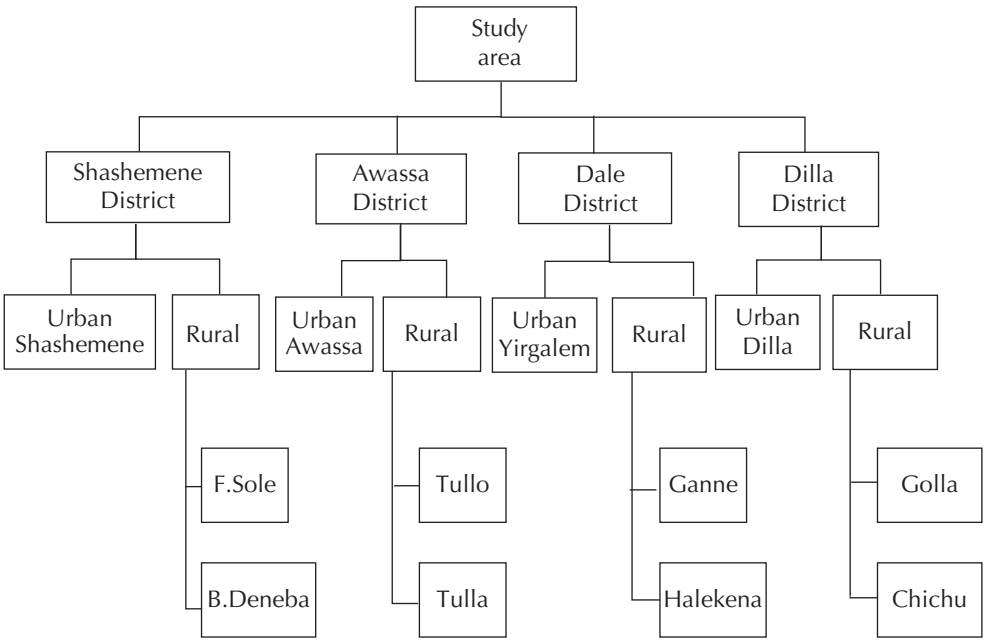

Figure 1. *Study areas and the respective rural* kebeles *selected for the study.*

Enset in these areas are the staple food and contains low protein level. Milk and its by-products from cattle, being a good protein source to supplement *enset* and the contribution of animal dung to those perennial crop production, signifies the importance of dairying in this production system. Contrary to the other study areas of livestock rearing, particularly dairying is not a common practice in the rural areas of Dilla *woreda*. However, there are relatively better beef cattle fattening practices. Communities in the area are more accustomed to consume beef than milk and other dairy products. It is not unusual to see groups of bull calves tethered at the backyard and/or allowed to graze along the roadsides. This area is different from the other studied areas because meat is commonly sold in open markets; and most farmers, particularly during harvest time of coffee, buy meat for family consumption. Nowadays, through the new extension system, people of this area have started dairy farming as well.

4.1.1.2 Urban dairy production system

Likewise, the urban dairy production system was identified in the four towns, namely Shashemene, Awassa, Yirgalem and Dilla. The urban dairying, like most urban dairying of Ethiopia and other east African countries, is characterized by market orientation and by the types of inputs particularly feeds. The feeds are of purchased concentrates and roughages of conventional and non-conventional ones. Most dairy producers found in the four towns are smallholders with relatively (compared to rural parts) higher composition of Holstein Friesian crosses with different blood levels. This observation is in agreement with Addis Ababa and Mekele urban dairying (Yoseph et al. 2003; Nigussie 2006). Evidence of spatial growth and economic importance of urban agriculture in general, and urban livestock production in particular in many African cities and capitals are also well documented in literatures, for example Mosha (1991) in Tanzania; Lee-Smith and Memon (1994) in Kenya; Azage and Alemu (1998) in Ethiopia, Addis Ababa; Smith and Olaloku (1998), Nigussie (2006) in Ethiopia, Mekele.

In the following sections, important production parameters are compared between the mixed crop–livestock production systems and urban dairy production system. For some of production and reproduction parameters, the four *woredas* are grouped into the cereal crop-based and *enset* and coffee-based urban and rural systems respectively (totalling four systems). In case of some socio-economic characteristics of respondents, the overall values are presented for discussion.

4.1.2 Household characteristics and socio-economic profile of respondents

Out of the total interviewed dairy cattle producers (N = 240), 77% were male and the rest (23%) were female household members of different age and educational status. Most (87%) of the respondents were household heads while the rest were other family members (mainly wives). Most of the respondents ranged in age between 25–40 years (31.5%) and 41–50 years (32%). Out of the sample dairy cattle producers, 211 households (88%) were male headed households.

With respect to educational status of the household head, the majority of urban dairy producers were literate beyond elementary school. The overall proportion of illiterate farmers was 19%. About 29 and 7% have completed grades 1–6, and grades 7–10, respectively, while 20% have greater than 10^{th} grade and 25.6% have diploma or advanced level education. The results in general indicate that dairy cattle owners in the study areas are mainly literate; suggesting that with good extension and training program they can improve their dairy production and marketing.

The average family size composition by age group indicates that the majority of household members (58.84%) were within productive age group categories in both urban and mixed crop–livestock production systems. For instance, the overall mean (± SE) number of family members in urban and rural areas within the age groups of 11 and 25 years was 3.17 (0.17) and 1.63 (0.16), respectively and within the range of 25 to 40 years of age was equal to 2.54 (0.16) and 1.53 (0.10), respectively.

Dairy cattle owners of the sampled households generate income from different sources and for the majority of rural producers dairying is not the main income source. Although butter and sour buttermilk were marketable dairy products, throughout the year, the income obtained from these was meager in the studied rural communities. Urban producers generate substantial (50% of their total income) level of income that dairy producers achieve from dairying. Contrary to this, dairying contributed only 1.6% to the total income of families in the rural areas (Table 1). The result of studies in the mid highland crop–livestock production system of Ethiopia have shown that depending on the distance from urban centres, the level of income share from dairying increases and ranged from 0.07 to 44% of the total income of farmers (Zelalem and Ledin 2000). Similar studies conducted on market oriented-dairy producers around Holleta area indicated that dairying on average contributed 34% to the total income of the farmers (Ahmed et al. 2002). Compared to other areas, therefore, the present study showed that the contribution of dairying to the income of rural families is quite insignificant.

By contrast, urban producers in the study areas generated considerable amount from dairying and this can be considered as a good prospect to further promote dairying in these areas.

Table 1. *Total income vs. income from sale of dairy and its derivatives by area and production systems*

Study area	Production systems	n	Income sources and level per month (ETB)*		
			Total of different income sources	Share from dairying	
			Mean ± SE	Mean ± SE	Per cent
Shashemene	Mixed crop–livestock	30	238.8 ± 3.73	2.3 ± 2.33	0.98
	Urban dairying	29	687.2 ± 0.20	383.1 ± 76.63	55.8
Awassa	Mixed crop–livestock	28	209.5 ± 49.01	44.1 ± 23.28	21.1
	Urban dairying	27	2126.7 ± 1.98	1071.4 ± 260.37	50.4
Dale	Mixed crop–livestock	21	174.0 ± 41.58	17.1 ± 6.44	9.9
	Urban dairying	30	1168.4 ± 188.41	415.3 ± 153.94	35.6
Dilla	Mixed crop–livestock	30	278.8 ± 59.63	55.7 ± 9.11	19.97
	Urban dairying	29	961.3 ± 211.17	554.3 ± 42.14	57.66
Overall rural		109	229.78 ± 23.99	30.6 ± 6.87	1.6%
Overall urban		115	1219.83 ± 124.53	596.3 ± 86.38	48.88%

* In January 2008, USD 1 = 9.2007 Ethiopian Birr (ETB).

The amount of income obtained by dairy producers in the studied areas was affected by different factors. Among these, herd size, income from other sources, crop land (farm) size, and productivity of animals owned (high yielder vs. low yielder) were the main factors. The overall correlation analysis based on data of all towns indicated that there was a positive correlation ($r = 0.45$, $P < 0.001$) between total household income and total cattle size. Total family income was also positively correlated ($r = 0.39$, $P < 0.001$) with the number of educated family members, mainly with those that have diploma or higher level of education.

Like most smallholder dairy production systems of Ethiopia, family members are the major source of labour for any dairy activities in the studied areas, such as indicated for Addis Ababa milkshed (Yoseph et al. 2003). Results of the interviewees indicate that cattle purchasing, selling and breeding activities were mainly operated by adult males. Of the interviewed producers in the mixed crop–livestock and urban system households, 89.8 and 71.2% of adult males were involved in purchasing, 87.4 and 66.4% in selling of cattle and 45.8 and 46.6% in breeding activities, respectively. Cattle herding, if grazing is allowed especially in the mixed crop–livestock production, was found to be operated by either male family or hired children. But other family members were also found to be involved in this activity on a shift basis. Routine dairy activities like feeding, milking

and nursing of sick animals were operated by family members and hired labourers. In the case of urban producers, the overall role of hired labour in the four towns ranged from 5 to 11.7%. This figure is lower as compared to the urban dairying of Mekele town, where the involvement of hired labour goes as high as 75.7% in large and medium scale farms (Nigussie 2006). Most activities related to milking, milk handling, processing (churning) and milk selling were performed mainly by household wives and other adult female members and/or female children above 15 years old. For example, 86 and 60% of household wives were involved in milking, in the mixed crop–livestock and urban production systems, respectively.

With respect to control over of dairy products, females in all of the studied areas had control over milk and its by-products. For example, 76.3% of the females in the mixed crop–livestock system were involved in churning activities and marketing of dairy products, while in the urban areas 70.3% of the spouses handled the milk marketing activity. The overall dairy cattle management in the study area is controlled by male adults, female adults or combination of both. For example, 88, 7.7, and 3.4% of the cases in the mixed crop–livestock system and 61.9, 26.3, and 11% in urban dairy cattle producers, adult males, household wives or both, respectively, were involved in the whole control over of cattle management.

4.1.3 Farm land size of dairy producers

The overall average land size in the surveyed rural areas was 1.14 ha per household, but this varied in different areas considered (Table 2). The largest holding was in the rural areas of Shashemene (1.97 ha/household) followed by Dale area (1.12 ha/household). But holdings were fairly small around Dilla (0.87 ha/household) and Awassa (0.59 ha/household). Land is one of the important prerequisites for any farming activity. One of the big challenges of both rural and urban dairy producers in the area is the diminishing land size they own. Because of rapid urbanization in the area, farmers do not have extra land to develop improved animal feeds or do not have access to communal grazing land. As indicated in Table 2, there is small land size especially in the rural parts of Awassa and Dilla area, but compared to the regional average land holdings of SNNPRS and Oromia, the overall mean value of 1.14 ± 0.99 ha for this study area is not low compared to the fact that 46.5% of the farmers in SNNPRS and 24.6% in Oromia households own only 0.1–0.5 ha of farm land (CACC 2002). More than 96.6% of the interviewed dairy cattle producers in the urban system run dairy farming within their own residence compound. These producers indicated that land size is among the main constraints for expanding their dairy farming.

Table 2. *Mean (± ME) total farm land size (ha) of households in the mixed crop–livestock production systems*

Mixed crop–livestock systems	Study areas (rural)	Total farm land size (ha)		
		n	Mean	Std. error
Cereal crop based system	Shashemene	30	1.97	0.15
	Awassa	30	0.59	0.09
Enset and coffee based system	Dale	29	1.12	0.09
	Dilla	30	0.87	0.23
Overall		119	1.14	0.99

4.1.4 Trends in dairy development in the study area

The majority of dairy farms were established about 15 years ago, and the proportion of farms established during the last 6–10 years in the rural areas of Shashemene, Awassa, Dale, and Dilla areas was 32, 20, 24, and 27.6%, respectively. Slightly higher percentages of urban dairy farms were established during these period with the highest in Shashemene (46.7%), followed by Dilla (38%) and Awassa and Dale (31%). Most of the dairy farms in the mixed crop–livestock system of Dilla (38%) and urban areas of Awassa (34.5%) flourished over the last 5 years. This result shows that farmers in both mixed crop–livestock and urban systems have been encouraged to engage in dairying activities quite recently and improved dairy farming is fairly a recent development in these areas. The overall trends in dairy development showed that the majority (55.7%) of the farms were showing a progressive trend, while 27.4% regressed, 13.5% remained stable and the remaining 3.5% was unknown.

4.1.5 Characteristics and types of cattle owned by dairy producers

4.1.5.1 Herd size and composition

Compared to *enset* and coffee based crop–livestock production system, cereal based crop–livestock production system was found to be better in terms of average total livestock (4.35 ± 0.47 TLU) holdings and total cattle herd size (3.80 ± 0.42 TCU) (Table 3).

From the livestock census report (Table 4), conducted during October–November 2006 with special reference to cattle owners at the four towns, out of the total livestock population of 11,620 TLU found in all towns, 85% (9871 TCU) was cattle of different breeds. The proportion of local cattle was 57.8% (5703 TCU) and the rest were crosses between exotic dairy types and local breeds. This being the overall situation, notable differences were also observed among the considered towns. For instance, both livestock

and cattle population in the two towns within cereal based systems were nearly fourfold than those two towns that exist within the *enset*–coffee systems. With respect to cattle breed composition, although crosses were fewer than locals in all four towns, the proportion between the two was fairly narrow except for Dilla, where locals were more than three times higher than crosses.

Table 3. *Dairy cattle and overall livestock holdings of the mixed crop–livestock production system*

	Mean total livestock holdings in TLU			Cattle herd size in TCU		
	Mean (SE)	95% confidence interval		Mean (SE)	95% confidence interval	
		Lower	Upper		Lower	Upper
Rural comparisons by *woreda*						
Shashemene	4.08 (0.39)a	2.90	5.26	3.34 (0.31)[a]	2.26	4.43
Awassa	4.63 (0.85)a	3.45	5.80	4.25 (0.79)[a]	3.17	5.34
Dale	3.39 (0.71)ab	2.22	4.57	3.13 (0.69)[ab]	2.05	4.22
Dilla	1.66 (0.17)b	0.49	2.84	1.51 (0.13)[b]	0.43	2.60
Rural comparisons by feed resources used						
Cereal based	4.35 (0.47)a	3.52	5.19	3.80 (0.42)[a]	3.03	4.56
Enset and coffee based	2.53 (0.38)b	1.70	3.36	2.32 (0.36)[b]	1.56	3.09

a, b Means that bear same letters are not significantly different from each other at p=0.05.

4.1.5.2 Purposes of keeping cattle

In the cereal based mixed crop–livestock production system, cattle of dual purpose predominated by local type (zebu), were mainly kept to produce milk for household consumption and male calves were grown to assist the crop production by providing draught power. Above all, cattle were an asset to farmers, which provides collateral during purchase of farm inputs like fertilizers and improved seeds for the next crop production cycle. The role of animal dung in this subsystem was not that much important to the crop production system, as compared to the *enset* and coffee based mixed crop–livestock system. In the cereal based mixed crop–livestock production system, the primary purpose of keeping cattle is quite different from any urban dairy or some other mixed crop–livestock production system. These characteristics were also noted by other authors for different crop–livestock production systems in the country, such as Wollega (Alganesh et al. 2004); Oromia Regional State (van Dorland et al. 2004); and Wollo in Amhara Regional State (Dereje et al. 2005).

Dairy cattle production in the *enset*–coffee based crop–livestock production system was very important. Unlike the cereal based system, cattle were not used as draught animals in the *enset* and coffee based system; rather perennial crops were cultivated with hand tools. Milk and milk products, being a good protein source to supplement *enset*, and

the contribution of animal dung to perennial crop production signifies the importance and integration of cattle and crop production in this production system. Talew (2006) also reported that the need for animal dung is the primary purpose of keeping cattle in Yirgachefe area, which is the other *enset*–coffee based system located south of Dilla.

Table 4. *Dairy cattle population by breed and classes, livestock composition (in tropical units), estimated annual milk production*

Cattle class by breed	Cattle heads at each towns				
	Shashemene	Awassa*	Yirgalem	Dilla	Overall sum (%)
Local breeds					
Lactating cows	771	1482a	255	336	3901 (31.3)
Dry cows	557		270	230	
Heifers	466	306	214	221	1207 (9.7)
Bulls/oxen	474	240	46	97	857 (6.9)
Male calves	563	205	180	169	1117 (8.9)
Female calves	382	250	131	188	951 (7.6)
Crosses with exotic breeds					
Lactating cows	609	1110a	185	87	2420 (19.4)
Dry cows	305		99	25	
Heifers	380	76	130	58	644 (5.2)
Bulls/oxen	105	7	36	17	165 (1.3)
Male calves	310	34	96	76	516 (4.1)
Female calves	378	56	105	168	707 (5.7)
Total TCU[a]	3640	4144	1129	959	9872
Number of cattle owning households	1882	1470	587	490	4429
Total TLU[a]	4272	5115	1197	1035	11,620
Estimated overall milk production/year (litres)[b]	3,587,938	4,257,111	1,128,915	671,056	9,645,020

Source: Own survey, 2007 and secondary data (* Wuletaw 2007).
a. TLU = Tropical Livestock Unit, TCU Tropical Cattle Unit.
b. Estimated overall milk production was calculated based on the total cows multiplied by the sample mean daily milk off-take and lactation length of 240 household interviewees.

Dairy producers in urban and mixed crop–livestock production systems had also different purposes for keeping cows (Table 5). There is a big difference between the mixed crop–livestock and urban production system, where the majority proportion of households (74.2%) in the urban system produced milk primarily for sale, while the majority of households (37.9%) in the mixed crop–livestock system used milk for household consumption.

Table 5. *Primary purposes for keeping cattle by dairy farmers in urban and mixed crop–livestock production systems*

Primary purposes for keeping cattle	Frequency (%)	
	Urban system (n = 120)	Mixed crop–livestock system (n = 120)
Produce milk for sale	89 (74.2)	8 (6.9)
Produce milk for consumption	21 (17.5)	44 (37.9)
For milk and meat	1 (0.8)	37 (31.9)
For asset	5 (4.2)	21 (18.1)
For sale of calves	4 (3.3)	5 (4.3)
Growing males for ploughing	0	1 (0.9)

4.1.6 Cattle husbandry and management practices

4.1.6.1 Feeds and feeding systems

Animal feeds and feeding are the major inputs in any dairy activity. Common feed resources in the studied areas varied between production systems. In the mixed crop–livestock system of both cereal crop based and *enset* and coffee based systems, grazing is the major feed resource. The majority (53.7%) of the households use animal feeds from their own crop farm, while 23.7% use a combination of own farm and communal grazing, and 15.8% use own farm and purchased feed and about 7% use other sources. Contrary to this, 76% of dairy producers in the urban production system use purchased feeds from different sources. The rest 16 and 1.7% use road side grazing and own feed resources, respectively.

Figure 2. *Cereal crop residues and* enset *crops as feeds of cattle in the two production systems.*

Like most dairy cattle production systems in the country, both conventional and non-conventional feed resources are used in the study areas. Feed resources commonly used

by dairy producers include grazing land, hay and purchased succulent grass, cereal crop residues, pseudo stems of *enset* and banana, maize stover, improved forages, mixed/balanced home made concentrate feeds, plant weeds, and non-conventional feeds like *attella* (brewery by-product from locally produced beer, and other alcoholic drinks), kitchen and fruit wastes, and leaves of other palatable agro-forest plant. Maize stover is the most commonly used roughage feed resource in all the production systems of the study areas and 77.5 and 45.4% of households use it during wet and dry seasons, respectively.

The cereal crop based system, which is mainly found in the rural areas of Shashemene and parts of Awassa, is similar in feed resource use with most mixed crop–livestock production systems of Ethiopia (Mohammod 1992; Agajie et al. 2002; Zelalem and Ledin 2003; Tessema et al. 2003; Dereje et al. 2005). Crop residues are also the major source of feeds for most African countries as reported by Aregheore and Chimwanu (1992) in Zambia; Boitumelo and Mahabile (1992) in Botswana; Ayoola and Ayoade (1992) in Nigeria; and Mdoe et al. (1992) in Tanzania. In these systems, annual food crops particularly cereals and root crops are dominant, and crop farming is highly integrated with livestock production, particularly with cattle rearing.

In the *enset* and coffee based system, cows are grazed along roadsides or tethered and grazed in the backyard. Other feeds provided to cattle include the pseudo-stem (well chopped), tinned and/or whole maize plant and leaves from different fruits and trees. What makes these areas peculiar from the rest of the production systems, with regard to animal feeding practices is that, cattle are fed with succulent roughage throughout the year. During the dry season, unlike cereal crop based systems of the mid-highlands of Ethiopia, farmers feed their cattle with *enset* pseudo stem, pseudo stem and leaves of banana, parts of sugar cane and its bagasse, and leaves from different trees. Similar feeding practices were identified in Wolaita (Adugna and Said 1992) and Yirgachefe areas (Talew 2006).

Dairy producers in the urban areas mainly used purchased roughage and concentrate feeds along with non-conventional feeds like *attella*. Hay stacking for the dry period was also practised by 35.8% of the urban dairy producers. According to Yoseph et al. (2000), hay stacking is also the most common feed resource in intra-urban and peri-urban dairy farmers around the Addis Ababa milkshed. In the current study, about 22.7 and 27.5% of smallholder dairy producers who live around the periphery of towns and those who keep local cattle in the towns also graze their cattle along the road sides during the dry and wet seasons, respectively. Dairy producers in Awassa, Yirgalem and Dilla towns, particularly smallholders, who do not have access or space to stack crop residues or hay, incur extra cost for purchasing sugar cane and succulent/dry grass during the dry season.

Cattle, mainly local breeds, also roam in open market places and other parts of the town in search of wasted foods, wasted fruits and other edible garbage. Feed resources identified in the present study are similar to the commonly used feeds in other urban dairy farming systems in the country (Yoseph et al. 2003; Nigussie 2006). In the study area, supplementary feed was mainly given to lactating cows. For example, 137 (58%) of the respondents indicated that they give priority to lactating dairy cows, while the rest did not give any special attention.

4.1.6.2 Water resources and watering practices

The main sources of water identified in the present study areas were rivers, pipe water, dams and wells, lakes, spring water and bore holes. The majority (45.8%) of the households in the mixed crop–livestock system obtained water from rivers, while 24.2% from pipe water, 10.8% from lake, 10% from spring, and the rest from other sources. With regard to urban producers the majority (71.8%) obtained water from pipe water. Although relative, all the interviewed dairy producers perceived that they provide good quality water to their cattle.

Frequency of watering to dairy animals varies from one production system to another, which is affected by different factors, among which season of the year, accessibility, performance and/or breed of the cow, and type of predominant feed and feeding systems are some to be mentioned. The overall figure during wet season shows that the majority (35.6%) of the households water their cattle once a day while the rest 21, 16.7, and 5.6% water freely, twice a day, and none at all, respectively. During the dry season, the majority (47%) of the households provide water once a day, but the percentage for twice a day is increased by double. From this figure it can be seen that, in the mixed crop–livestock system, the majority (68.4%) of farmers water their cattle once a day during dry season, and 38% of households water their cattle during wet season. Since urban producers usually give water in the form of liquid feeds (mixed *atella*, concentrates, and water) free water is not given by some of the households (8.4 and 4.2% for dry and wet seasons, respectively). The development of livestock rearing could not be considered without water supply.

4.1.6.3 Housing systems

Most households (70%) in the mixed crop–livestock system kept their cattle within their own residence compound, while considerable proportions (27%) used open barn/shed. By contrast, in the urban systems sheltering cattle with the family or cooking places (kitchen) was uncommon and was only practised by 6% of the households. Similarly, urban dwellers seldom used open barn as a night shelter for cattle and the majority (85%)

used a separate shelter for their animals. Sheltering cattle, not only protects animals from extreme environmental hazards, but also ease some other husbandry practices. Therefore, cow sheds must be designed in such a way that routine activities like feeding, watering, milking, waste management and other activities can be easily and effectively handled. Though this is the principle behind housing, certain factors prohibit farmers to do so.

4.1.6.4 Breeding practices

In the mixed crop–livestock system, most of the households (81.7%) used local bulls for mating, and only few households used AI (10%) or bulls with exotic blood (4.2%). Whereas in the urban system, the majority (50%) of the households used AI as a sole source of genetic improvement and among those who used natural mating, only 20% used solely local bulls and the rest used exotic (4.2%) or combinations of AI and exotic (15%) or combinations of AI and local bulls (10%).

The type of crop farming system is one of the factors that determined the proportions of the breeding bull or oxen in the area. In cereal based system, crop farming is usually practised with male animal power, and prior to castration these animals can also be used as a breeding bull for those who do not have access or do not want to use AI. In *enset*–coffee based system, since oxen were not commonly used as draught power, lower proportions of oxen or bulls were observed, and this often posed a problem of finding breeding bulls in the area. With regard to preferences of breeding methods, the majority of the households (53.9%) preferred AI.

Genetic improvement of cattle does not come free of cost, but once attained it is generally there without the need for further effort (Wiener 1994). Provision of genetically potential dairy cattle and/or good breeding services as per the demands of producers is one of the prerequisites for the development of dairying in the studied areas. As discussed earlier there is a marked difference in milk productivity and other economically important traits between locals and crosses in the studied urban systems, and the profitability of urban dairying as well as future prospects to improve urban dairying largely depends on the productivity of the animals. As a result, if urban and peri-urban dairying production is to flourish, access to improved genetic material through improved AI or breeding service is critical. Similarly in the suburb parts of mixed crop–livestock systems, there is a good prospect of intensifying dairy production because of market availability.

4.1.6.5 Milking practices

Out of the interviewed dairy cattle producers, 96.3% of households milked their cows twice a day. Very few farmers and milk their cows thrice (3.3%) and once (0.4%) a day.

The high percentage of milking twice a day is similar to the milking frequency practised in many parts of the country. Fekadu (1994) also noted that in some *enset* producing areas of Wolaita Zone, farmers milk cows thrice a day. Time of milking is normally in the early morning and late evening for twice/day milking. Rural farmers did not bother about the regularity of milking time. Urban producers, however, milk their cattle early and at a specific time so that milk is delivered to urban consumers early. Among the urban producers, about 52.2 and 41.4% indicated that they complete their morning milking between 0600 and 0700 hours, and 0700 and 0800 hours, respectively. Regarding evening milking, 16.8% of the households complete milking before 0600 hours, and the remaining 41 and 36.2% milk their cows between 0600 and 0700 hours and 0700 and 0800 hours, respectively.

In 79.3% of the cases in all production systems milking was predominantly handled by household wives or adult females. The rest 9.3, 6, 2.5 and 3% are handled by hired labour, household adult males, children and combination of wives and husbands, respectively. Milking in different parts of Ethiopia is primary handled by women, nonetheless, there are few exceptions such as the Fogera area of Amhara region where milking is entirely performed by males (Belete 2006).

4.6.6.6 Calf rearing practices

All dairy cattle producers in the mixed crop–livestock system practised partial suckling prior to milking, and colostrums are given freely. However, in the urban production system, 31.6% of households followed early weaning while the rest 68.4% practised partial suckling prior to milking. Since local/zebu cows are believed not to give milk without partial suckling, local or cross calves from such cows are not weaned early. Colostrums feeding for early weaning calves in the urban system lasted for 4 to 7 days in the majority (52.8%) of the cases, while 37% fed milk beyond 7 days and the rest 10.2% terminated within 3 days of birth.

Out of the interviewed dairy producers in the mixed crop–livestock production system, 68.6% of households provided supplementary feed (on top of milk) to calves between 15 and 30 days after birth, while 28.8% provided supplementary feeding after one month of age. On the other hand providing supplementary feed within seven days after calving is quite rare and was practised by only 2.5% of the respondents. In case of urban producers, the majority (66%) started supplementation within 7 to15 days after birth, and relatively less proportions, i.e. 25.7 and 8.3% started between 15 to 30 days, and after 30 days, respectively. This figure shows that, urban producers follow early weaning practices with the assumption of profit maximizations from sale of milk that was otherwise be used by calves.

4.1.6.7 Waste management

Waste disposal in the urban production system is one of the major problems of dairy producers in the study areas. Almost all the interviewed dairy cattle producers in the mixed crop–livestock system (97.4%) used animal dung primarily as fertilizer while only few (2.6%) households used primarily as household fuel. Similarly, 72.5% of households did not use animal dung other than as fertilizer and the rest 18.2% used it for household fuel. Manure from these animals played a vital role for their perennial crop farming, particularly for coffee, *enset* and fruit crops in Dale and Dilla areas. *Enset* usually requires a large quantity of organic fertilizer and thus animal dung in the *enset*–coffee system had special attention than the cereal based areas. Some people who do not have their own cattle in the *enset*–coffee based areas kept dry and pregnant cows that belonged to other people until calving for the benefit of using the manure to fertilize their *enset* plantation.

The majority (46.5%) of urban producers spend extra money to dispose off animal dung out of the towns. The rest 33.8% of households used the cow dung primarily as household fuel. Unlike most production systems in the country, animal dung (dung cake) in the investigated areas is not marketed for fuel or fertilizer purpose. Rather, the majority of dairy producers in the mixed crop–livestock system used animal dung as organic fertilizer for their perennial and annual crops while the majority of dairy producers in the urban system spend extra cost to dispose it out of the town. Waste disposal was among the burning issues in the rapidly growing towns like Awassa. Urban producers in these areas are seen usually pleading for availability of efficient and less costly mechanisms of manure disposal and the issue should receive the attention of concerned authorities. Alternatively, collected manure from urban dairy farms can be made available to the surrounding rural communities for use as organic fertilizer and thereby reduce expenses of farmers spent on purchase of inorganic fertilizers. As a third option, the manure can be used as a source of energy through biogas production, if the facility can be installed within reach of urban farmers. Thus, concerned bodies should facilitate better use of this useful product and pave the way for a twofold advantage, promote urban dairying as well as make use of organic energy than wasting it. Next to feeding and milking, waste handling is one of the major routine activities in dairy production. Manure and urines must be properly cleaned from the dairy farm to ensure good and hygienic working conditions.

4.1.6.8 Record keeping

About 79 and 94% of the urban and mixed crop–livestock producers, respectively, did not have any record keeping schemes. Only 21.2 and 6% of the urban and mixed

crop–livestock producers, respectively, were found recording some reproduction parameters using informal sheets. Record keeping in modern dairying is a prerequisite for any decisions and control over certain production and reproduction performance of dairy cattle in the farm and to measure the profit of any market-oriented farms. Despite this principle, record keeping in the area is not practised as the owners do not have adequate experience and are not aware of the benefits. It is therefore essential to provide formal training on this useful practice to dairy owners in both the urban and rural areas. Given that the majority of dairy producers are literate, this practice should not be considered difficult to extend especially in urban areas.

4.1.7 Milk utilization, handling and processing

4.1.7.1 Dairy products utilization

The overall daily milk production/farm per day in the mixed crop–livestock system ranged from 1.97 ± 0.24 to 2.84 ± 0.28 litres, while in the urban system it ranged from 10.21 ± 1.59 to 15.90 ± 2.36 litres. These figures suggest that urban producers, which relatively keep better performing dairy cows, are able to benefit much more from dairying and provide good service to the community by providing milk to the urban population. However, the total estimated annual milk production (from the census result), which was 9.645 million litres from 4469 dairy farms in the 4 towns, is low as compared to other urban production systems like the Addis Ababa milkshed which produced 34.65 million litres per annum from 5167 small, medium and large farms (Azage and Alemu 1998). This suggests that a comprehensive intervention program has to be in place with respect to genetic improvement, feeds and feeding systems, animal health care and other management aspects in the current study area.

Out of the interviewed dairy producers in the mixed crop–livestock system, the majority of the households (61.7%) used whole milk primarily for home processing (traditional), while the rest 25% and only 13.7% of the households used primarily for household consumption and sale, respectively. On the other hand, the result in the urban system showed that the majority (79.2%) of the households produced milk primarily for sale, while only 14.2 and 6.6% of the households used it for family consumption and home processing, respectively. Similar studies conducted in different parts of the country showed differences in the utilization pattern of milk in different production systems. A study conducted in Borena area of Ethiopia showed out of the total milk produced, 69% was used as fresh milk, 24% was stored and soured to make butter, 6% was used for short-term sour milk and 1% was used as long-term sour milk (Layne et al. 1990). These values are quite different from the utilization of milk in the studied mixed crop–livestock

systems. Other studies conducted around Addis Ababa (Azage and Alemu 1998), and Mekele (Nigussie 2006) indicated that 73 and 79% of the fresh milk produced by urban dairy farmers, respectively, was marketed.

4.1.7.2 Milk handling

One of the major factors affecting the quality of dairy products is related to milking utensils. The type and quality of milking utensils used as well as methods and frequency of cleaning milking utensils affect the quality of milk and its products. With regard to type and quality of milking utensils, there was a difference between the study areas. The majority (92%) of urban producers used plastic milk utensils and about 43.3% of the rural producers used clay pot and plastics, while few (12.5%) farmers used locally made grass utensils.

Most urban producers (73.5%) usually clean their milking utensils before and after milking while the rest 13.3% did it twice a day, 7% once a day and 6% once in two days. However, nearly half (43.3%) of rural producers did it once in two days while 30% before and after milking, 16.7% twice a day and 10% once a day. With regard to milking utensils, two major noticeable differences were observed for dairy producers in the studied areas—type of materials used for milking and methods employed in cleaning.

Different ways of cleaning milking utensils were identified in the area. The majority of the households (70%) washed with or without hot water followed by smoking with different aroma producing plants like *Woira (Olea africana)* and *Tid (Juniperous procera)*. Likewise, 22.7, 6.4 and 4.7% of the households cleaned with water and detergents, smoked with aroma producing plants, and washed only with water, respectively. Smoking of milk utensils prior to milking and churning is a common traditional practice in most parts of the country. Some of the plant species used in different parts of the country include *Achynthes aspera, Ruta graueolens*, *Eucalyptus globulus*, *Ruta cymbopogon* and *Ocimum hardiense* in Wolaita areas (Ayantu 2006); *Acacia nilotica, Cordia glarfa, C. ovalis* or *Combertum molle* in the pastoral areas of Borena (Layne 1994); *Deinbollo kilimandshorica*, *Syzygium guinecnse*, *Heeria reticulala* and *O. africana* in Eastern Wollega (Alganesh 2002); and *O. Africana, J. procera* and *Ocimum hardiense* in East Shoa (Lemma 2004).

Frequency and methods of cleaning of milking utensils and types of material used by the urban dairy producers were better for hygienic milking procedures. However, one should not forget about the consumption preference of dairy products in the two areas. Proper milk handling practice is a prerequisite prior to consumption, marketing and/or

further processing purposes. Milk is an ideal medium for the survival and multiplication of pathogenic and spoilage microbes. Utensils that are used in milking, fermenting, churning, or consumption of milk must be properly cleaned. With this respect proper training should be given to create awareness among producers in different aspects of milk handling practices.

4.1.7.3 Milk processing

Out of the interviewed urban dairy producers, 54.5% of the households practised butter churning only at times when all the produced milk is not sold. Only surplus milk from market and house consumption had been further churned. The rest 37.3% of the households did not churn at all and 8.2% of the households did not sell milk and were always churning. In the crop–livestock mixed system, 66% the households churn all the milk produced and the rest 37.3% of households did it intermittently, while only 1.7% did not churn at all.

The primary dairy product traditionally processed by urban and crop–livestock system differed between the two production systems. In the urban system, the primary dairy product was butter for 71.6% of the households, fermented whole milk (*ergo*) for 24% of the households and cottage cheese for 4.5% of the households. Similarly, in the mixed production system butter was the primary product for 87.7% of the households, *ergo* for 9.6% the households and cottage cheese for the remaining 2.6% of the households.

Out of the interviewed households in the mixed crop–livestock production system, 58.8% preferred churning to get butter and use buttermilk for household consumption, while 14% had not access for whole milk market and 12.3% households were restricted by traditional taboos not to sale whole milk and preferred to churn it. With regard to urban producers the majority of households (41.8%) did churn during fasting days where there is less demand for dairy products. The rest 18.2, 16.4, 12.7 and 10% of households did churn because of preference of butter and other by-products, if all milk could not be marketed, because of taboos against selling whole milk and other reasons, respectively.

The majority (96.5%) of dairy producers used traditional churning material made from clay pot while the rest used wooden, '*Kell*' and metal. This observation is similar to the case for the central highlands where clay pot churn is mostly used (O'Mahoney and Peter 1987), whereas it is different from the case of East Wollega where 91% of women used gourd for churning and storage of milk (Alganesh 2002).

4.2 Dairy marketing systems

4.2.1 Involvement of producers in dairy marketing

In the mixed crop–livestock system, the majority (62.5%) of dairy farmers produced butter as the predominant dairy product for sale while 20.6% of households produced sour buttermilk for sale and 14.3% of households sold whole milk and the rest sold cottage cheese and *ergo*. In this production system, the amount of income from the sale of whole milk was low. The major dairy products used for income generation in this production system were only butter and sour buttermilk. Out of the total sour buttermilk produced after churning, a higher proportion (74.4%) was used for household consumption while the rest 24.5% was sold.

In contrast, the majority of urban dairy farmers (89%) primarily produced whole milk for sale, while 7.3, 1.8, and 1.8% of the households produced *ergo*, butter and sour buttermilk, respectively, as primary dairy products for sale.

Out of the interviewed producers in the crop–livestock system, only 18.5% of households were market oriented, while in the urban production system the majority of households (78.2%) were market oriented. Most dairy producers were engaged in market-oriented dairy business quiet recently. For example, producers in the mixed crop–livestock production system begun to adopt market-oriented dairy business over the last 6.6 years where as in the urban system, market-oriented dairying started on average about 11.6 years ago. The overall mean capital that dairy producers used to establish their dairy business in the mixed crop–livestock system was ETB[1] 1127 per farm, while in the urban system it was ETB 1750 per farm.

The major dairy marketing system found in the studied areas was informal marketing. Milk was sold mainly on contract basis to customers. However, cooperatives/producer groups were trying to fix price for milk collection in Shashemene, Awassa, and Yirgalem towns based on organoleptic qualities of milk. Dairy producers are the ones who fix price of milk and other dairy products when selling their product to consumers and through negotiated prices when selling to traders. The government does not substantially intervene, in any way, be it through regulation or trade of dairy products in the area. Dairy marketing channels were established by producers, few cooperatives, traders and consumers and there is no formal marketing system. Similarly, Nigussie (2006) reported the absence of formal marketing system in Mekelle urban dairy system. In contrast, because of the presence of milk processing plants in Addis Ababa there are emerging formal marketing systems in the Addis Ababa milkshed (Sintayehu 2003).

1. ETB = Ethiopian birr. In January 2008, USD 1 = Ethiopian Birr (ETB) 9.2007.

The primary selling outlets and criteria for selection of these outlets in the two production systems are shown in Table 6. Individual consumers or traders usually buy milk at specified milk selling points as well as at the farm gates. The majority of producers in both urban (52% households) and crop–livestock systems (68% households) sold their milk directly to consumers either at the producers or consumer's gate, as their selling outlets. Next to consumers, the major recipients of milk from producers are catering institutions both in urban system (33.3%) and in the mixed crop–livestock (22.7%). Most of the households in the urban production system use proximity (47%), better price (17.7%) or both (13.5%) as their primary selection criteria for selling outlets. Also in the mixed crop–livestock system proximity is the main criteria (45.5%) for using a given selling outlet but considerable proportions 22.7% said lack of alternative is the other factor for using the available outlet. This indicates that market options need to be improved in the mixed crop–livestock system to encourage rural producers and thereby enhance dairying in this system. Out of the total households, 77% of urban producers did not face any problem with selling agreement, while 23% reported problems with selling agreement. With regard to pricing, 92.5% of the urban dairy producers followed flat pricing, while only 7.5% followed quality based pricing.

Table 6. *Percentage of producers under the respective primary selling outlets and selection criteria for selling outlets of milk in mixed crop–livestock and urban production systems*

	Crop–livestock production system N = 22	Urban production system N = 96
Primary selling outlets	(%) of dairy producers	
Direct to consumers	68.2	52.1
Catering institutions (tea or coffee houses)	22.7	33.3
Own milk/*ergo* shop	4.6	8.3
Cooperative/ producers group	4.6	5.2
Open market point	–	1.1%
Primary criteria for selection of selling outlets	(%) of dairy producers	
Proximity	45.5	46.9
Better price	9.1	17.7
Proximity and better price	9.1	13.5
Lack of alternative	22.7	6.3
Guaranteed contract for whole month	13.6	15.6

The dairy marketing systems identified in the present study is similar to the previous findings reported for other African countries and within Ethiopia. Staal and Shapiro (1996) reported that about 90% of the milk marketed in sub-Saharan Africa is delivered informally to consumers. Similarly, 75% of dairy producers in Addis Ababa milkshed are sold directly to consumers, while 15% of the households supplied their milk to catering

institutions and the rest marketed through retailers and farm shops. Staal and Shapiro (1996) also showed 44 and 27% of the farms in and around Addis Ababa sold their milk directly to individuals and institutions, respectively.

Although there was high seasonality for the demand in dairy products in the study areas, the majority of dairy producers (87%) said they did not satisfy the demand of their customers. As a matter of fact, this figure has some implication towards dairy development in the area. Dairy producers should be encouraged in order to optimize milk production for the ever increasing population in the urban centres. Producers were found mentioning many problems and constraints that limit them not to produce as per the demand.

4.2.2 Marketable dairy derivatives and prices

Data obtained from the Rapid Market Appraisal (RMA) showed that marketable dairy products in the study areas include whole milk, traditionally processed butter, *ergo* (fermented whole milk), cottage cheese, and sour buttermilk. Moreover, imported dairy products and processed products from Addis Ababa processing plants were also identified in Awassa supermarkets. These include pasteurized milk, imported and locally produced cheese of different varieties, yoghurt, table butter, cream and imported milk powder (Table 7).

Marketable dairy products of a certain locality are dependant on many factors, amongst of these the production system, the purchasing ability of consumers, taste of the consumer, development of the country in general and the dairy sector in particular are some of the influential factors to be mentioned. Prices of each dairy derivatives are indicated with its possible factors determining the demand and prices of dairy commodities in the studied areas.

Price data were collected from 484 *ergo* sellers, 145 butter sellers, 240 milk producers, 10 sour buttermilk producers and 3 supermarkets and data were averaged for each town (Table 7). Prices of some dairy products varied by more than twofold. For example, the price of whole milk ranged from ETB 2 to 4 per litre and the price of butter ranged from ETB 25 to 50 per kg in the four towns. In general, prices of dairy products varied greatly among and within each town. Since informal dairy marketing was the only means of marketing in the area, there was no fixed price for each dairy product. This suggests the importance of some regulations related to control of quality and prices of dairy products which guarantee dairy producers not to be discouraged by such big price and demand fluctuations.

Table 7. *Average prices of milk and milk products*

Marketable milk and its derivatives	Predominant price range by town (ETB)			
	Shashemene	Awassa	Yirgalem	Dilla
Locally produced dairy products				
Whole milk (litre)	2–3	2.50–4	2–3.75	3–4
Ergo (fermented whole milk) (litre)	3–10 (4)	3–8 (5)	3–8 5)	4–5 (5)
Butter (kg)				
Peak season	38–47	40–50	35–48	35–48
Lean season	30–36	28–38	25–37	28–35
Sour butter (litre)	1.50–2.50	2-2.50	2–2.50	–
Cheese (kg)	7–12	12–14	12–14	–
Imported dairy products (price of supermarkets)				
Milk powder (900 gm)		53–60		
Cheese of different varieties (kg)		130–166		
Dairy products from Addis Ababa milk processing plants (price of supermarkets)				
Pasteurized milk (litre)		6–8		
Yoghurt (litre)		64		
Cheese cottage (kg)		12–14		
Cream (kg)		85		
Table butter (kg)		50–55		

4.2.3 Determinants of price and demand for dairy products

The major factors affecting the prices and demands of dairy products in the studied areas included season (dry and wet seasons), access to market (proximity to urban consumers), fasting and non-fasting days (followers of the Orthodox Christian church), holidays and festivals, quantity of dairy supply vs. purchasing ability of the urban dwellers as well as quality vs. origin of the product. The price and demand for milk and milk products, especially butter, are highly vulnerable to the mentioned factors.

Season

Wet seasons are characterized by better vegetation cover, and hence provide better roughage supply to dairy cattle, resulting in higher milk yields. Moreover, the wet season in the studied areas mark the period of limited cash income for cereal as well as cash crop producing rural farmers. Thus, farmers are forced to sell much of their dairy products for immediate cash generation. It was also noted during the survey that there was a relatively higher supply of especially butter and buttermilk in the rural open market points. Therefore, during the wet season the price of butter and buttermilk is lower, and there was relatively higher supply of milk and milk products in most rural markets.

Contrary to this, there was relatively a shortage of succulent roughage during dry season and hence poorer performance of cattle in the area. Moreover, during the early dry season, farmers in the mixed crop–livestock system harvest cash (mainly coffee) and food crops. Therefore, rather than selling, there is preference to consume dairy products at home. This results in less supply of milk and milk products to the market and even higher price for dairy products. Out of the dairy products, the price of butter was the most affected by season. In addition to feed limitations during the dry season, most traditional and religious holidays occur during the dry season and further aggravate the price of butter. Although dry season inflicted less pronounced effect on urban producers, the price of butter in the nearby small rural towns affected the overall price during the stated season.

Access to market/distance from towns

Fresh milk could not be kept for long hours before consumed or processed. Distance from the market was a major factor that prohibited farmers from selling whole fresh milk to urban consumers. Moreover, in some parts of the studied areas, some traditional taboos prohibit the sale of milk by rural producers. Therefore, the prices of dairy products in the rural markets were lower than in urban markets. Even the price of dairy products in large towns like Awassa was higher than smaller towns. Therefore, distance from market determined the type and price of dairy products marketed.

Fasting vs. non-fasting days

The price of dairy products especially butter and the demand for whole milk, *ergo* and other dairy products, particularly in the urban centres, were highly affected by the long fasting period of the followers of the Orthodox Christian religion. Because of low demand for dairy products during these days, dairy producers in the urban centres were obliged to process unsold milk into butter and sometimes to cottage cheese. Even then, the cottage cheese which contains higher moisture does not last long. Therefore, milk is mostly converted into butter. Butter traders usually store large amount of butter until the end of fasting, and sell it afterwards.

Festivals and holidays

During religious and some cultural festivals in the region, dairy products were highly demanded. Thus, the price of dairy products especially butter inflates highly. Religious festivals of Ethiopian Christians such as '*Enkutatash*' (Ethiopian New Year), '*Meskel*' (Finding of the True Cross), '*Genna*' (Ethiopian Christmas), and '*Fasika*' (Ethiopian Easter) were the main ones when animal products are highly demanded leading to high prices.

In addition, the demand for dairy and other animal products increase many folds during the locally celebrated festivals such as '*Fiche*' (which is Sidama New Year).

Level of supply vs. purchasing ability of the urban dwellers

The relatively low supply, compared to the high demands for milk, in Dilla and Awassa towns resulted in higher price of milk as compared to the price in Shashemene and Yirgalem towns (Table 7). Moreover, the rapid urbanization of the regional capital, Awassa, has led to increased use of dairy products. In general, the low level of supply as compared to the demand has resulted in increased prices of dairy products in the studied area.

Quality and sources of dairy products

Imported products and those produced in Addis Ababa milk processing plants were relatively more expensive in most supermarkets (Table 7). This is attributed to the value addition due to processing, organoleptic value (quality) and safety of processed foods for consumption than those locally produced products.

The price of locally produced dairy products also varied depending on the origin of the product. For example, butter from Wolaita and Kucha areas were considered high quality and therefore fetched better price. Also the level of fermentation of butter caused price variations, i.e. fermented butter fetches fewer prices as compared to fresh one. Adulteration was also one of the big price determining factors, especially for butter. Among others, vegetable oils are mixed with butter mostly by retailers that collect butter from rural primary markets and deliver to markets in nearby towns and/or to butter shops in towns. For example, even if pure Wolaita butter in most parts of the towns is more expensive, it was noted that Wolaita butter adulterated with vegetable butter was marketed with reduced prices in Dilla and Shashemene towns.

4.2.4 Market channels of dairy commodities

Marketing channels of each marketable milk and milk products in the studied areas is indicated below. Butter was the most marketable dairy derivative having the longest market channel and more intermediates between producers and consumers, while sour buttermilk had few intermediates and reached consumers with the shortest channel. Market channels for each dairy commodity are depicted in the following manner:

1. Butter

Producer → Consumer
Producer → Cooperatives (Producer groups after traditional processing) → Consumer
Producer → Rural assembler → Consumer
Producer → Rural assembler → Retailers → Consumer
Producer → Rural assembler → Wholesalers → Consumer
Producer → Rural assembler → Wholesalers → Retailers (Addis Ababa) → Consumer (Addis Ababa)
Producer → Rural Assembler → Wholesalers → Retailers (Harar and Dire Dawa) → Consumer (Harar and Dire Dawa)

2. Whole milk

Producer → Consumer
Producer → Trader (hotels, tea and coffee houses) → Consumer
Producer → Cooperatives (producer groups in Shashemene, Awassa, Yirgalem, Dilla towns) → Consumer

3. *Ergo*

Producer → Consumer
Producer → Trader (Hotels, tea, *ergo* and coffee houses) → Consumer

4. Cottage cheese

Producer → Consumer
Producer → First assembler → Consumer
Producer → Cooperatives (producer groups after traditional processing, Shashemene, Awassa, Yirgalem, Dilla) → Consumer
Producer → First assembler → Traders → Consumer

5. Sour buttermilk

Producer → Consumer
Producer → Cooperatives (Producer groups, Shashemene) → Consumer

4.2.5 Market chain for dairy

The combinations of market channels give rise to the market chain. Compared to other areas, the market chains in the studied areas is not complex. The dairy market chain of the present work is depicted in Figure 3.

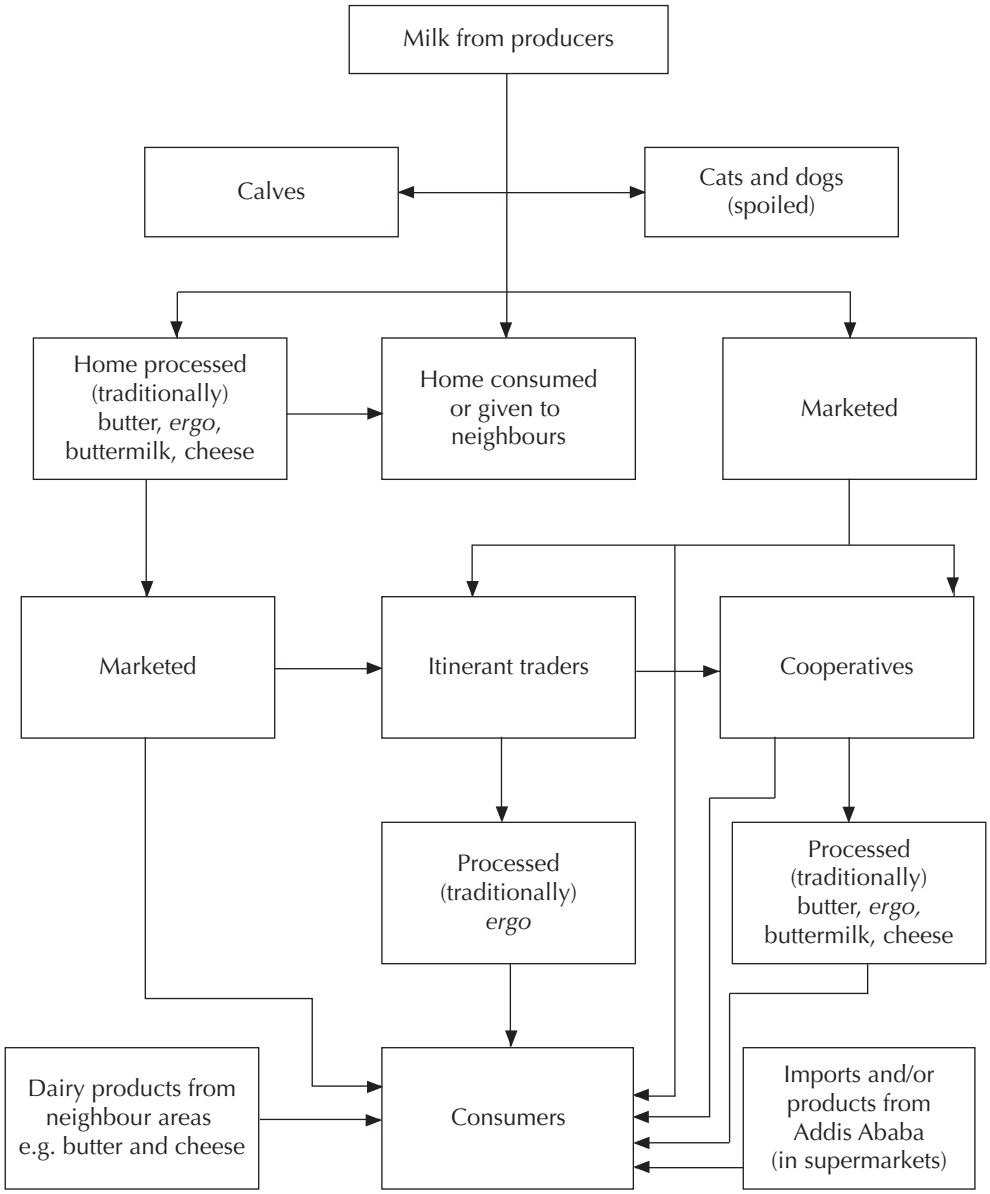

Figure 3. *Marketing chain of dairy commodities in Shashemene–Dilla area.*

4.2.6 Butter trade routes and trading activities

Table 8 shows the butter trade routes in the study area. Accordingly, butter from this area was transported long distances of over 500 km up to Harar and Dire Dawa. Although butter from this area, particularly from Arbegona and Aleta Wondo was

carried long distances, butter from other areas such as Kucha, Wolaita, Borena, and Bale are channelled to market places of Shashemene, Awassa, Yirgalem and Dilla towns. Therefore, butter is the most marketable dairy product having more market channels over long distances.

Table 8. *Butter trade routes to, from and within the study area*

	Origin (region, zone, *woreda*/ market)	Destination market (town)	Approximate distance (km)
Inflow of butter into the studied areas	Oromia, Bale, Kokossa	Shashemene	100–120
	SNNPRS, Wolaita, Kucha	Shashemene Awassa Yirgalem Dilla	145–285 170–232 220–275 260–322
	Oromia, Borena	Dilla	150–200
	SNNPRS, Sidama, Aleta Wondo	Yirgalem Dilla	 75–100
	SNNPRS, Dara	Dilla	46–50
	SNNPRS, Arbegona	Yirgalem Dilla, Awassa	90–100 140–150
Outflow of butter from the studied areas	Arbegona, Aleta Wondo, Hantate	Addis Ababa	415–430
	Arbegona, Aleta Wondo	Harar, Dire Dawa	700–800
Movement of butter within the studied areas	Shashemene (Kucha)	Dilla	115–125
	Shashemene (Kucha)	Yirgalem	65–70
	Yirgalem	Awassa	40–45

4.2.7 Stakeholders in dairy production and marketing

The Offices of Agriculture and Rural Development (OoARD) of the respective *woredas*, dairy cooperatives, different governmental and non-governmental dairy development projects, dairy traders, higher educational and research institutions, private input suppliers, and dairy producers, both commercial and non-commercial parastatal farms are the important stakeholders/institutions that contribute to the development of dairy production and/or marketing in the studied areas.

Services related to veterinary, extension, AI and sometimes training were considered as the responsibility of the OoARD. Out of the interviewed dairy producers in urban and mixed crop–livestock system, respectively, 75 and 34% had access to AI service, 84.2 and 67.5% got veterinary services, and 12.5 and 35% got extension services from the OoARD. This shows that the proportion that received AI service were lower in mixed system, whereas producers in both systems that received extension service are low, and the situation is worse in urban production system. On the other hand, none of the interviewed dairy producers were given credit and training services, and there were no defined and responsible institutions to render such services to dairy producers in the area.

Dairy cooperatives also contribute a lot especially with regard to linking producers to market and by providing input supply. With this regard, the role of dairy cooperatives, in Shashemene and Awassa appeared to be quite active and more beneficiary to their members than those in Dilla and Yirgalem. For example, 163 members in Shashemene, 81 members in Awassa (through two cooperatives), 37 members (both urban and rural producers) in Yirgalem and 30 urban producers in Dilla were linked with market through their producer groups/cooperatives. In view of the number of dairy producers in each of the four investigated areas, only few producers had benefited through their producer groups/cooperatives. Thus, cooperatives are expected to be more active and beneficiary to their members.

Different governmental and non-governmental dairy development projects had been launched in the area. Past projects that operated in the study area included the Dairy Rehabilitation and Development Project (DRDP), Smallholder Dairy Development Project (SDDP), Sidama Development Project (SDP), National Livestock Development Project (NLDP). Currently, non-governmental organizations like Goal Ethiopia and Care Ethiopia are assisting smallholder dairy producers by supplying Boran heifers in some parts of the study areas.

Traders of different types with different capital sizes are also contributing a lot in facilitating dairy marketing in the area. Locally produced whole milk, traditionally processed dairy products such as butter, *ergo*, and fermented cottage cheese were some of the dairy products traders were involved with. The census conducted in the four towns indicated that there were more than 145 permanent traders engaged in butter marketing at the 4 towns, with estimated stocking capacity of 5290 kg of butter per month. The number of *ergo* sellers in the 4 towns was 484, out of which more than 75% were found in Awassa town. An estimated amount of 4300 litres of milk is sold in the form of *ergo* (fermented whole milk) in a day in the 4 towns. Substantial amount of milk is also sold in hotels, coffee/tea houses and the contribution of these traders in supplying milk to consumers is quite remarkable. *Ergo* sellers usually fill up glasses with fresh milk and keep them in refrigerators overnight so that *ergo* will be readily sold in the following morning. The price of *ergo* especially sold in small coffee/tea houses is quite affordable for low income groups like daily labourers. Thus, the role of this small coffee/tea houses in supplying this rich protein source to low-income part of the society had a twofold advantage for both producers and consumers.

The role of Awassa College of Agriculture (ACA) and the regional research institute were also worth mentioned as stakeholders partly contributing to the sector. Dairy producers of especially Awassa town benefited and continue to benefit from the contributions of the Awassa College of Agriculture (ACA), directly or indirectly. This institution, in addition

to producing qualified agricultural scientists, conducted different research projects with highly qualified instructors and students, which may indirectly contribute to the dairy sector. Above all, the dairy farm found in ACA was the first parastatal farm which has been used as demonstration farm as well as a source of improved dairy stocks for some dairy farmers in Awassa town. The Regional Research Institute is also another intuition to be mentioned for its research outputs that could assist dairy development in the area.

Private input suppliers are the other stakeholders to the sector as they supply different inputs such as feeds, animal drugs, and other small-scale processing utensils. The contribution of concentrate feed suppliers and milling factories (wheat flour factories) as the major feed resource especially for urban producers has been very high. It was, however, noted that there is no commercial feed processing plant in the area.

The role of dairy producers, particularly the urban and peri-urban farmers, has been high as compared to the level of support rendered by different stakeholders. They are the predominant milk producers providing dairy products to the rapidly growing urban population in the area. The contribution of NGO farms like SOS farm in Awassa, and the government owned Gobe cattle breeding station near Shashemene also contributed as sources of improved dairy animals to the adjoining dairy producers.

4.3 Constraints, opportunities and prospects

4.3.1 Constraints of dairy production and marketing

Dairy production and marketing in the studied areas was constrained by different problems. Dairy producers in the studied areas prioritized the major problems and constraints as: availability and costs of feeds, limitations of land for sustainable dairy development, problems related to waste disposal (for urban producers), discouraging seasonal marketing systems, shortage of supply of genetically superior dairy animals, poor animal health services, poor extension services (especially to urban producers), knowledge gap regarding improved dairying and labour problems for urban producers. The extent and significance of the problems and constraints differed between and within the different production systems and/or studied areas.

4.3.1.1 Availability and costs of feeds

Large proportions of dairy producers, both in the mixed and urban production systems, ranked shortage and high costs of feeds as number one problem. About 55 and 73% of producers in the mixed crop–livestock and the urban system highly stressed the problem of seasonal variation in availability and the high price of feeds. With regard to

roughage feeds of animals, maize stover collected during October to November, sugar cane and sometimes succulent grass brought from the surrounding suburban areas was seen in Awassa markets as animal feed. However, it was observed that the rural agricultural system was not highly integrated with the urban dairy production system of Awassa, Yirgalem and Dilla areas. This created major roughage feed shortage to the urban dairy cattle producers of the respective towns. Unlike the above mentioned towns, in Shashemene the contribution of cereal crop residues and straw supplied from the surrounding suburb to the urban dairy producers was high and satisfying roughage feed needs of the urban towns during the dry season. Prices of concentrate feeds were among the major problem dairy producers could not cope with, in all production systems.

The problems of seasonal availability of roughage feeds can be minimized through conventional feed conservation practices like hay making, silage making and straw treatments so that roughage feed supplies would continue throughout the year. The availability and cost of concentrate feeds and other inputs could be alleviated through formation of producer groups, which could transport it from long distances and store for the next seasons. It is also essential to motivate and support the suburb farmers surrounding the towns to specialize in supplying dry season roughage to urban farms. If rural farmers within the vicinity of towns are trained on how to make silage using less sophisticated procedure and material and specialized as feed producers, it can greatly remedy roughage supply problems. Cereal crop producing areas like Shashemene and Awassa could also improve the poor quality of crop residues through urea treatment.

4.3.1.2 Limitations of land for sustainable dairy development

Next to feed related problems, dairy producers ranked access to farm land related problems as the second important constraint that hindered dairy development in the area. The proportion of dairy producer households who identified this as a serious problem was 57.5 and 48% in the urban and in the mixed crop–livestock system, respectively. Most urban producers (97%) keep their cattle within their own residence compound, which is not usually more than 200–400 metre square. Even if dairy producers are interested to expand their farm, the land size cannot allow most of them to do so. As land size increases more and more facilities become inevitable that take-up space other than the animal barn.

4.3.1.3 Waste disposal problem

Waste disposal was considered as one of the most important problems by urban producers, particularly in Awassa town. Because of the rapid urbanization, the problem of land shortage was aggravated by the absence of appropriate place to dispose or

to reutilize animal dung in Awassa town. Although adjoining rural crop farms were constrained by fertilizers, urban producers suffer from appropriate ways of disposing animal dung. Most producers pay extra money for labourers to dispose the manure. Even then, there is no place allocated for disposing this animal dung. Waste disposal was not a problem for rural dairy producers.

4.3.1.4 Discouraging marketing systems

Seasonality in demand for milk and milk products was identified as one of the major problems by 10.5% of the rural and 75% of the urban dairy producers, respectively. There was no strong market chain between the rural producers and urban consumers. Moreover, potential areas like Shashemene and Yirgalem were not linked with consumers in Awassa and Dilla towns. This discouraged producers, which was also aggravated by high costs of inputs and lower prices of milk.

With regard to marketing of dairy products in the studied areas, adulteration of milk and milk products was considered as a problem especially in butter marketing.

For the seasonality in demand for milk and milk products, processing technologies which could extend the shelf-life of dairy products may remedy the problem. For potential dairy areas, where there is no market access, a milk collection scheme through establishment of milk marketing groups may alleviate the problem.

4.3.1.5 Reproductive problems vs. genotype development

The majority of dairy farmers (58%) in the mixed crop–livestock production system and 6% of the urban producers were constrained on unavailability of AI services, which curtailed genetic improvement. Reproductive problems were also identified as serious problems that affected performance of dairy herds. In the mixed crop–livestock production system 30, 10 and 5% of the respondents indicated problems related to long calving interval, abortion, and late age at first mating, respectively. The major reproductive problem in the urban production system was long calving interval (85.6%) and late age at first mating (8.5%). Although calving interval is relatively better in the urban production system, market-oriented farmers were dissatisfied with the unavailability of improved genotypes and the AI service.

4.3.1.6 Miscellaneous problems

Poor animal health services, scarcity of capital to expand the farm, and lack of skills in different aspects of dairy activities were among the other problems encountered in

the studied areas. The poor extension service, particularly to urban dairy producers has forced farmers to run their farm operations without important skills. Most farmers had never been given any training or extension services. The major areas of interest in training included feed conservation techniques, feeding systems, housing, basic animal health, reproductive management, milk handling and processing, record keeping and business development.

4.3.2 Opportunities for dairy developments

Although many problems and constraints that may hinder the development of the dairy sector were identified in the area, the majority of dairy producers of both the mixed crop–livestock (67.5%) and urban (86.6%) production systems were willing to continue, expand and/or involve in dairying in the future. The rest of the producers were not willing to expand dairying in the future for various reasons. About 27.5 and 5% of the respondents in the mixed crop–livestock system and 11 and 2.5% in the urban system, respectively, indicated that they will maintain their stock or stop dairying, respectively. Generally the urban producers were more willing to continue and expand dairying due to market opportunities in urban areas. Because of the rapid urbanization, substantial population growth and change in the living standard by urban societies in the area, the demand for good quality and quantity of dairy products are increasing. A good example is that supermarkets in Awassa town indicated that there is a high demand for quality milk and milk products in the town and they are not in a position to fulfill the demand.

Dairying provides the opportunity for smallholder farmers to use land, labour and feed resources and generate regular income. Although market opportunity and linkage are key issues for smallholder dairy development, support services in terms of accessing adequate land, organizing input supplies (improved genetic material, feeds, AI, drugs), provision of credit, extension and training services, production and entrepreneurial skills development are key elements for success.

5 Summary and conclusion

This study covered dairy production systems in the Shashemene–Dilla area of southern Ethiopia and covered four major towns along the main Addis Ababa–Moyale highway. These are Shashemene, Awassa, Yirgalem and Dilla. Two major dairy production systems, namely the urban and mixed crop–livestock systems, were identified and characterized. The mixed crop–livestock systems were still divided into cereal crop and *enset*–coffee crop based subsystems. Dairying was found as a good source of income for urban producers which accounted for 48.8% share of the total income, while the crop–livestock producers generated only little share from dairying. Family labour was the major source of dairy activities where milk related activities and control-over were the responsibility of women in both systems. Cattle in the cereal based mixed crop–livestock system had multipurpose. However, cows in both production systems were mainly kept for milk production.

Most of the foundation stocks of both the urban and mixed crop–livestock producers were purchased from open markets, which revealed that producers were not curious and/or did not have access to the selection of dairy cattle. Producers were found to have different perceptions on some of adaptation and production traits of the cattle they own and were found to give priorities to production traits for optimum resource utilization and maximum outputs. As a result of differences in the production system, types of breeds and the management conditions, the reproductive and productive performance of cattle in the study areas were highly variable.

The major feed resources identified in the area included grazing land, hay and purchased succulent grass, cereal crop residues, pseudo stems of *enset* and banana, maize stover, improved forage, mixed/balanced homemade concentrates, plant weeds, and non-conventional feeds like *atella*, kitchen and fruit wastes and other tree parts. Major sources of water for urban producers were pipe water while rivers were used in the mixed crop–livestock systems. The majority (81.7%) of rural producers used natural mating by local bulls, while 50% of the urban producers used AI as sole source of breeding improvement. Twice milking was the predominant frequency of milking in both the mixed crop–livestock and urban production systems. Animal dung was used primarily as fertilizers in the mixed crop–livestock system, while the majority of urban producers pay extra money to dispose it out of the respective towns. Record keeping is not a common practice in all the systems.

An estimated total of 9,645,020 litres of milk was produced annually from 4463 small and medium farms in and around the 4 towns. The majority of producers (61.7%) in the

mixed crop–livestock system used milk for home processing, while the majority of urban producers (79.2%) produced milk for sale. Unless there was some problem with milk market urban producers do not prefer to churn milk.

Marketable dairy commodities in the area included whole milk, butter *ergo* (fermented whole milk), cheese and sour buttermilk. These products are supplied from both local produce and from dairy processing plants in Addis Ababa. Butter in the mixed crop–livestock system and whole milk in the urban systems was the major dairy products sold. Informal dairy marketing was the only means of marketing system in the study area and there is no proper milk processing plant in the region. The primary selling outlet of milk was direct sell to consumers. Price of dairy commodities were determined by different factors such as season, access to market/distance from towns, fasting and non-fasting days, festivals and holidays, level of supply vs. purchasing ability of the urban dwellers, and quality and sources of dairy products.

The major constraints for dairy development in the area included availability and costs of feeds, shortage of farm land, discouraging marketing systems, waste disposal problems, lack of improved dairy animals, poor extension and animal health services, and knowledge gap on improved dairy production, processing and marketing. The rapid urbanization of the regional capital town Awassa and even the rest towns like Shashemene, Dilla and Yirgalem, with that of human population increase is an opportunity for the development of dairying in the area. Dairy development in the studied areas can be improved by encouraging private investors to establish dairy processing plant in the area, and thereby rural and urban producers could be encouraged to enter into milk collection schemes. Moreover, smallholder dairy producers should be supported through services related to feed supply, land, marketing systems, waste disposals, veterinary, AI, credit, extension and training.

In conclusion, development of dairy production and marketing in the studied areas could be achieved with the contribution and integration of different stakeholders in a sustainable way. Urban producers have permanent buyers through informal marketing channel; however, rural dairy producers do not have reliable market for milk. Even then, highly potential areas like Shashemene and Yirgalem have not been well exploited and linked with strong market-chains between potential consumers in the major towns. As market is the deriving force to the development of this sector, responsible stakeholders should not only work towards dairy production and productivity of cattle but also towards dairy marketing options.

References

Adugna Tolera and Said AN. 1992. Prospects for integrating food and feed production in Welayita Sodo, Ethiopia. In: Stares JES, Said AN and Kategile JA (eds), *The complementarity of feed resource for animal production in Africa. Proceedings of the joint feed resources networks workshop held in Gaborone, Botswana, 4–8 march 1991.* African Feeds Research Work. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. pp. 309–318.

Agajie Tesfaye, Chilot Yirga, Mengistu Alemayehu, Elias Zerfu and Aster Yohannes. 2002. Smallholder livestock production systems and constraints in the highlands of North and West Shewa zones. In: *Livestock in food security—Roles and contributions. Proceedings of the 9th annual conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia, 30–31August 2001*. ESAP, Addis Ababa, Ethiopia. pp. 49–53.

Ahmed MAM, Ehui S and Yemesrach Assefa. 2003. Dairy development in Ethiopia. Paper presented at the 'Successes in African agriculture' conference In: WEnt, IFPRI, NEPAD, CTA conference paper no. 6. 1–3 December 2003, Pretoria, South Africa.

Alganesh Tola, Mathewos Belissa and Gizaw Kebede. 2004. Survey on traditional livestock production system in Manasibu District of West Wallaga, Ethiopia. In: Farm animal biodiversity in Ethiopia: status and prospects. Proceedings of the 11th annual conference of the Ethiopian society of animal production (ESAP) held in Addis Ababa, Ethiopia, 28–30 August 2003. ESAP, Addis Ababa, Ethiopia. pp.141–145.

Alganesh Tola. 2002. Traditional milk and milk products handling practices and raw milk quality in eastern Wollega. MSc thesis. Alemaya University, Alemaya, Ethiopia.108 pp.

Aregheore EM and Chimwano AM. 1992. Crop residues and agro-industrial by-products in Zambia: Availability, utilization and potential values in ruminant nutrition. In: Stares JES, Said AN and Kategile JA (eds), *The complementarity of feed resource for animal production in Africa. Proceedings of the joint feed resources networks workshop held in Gaborone, Botswana, 4–8 March 1991.* African Feeds Research Work. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. pp. 233–238.

Ayantu Mekonnen. 2006. Women's role on production, processing and marketing of milk and milk products in Delbo watershed of Wolayta zone, Ethiopia. MSc thesis. Hawassa University, Awassa, Ethiopia. 64 pp.

Ayele Solomon, Assegid Workalemahu, Jabbar MA, Ahmed MM and Belachew Hurissa. 2003. *Livestock marketing in Ethiopia: A review of structure, performance and development initiatives.* Socio-economics and Policy Research Working Paper 52. ILRI (International Livestock Research Institute), Nairobi, Kenya. 35 pp.

Ayoola GB and Ayoade JA. 1992. Socio-economic and policy aspects of using crop residues and agro-industrial by-products as alternative livestock feed resources in Nigeria. In: Stares JES, Said AN and Kategile JA (eds), *The complementarity of feed resource for animal production in Africa. Proceedings of the joint feed resources networks workshop held in Gaborone, Botswana, 4–8 March 1991.* African Feeds Research Work. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. pp. 377–384.

Azage Tegegne and Alemu G/wold. 1998. Prospects for peri-urban dairy development in Ethiopia. In: *Fifth national conference of ESAP (Ethiopian Society of Animal Production)*. ESAP, Addis Ababa, Ethiopia.

Azage Tegegne. 2003. Financing market-oriented dairy development. The case of Ada'a-Liben *Woreda* Dairy Association. *Urban Agriculture Magazine (the Netherlands)* 9:25–27.

Bayemi PH, Bryant MJ, Pingpoh D, Imele H, Mbanya J, Tanya V, Cavestany D, Awoh J, Ngoucheme A, Sali D, Ekoue F, Njakoi H and Webb EC. 2005. Participatory rural appraisal of dairy farms in the North West Province of Cameroon. In: *Livestock research for rural development 17(6).* File://E:\pra-files\baye17059.htm

Belachew Hurissa and Jemberu Eshetu. 2003. Challenges and opportunities of livestock marketing in Ethiopia. In: Jobre Y and Gebru G (eds), *Challenges and opportunities of livestock marketing in Ethiopia. Proceedings of the 10th annual conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia, 21–23 August 2002.* ESAP, Addis Ababa, Ethiopia. pp. 1–13.

Belachew Hurissa. 1998. Milk sales outlet options in Addis and the surrounding peri-urban areas. In: ESAP (Ethiopian Society of Animal Production), *Fifth national conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia, 22–24 August 2003*. ESAP, Addis Ababa, Ethiopia. pp. 72–81.

Belete Anteneh. 2006. Studies on cattle milk and meat production in Fogera *woreda*: Production systems, constraints and opportunities for development. MSc thesis, Hawassa University, Awassa, Ethiopia. 54 pp.

Berhane Mekete and Workneh Ayalew. 2003. Promotion of dairy marketing using farmer's cooperatives: Lessons from India. In: Jobre Y and Gebru G (eds), *Challenges and opportunities of livestock marketing in Ethiopia. Proceedings of the 10th annual conference of ESAP(Ethiopian Society of Animal Production) held in Addis Ababa, Ethiopia, 22–24 August 2002*. ESAP, Addis Ababa, Ethiopia. pp. 81–87.

Boitumelo WS and Mahabile W. 1992. Improving milk production in small-scale dairy farms in Botswana: Incorporating legume fodder in the farming systems. In: Stares JES, Said AN and Kategile JA (eds), *The complementarity of feed resource for animal production in Africa. Proceedings of the joint feed resources networks workshop held in Gaborone, Botswana, 4–8 March 1991*. African Feeds Research Work. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. pp. 353–361.

CACC (Central Agricultural Census Commission). 2002. Ethiopian agricultural sample enumeration report, held 2001/02 (1994 EC).

DaWARDO (Dale *Woreda* Agriculture and Rural Development Office). 2006. Annual report of Dale *Woreda* Agriculture and Rural Development Office. Dale, Ethiopia.

de Leeuw PN, Omore A, Staal S and Thorpe W. 1996. Dairy production systems in the tropics. The University of Melbourne, Thailand Research Funds, and ILRI, (International Livestock Research Institute), Nairobi, Kenya. pp. 19–37.

Debrah S and Berhanu Anteneh. 1991. *Dairy marketing in Ethiopia: Markets of first sale and producers' marketing patterns.* ILCA Research Report 19. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. 21 pp.

Debrah S. 1990. Dairy marketing by intra-urban, peri-urban and rural dairy producers near Addis Ababa, Ethiopia. In: Brokken RF and Senait Seyoum (eds), *Dairy marketing in sub-Saharan Africa: Proceedings of a symposium held at ILCA, Addis Ababa, Ethiopia, 26–30 November 1990.* ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.

Dereje Tadesse, Workneh Ayalew and Hegde BP. 2005. Survey of traditional cattle production systems and preferred cattle functions in North and south Wollo zones, Ethiopia. *Ethiopian Veterinary Journal* 9(1):91–108.

DiWARDO (Dilla *Woreda* Agriculture and Rural Development Office). 2006. Dilla *Woreda* Agriculture and Rural Development Office, the year report. Dilla, Ethiopia.

van Dorland HA, Workneh Ayalew, Asfaw Tolessa, Ronalds GJ and Rege JEO. 2004. Understanding the purposes for keeping cattle and their perceived traits by farmers in Oromia Regional state, Ethiopia. In: Asfaw Yimegnuhal and Tamrat Degefa (eds), *Farm animal biodiversity in Ethiopia: Status and prospects. Proceedings of the 11th annual conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia, 28–30 August 2003.* ESAP, Addis Ababa, Ethiopia. pp. 191–201.

ECSA (Ethiopian Central Statistical Authority). 2005.

Edmond KJ. 2007. Ethiopia. Microsoft Encarta® 2007 [DVD]. Microsoft Corporation, Redmond, Washington, USA.

Falvey L and Chantalakhana C. Perera O.1999. Management of reproduction. In: *Smallholder dairying in the tropics*. ILRI, Nairobi Kenya Pp 1-18.

FAO (Food and Agricultural Organization of the United Nations). 1996. Milk processing guide series. Training programme for small scale dairy sector and dairy training institute. Volume 6. FAO/TCP/KEN/6611 Project. FAO, Rome, Italy.

FAOSTAT (Food and Agricultural Organization of the United Nations Statistics). 2007. Online database on food and agricultural products and producers. Accessed online at: http://www.faostat.fao.org/. FAO, Rome, Italy.

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

Felleke Getachew and Geda Gashaw. 2001. The Ethiopian dairy development policy: A draft policy document. Ministry of Agriculture/AFRDRD/AFRDT Food and Agriculture Organization of the United Nations/SSFF. Addis Ababa, Ethiopia.

Freeman HA, Ehui SK and Jabbar MA. 1995. Credit constraints and smallholder dairy production in the East African highlands: Application of a switching regression model. *Agricultural Economics* 19(1998):1–12.

Freeman HA, Jabbar MA and Ehui SK. 1998. Role of credit in the uptake and productivity of improved dairy technologies in Ethiopia. In: Freeman HA, Jabbar MA and Ehui SK (eds), *Role of credit in the uptake and productivity of improved dairy technologies in sub-Saharan Africa*. Socioeconomic and Policy Research Working Paper No. 22. ILRI (International Livestock Research Institute), Addis Ababa, Ethiopia. pp. 16–35.

Gebre Wold A, Alemayehu M, Demeke S, Bediye S and Tadesse A. 2000. Status of dairy development. Smallholder Dairy Development Project (SDDP) dairy research in Ethiopia. In: *The role of village dairy co-operatives in dairy development*. SDDP (Smallholder Dairy Development Project) Proceedings, MOA (Ministry of Agriculture), Addis Ababa, Ethiopia.

Holloway G, Nicholson C, Delgado C, Staal S and Ehui S. 2000. Agro-industrialization through institutional innovation: Transaction costs, cooperatives and milk-market development in the east African highlands. *Agricultural Economics* 23:279–288.

Holtzeman JS. 1986. Rapid reconnaissance guidelines for agricultural marketing and system research in developing countries. MSU International Development Papers, Working Paper No. 30. MSU (Michigan State University), East Lansing, Michigan, USA.

Ike A. 2002. Urban dairying in Awassa, Ethiopia. MSc thesis, University of Hohenheim, Stuttgart-Hohenheim, Germany. 113 pp.

IPMS (Improving Productivity and Market Success). 2005. *Dale thematic maps*. IPMS, Addis Aabba, Ethiopia.

Ketema Hizkias. 2000. Dairy development in Ethiopia. In: *The role of village dairy co-operatives in dairy development*. SDDP (Smallholder Dairy Development Project) Proceedings, MOA (Ministry of Agriculture), Addis Ababa, Ethiopia.

Kristensen E, Schou Larsen CE, Kyvsgaard NC, Madsen J and Henriksen J. 2004**.** *Livestock production—The twenty first century's food revolution*. (Discussion paper on the donor community's role in securing a poverty oriented commercialization of livestock production in the developing world). Accessed online at:

Layne C. 1994. *The Borena water of Southern Ethiopia: Synthesis of pastoral research, development and change, 1980–91*. ILCA Systems Study No. 5. ILCA, Addis Ababa, Ethiopia. Layne CD, Holden SJ and Mulugeta Assefa. 1990. Review of dairy marketing and processing in a semi-

arid pastoral system in Ethiopia. In: Brokken RF and Senait Seyoum (eds), *Dairy marketing in sub-Saharan Africa: Proceedings of a symposium held at ILCA, Addis Ababa, Ethiopia, 26–30 November 1990*. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.

Lee-Smith D and Memon PA. 1994. Urban agriculture in Kenya. In: *Cities feeding people; an examination of urban agriculture in East Africa*. IDRC (International Development Research Centre), Ottawa, Canada. 146 pp.

Lemma Fita. 2004. Assessment of butter quality and butter making efficiency of new churns compared to smallholders' butter making techniques in East Shoa Zone of Oromia. MSc thesis, Alemaya University, Alemaya, Ethiopia.129 pp.

Matthewman RW. 1993. *Dairying. The tropical agriculturist*. CTA publication, Waginingen, the Netherlands. pp. 23–31.

Mbogoh SG. 1990. Marketing efficiency, pricing and policy implications: A case study of milk marketing in Addis Ababa, Ethiopia. In: Brokken RF and Senait Seyoum (eds), *Dairy marketing in sub-Saharan Africa: Proceedings of a symposium held at ILCA, Addis Ababa Ethiopia, 26–30 November 1990*.ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. pp. 239–256.

Mdoe NSY, Mlay GI and Urio NA. 1992. Comparing costs associated with the utilization of crop residues and planted pastures in smallholder production systems in the highlands of Hai District, Tanzania. In: Stares JES, Said AN and Kategile JA (eds), *The complementarity of feed resource for animal production in Africa. Proceedings of the joint feed resources networks workshop held in Gaborone, Botswana, 4–8 March 1991*. African Feeds Research Work. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. pp. 385–392.

Menegay MR and Molina C. 1988. *Guidelines for Rapid Marketing Appraisals (RMA) in the Philippines*. Asian Research and Training Centre for Agricultural Marketing, Columbia, Maryland, USA.

Miles T. 2000. Agribusiness subsector assessments. In: Giovannucci D (ed), *A guide to developing agricultural markets and agro-enterprises*. World Bank, Washington, DC, USA.

Mogessie Ashenafi. 2002. The microbiology of Ethiopian foods and beverages: A review. *SINET: Ethiopian Journal of Science* 25(1):100–140.

Mohammod YK. 1992. Effect of grazing hours and concentrate supplementation on milk yield of crossbred cows under highland conditions in Arsi region, Ethiopia. In: Stares JES, Said AN and Kategile JA (eds), *The complementarity of feed resources for animal production in Africa. Proceedings of the joint feed resources networks workshop held in Gaborone, Botswana, 4–8 March 1991*. African Feeds Research Network. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. pp. 223–231.

Mosha AC. 1991. Urban farming practised in Tanzania. *Review of rural and urban planning in south and east Africa* 1:83–92.

Nicholson C. F, Getachew Gebru, Ehui SK, Shapiro BI and Delgado C. 1998. Producer milk groups in Ethiopia: Impacts on women's role in dairy production and marketing. In: *Women and animal production. Proceedings of 6th annual conference of ESAP (Ethiopian Society of Animal Production) held in Addis Ababa, Ethiopia, 14–15 May 1998*. ESAP, Addis Ababa, Ethiopia. pp. 30–39.

Nigussie Gebreselassie. 2006. Characterization and evaluation of urban dairy production system in Mekelle city, Tigray region, Ethiopia. MSc thesis, Hawassa University, Awassa, Ethiopia. 54 pp.

O'Mahoney, F. and Peters, J. 1987. Options for small holders milk processing. World Animal Review. No. 62. 16 - 30.

Ojala R. 1998. Gross margin and production cost of milk production at different production and management levels. SDDP Document. pp. 12–27.

Perera O. 1999. Management of reproduction. In: Falvey L and Chantalakhana C (eds), *Smallholder dairying in the tropics*. ILRI (International Livestock Research Institute), Nairobi, Kenya. pp. 241–264.

SAS (Statistical Analysis System). 1997. Users guide. Version 6.12. Statistical Analysis Systems Institute (SAS), INC., Carry, North Carolina, USA.

SEDPSZ (Socio-economic and demographic profile of Sidama zone). 2004. Finance and economic development coordination department. SEDPSZ, Awassa, Ethiopia.

Sere C and Steinfield H. 1995. World livestock production systems—Current status, issues and trends. In: Gardiner P and Devendra C (eds), *Global agenda for livestock research: Proceedings of a consultation, ILRI, Nairobi, Kenya, 18–20 January 1995*. ILRI (International Livestock Research Institute), Nairobi, Kenya. pp. 11–38.

Sintayehu Gebre Mariam. 2003. Historical development of systematic marketing of livestock and livestock products in Ethiopia. In: Jobre Y and Gebru G (eds), *Challenges and opportunities of livestock marketing in Ethiopia. Proceedings of the 10th annual conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia, 22–24 August 2002*. ESAP, Addis Ababa, Ethiopia. pp. 15–21.

SNNPRS–RSA. 2006. Southern Nations, Nationalities and People's Regional State–Regional Statistical Abstract, 2004/5, Bureau of Finance and Economic Development Division of Statistics and Population. Awassa, Ethiopia.

SPSS (Statistical Procedures for Social Sciences). 2001. SPSS BI Survey Tips. Statistical Procedures for Social Sciences (SPSS) INC. Chicaco, USA.

Staal S, Delgado C and Nicholson C. 1997. Smallholder dairying under transactions costs in East Africa. *World Development* 25(5):779–794.

Staal SJ and Shapiro BI. 1996. *The economic impact of public policy on smallholder peri-urban dairy production in and around Addis Ababa*. ESAP Publication No. 2. ESAP (Ethiopian Society of Animal Production), Addis Ababa, Ethiopia. 64 pp.

SWARDO (Shashemene *Woreda* Agriculture and Rural Development Office). 2006. Shashemene *Woreda* Agriculture and Rural Development Office, the Annual Report. Shashemene, Ethiopia.

Tadesse M and Dessie T. 2003. Milk production performances of Zebu, Holstein Friesians and their crosses in Ethiopia. *Livestock Research for Rural Development* 5(30):1–9.

Talew Chewaka. 2006. The current status of dairy production in Yirgachefe area of southern Ethiopia. MSc thesis. Hawassa University, Awassa, Ethiopia. pp. 38–74.

Tessema Zewdu, Aklilu Agidie and Ameha Sebsibe. 2003. Assessment of the livestock production system, available feed resources and marketing situation in Belesa *woreda*: A case study in drought prone areas of Amhara Region. In: Jobre Y and Gebru G (eds), *Challenges and opportunities of livestock marketing in Ethiopia. Proceedings of the 10th annual conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia, 22–24 August 2002*. ESAP, Addis Ababa, Ethiopia. pp. 165–175.

The Economist Intelligence Unit. 2007. Country Report for Ethiopia, January 2007. The Economist Intelligence Unit, 26 Red Lion Square, London WC1R 4HQ, UK. In: http: //www.alacrastore.com/.

Tsehay Redda. 1998. Milk processing and marketing options for rural small-scale producers. In: ESAP (Ethiopian Society of Animal Production), *Fifth national conference of the Ethiopian Society of Animal Production (ESAP) held in* Addis Ababa, Ethiopia, 15–17 May 1997. pp. 61–71.

Tsehay Redda. 2001. Small-scale milk marketing and processing in Ethiopia. In: Rangnekar D and Thorpe W (eds), *Smallholder dairy production and marketing—Opportunities and constraints. Proceedings of a South–South workshop held at NDDB, Anand, India, 13–16 March 2001*.

NDDB (National Dairy Development Board), Anand, India, and ILRI (International Livestock Research Institute), Nairobi, Kenya. pp. 352–367.

Wiener G. 1994. *Animal breeding. The tropical agriculturalist.* CTA publication, Waginingen, the Netherlands. pp. 210.

Wuletaw Belayneh. 2007. Economics of urban dairy farming in Hawassa town, Southern Nations, Nationalities and Peoples Regional Sate. MSc thesis. Haramaya University, Alemaya, Ethiopia. pp. 68.

Yoseph Mekasha, Azage Tegegne and Alemu Yami. 2003. Evaluation of the general farm characteristics and dairy herd structure in urban and peri-urban dairy production system in Addis Ababa milkshed. In: Jobre Y and Gebru G (eds), *Challenges and opportunities of livestock marketing in Ethiopia. Proceedings of the 10th annual conference of the Ethiopian Society of Animal Production (ESAP), held in Addis Ababa, Ethiopia, 22–24 August 2002*. ESAP, Addis Ababa, Ethiopia. pp. 139–144.

Yoseph Mekasha, Azage Tegegne, Alemu Yami and Umunna N. 2000. Feed resources and nutritional management of dairy herds in urban and peri-urban dairy production systems in Ethiopia. In: ESAP (Ethiopian Society of Animal Production), The complementarity of feed resource for animal production in Africa. Proceedings of the joint feed resources networks workshop held in Gaborone, Botswana, 4–8 March 1991. ESAP, Addis Ababa, Ethiopia. pp. 77–88.

Zegeye Yigezu. 2003. Imperative and challenges of dairy production, processing and marketing in Ethiopia. In: Jobre Y and Gebru G (eds), *Challenges and opportunities of livestock marketing in Ethiopia. Proceedings of the 10th annual conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia, 22–24 August 2002.* ESAP, Addis Ababa, Ethiopia. pp. 61–67.

Zelalem Yilma and Faye B. 2006. Handling and microbial load of cow's milk and Irgo—fermented milk collected from different shops and producers in central highlands of Ethiopia. *Ethiopian Journal of Animal Production* 6(2):7–82.

Zelalem Yilma and Ledin I. 2000. Milk production, processing, marketing and the role of milk and milk products on small farm's income in the central highlands of Ethiopia. In: ESAP (Ethiopian Society of Animal Production), *Pastoralism and agropastoralism: Which way forward? Proceedings of the 8th annual conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia, 24–26 August 2000.* ESAP, Addis Ababa, Ethiopia. pp. 139–154.