DEBRE BERHAN UNIVERSITY

COLLEGEE OF AGRICULTURAL AND NATURAL RESOURCES

DEPARTMENT OF AGRICULTURAL ECONOMICS

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

MUKEREM MOHAMMED----------0723/13

MESKEREM G/IGZAHBER----------1061/13

MULUNEH NEGALIGN----------0790/13

WELA SHARI----------1094/13

ABSERAT ABATE----------0563/13

FAIZA ABUSH----------0374/13

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ACRONYMS AND ABBREVIATIONS

AI - Artificial Insemination

DDA - Dairy Development Agency

DDE - Dairy Development Enterprise

DRDP - Dairy Rehabilitation and Development Project

OoARD - Offices of Agriculture and Rural Development

SDDP - Smallholder Dairy Development Project

SNNPRS - Southern Nations, Nationalities, and Peoples Regional State

SPSS - Statistical Procedures for Social Sciences

SAS - Statistical Analysis System

TCU - Tropical Cattle Unit

TLU - Tropical Livestock Unit

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Abstract

This study involved 240 dairy producers from both rural and urban areas in the Shashemene,Dilla area and southern Ethiopia, selected through multi-stage sampling. The aim was to characterize dairy production, processing, marketing systems, and to identify constraints and opportunities for dairy development. A Rapid Market Appraisal (RMA) technique was utilized, with producers interviewed using a structured questionnaire. Two primary dairy production systems were identified: urban and mixed crop-livestock systems, further categorized by major crops grown. The average household size was 7.19 for urban producers and 7.58 for rural producers. Dairy significantly contributed to the income of urban households, while it represented only 1.6% of income in mixed systems. The average farm size in mixed systems was 1.14 ha, while urban producers typically used small residential compounds for dairy. The average herd size was higher in cereal-based systems compared to enset-coffee systems. A total of 9,645,020 liters of milk were produced annually from small and medium farms. Most mixed system producers processed milk at home, whereas urban producers primarily sold it. An informal marketing system was the only one present. Various market channels and influences on pricing were identified, including seasonal factors and market access. Constraints for dairy development included feed availability, land shortages, inadequate marketing systems, and health service issues. Rapid urbanization and increasing living standards present opportunities for dairy development. Improving services related to feed, land access, marketing, and veterinary care could enhance smallholder dairy production. Encouraging private investment in dairy processing could provide stable markets for both rural and urban producers.

CHAPTER ONE

1. Introduction

In 2006, Ethiopia's estimated human population reached approximately 79.4 million, with a population density of 67 individuals per square kilometer. The demographic makeup consisted of about 61.4 million people living in rural areas (84%) and around 11.7 million in urban settings (16%), with an annual population growth rate of 2.78%. The country is home to a rich tapestry of over 70 distinct ethnic and linguistic groups.

Ethiopia's economy is heavily reliant on agriculture, which contributed around 48% of the GDP in the 2004/05 fiscal year. The services sector followed with 39%, and the industrial sector accounted for 13%. The agricultural sector is crucial for employment, providing jobs for approximately 80% of the population. Livestock farming plays an essential role in the economy, supplying food, income, services, and foreign exchange. It represents 12% of the total GDP and 33% of agricultural GDP, contributing 12-15% to export earnings. Notably, whole fresh cow milk ranked third among Ethiopia's top food and agricultural commodities in 2005, with production estimated at 1.5 million tonnes valued at nearly USD 398.9 million.

Dairy production is a significant component of Ethiopia's livestock sector, providing vital food and income sources. However, the potential of the dairy industry remains underutilized. Despite having the largest cattle population in Africa, Ethiopia’s dairy industry lags behind that of East African neighbors such as Kenya, Uganda, and Tanzania, with national milk production among the lowest globally, even by African standards. Although various efforts and research initiatives aimed at improving dairy practices have been undertaken, particularly around Addis Ababa, the results have been less than satisfactory.

The country's development is marked by rapid population growth, particularly in regional towns like Awassa, leading to a rising demand for dairy products. Dairy production is characterized as an efficient biological system that transforms abundant roughage into milk, a highly nutritious food. The dairy sector is unique due to several interrelated factors: milk is a bulky, daily-produced commodity; the majority of farmers are small-scale producers with limited market power; dairy cooperatives play a crucial role in marketing and processing; and milk is a valuable yet costly raw material for diverse products.

To increase milk production, assured and profitable marketing outlets are essential. Experiences from countries like India, Uganda, and Kenya highlight the importance of marketing systems for smallholder milk production. Long-term surplus milk can be processed into various products for export, generating foreign exchange. Policymakers and development organizations need to assess the efficiency of different milk marketing systems regarding costs, hygiene, quality, and price stability for both producers and consumers.

Numerous organizations, including agricultural research centers, the World Bank, the Ministry of Agriculture, and NGOs, have introduced improved dairy technologies to enhance productivity and income for smallholders in Ethiopia. Various dairy development projects have been initiated, including the Dairy Rehabilitation and Development Project (DRDP) and the Smallholder Dairy Development Project (SDDP). Despite these initiatives, studies evaluating the impact of these projects on market-oriented production are lacking. Dairy production in southern Ethiopia faces constraints categorized as technical or biological and socio-economic or institutional.

In 2007, the total population of the Southern Nations, Nationalities, and Peoples Regional State (SNNPRS) was around 15.3 million. This highlights the need to thoroughly assess and describe the different dairy production and marketing systems within the agricultural sector. There is a significant knowledge gap regarding dairy production, processing, and marketing systems in the study area.

1.1. Statement of problem

The dairy production, processing, and marketing systems in the Shashemene-Dilla area of South Ethiopia face several challenges that hinder their potential for growth and sustainability. Despite the region's favorable climatic conditions and a significant number of dairy farms, there is a lack of organized production systems, leading to inefficiencies in both dairy farming and processing. Farmers often struggle with inadequate access to quality feed, veterinary services, and modern dairy technologies, which adversely affect milk yield and quality. Furthermore, the absence of strong marketing channels limits farmers' ability to sell their products at fair prices, resulting in low income and economic insecurity. The processing sector is also underdeveloped, with few facilities capable of producing value-added dairy products, which could enhance market competitiveness. Additionally, cultural factors and limited awareness about nutritional benefits contribute to low dairy consumption in the region. Addressing these issues is critical for improving the livelihoods of dairy farmers and ensuring a stable supply of dairy products to meet local demand. Thus, a comprehensive understanding of the dairy production, processing, and marketing systems in the Shashemene-Dilla area is essential for developing effective interventions and policies aimed at enhancing the overall dairy value chain.

1.2. Objectives

1.2.1. General Objective

To facilitate dairy development in the region through detailed documentation of current practices, challenges, and opportunities in dairy production, processing, and marketing in the Shashemene-Dilla area.

1.2.2. Specific Objectives

-To characterize the dairy production systems in the Shashemene-Dilla area and prioritize associated challenges and opportunities.

-To describe the dairy marketing systems and identify constraints and opportunities for marketing in the area.

-To explore techniques for dairy processing and milk handling.

1.3. Research Question and Hypothesis

The study aims to address the following research questions:

1. What are the main factors influencing dairy production in the Shashemene-Dilla area?

- This question aims to identify the challenges and opportunities faced by dairy farmers, including access to feed, veterinary services, and technologies.

2. How do dairy processing practices vary among different producers in the region?

- This question seeks to understand the current methods of processing dairy products and the extent of value addition in the Shashemene-Dilla area.

3. What are the existing marketing channels for dairy products, and how effective are they in ensuring fair prices for farmers?

- This question focuses on evaluating the marketing systems in place, identifying stakeholders, and assessing the efficiency of these channels.

4. How do cultural perceptions and consumer preferences affect dairy consumption in the Shashemene-Dilla area?

- This question aims to explore the sociocultural factors that influence dairy consumption patterns among the local population.

5. What role do cooperative organizations play in enhancing dairy production and marketing in the region?

- This question investigates the impact of cooperatives on improving access to resources, information, and market opportunities for dairy farmers.

Hypotheses

The following hypotheses will be tested in this study:

H1: Limited access to quality feed and veterinary services significantly negatively impacts milk yield among dairy farmers in the Shashemene-Dilla area.

- This hypothesis will be tested by analyzing production data and correlating it with access to resources.

H2: Dairy processing practices that incorporate modern technologies result in higher quality and more diverse dairy products compared to traditional methods.

- This hypothesis will be explored through comparative analysis of different processing methods and their outputs.

H3: Farmers who engage in cooperative marketing systems receive higher prices for their dairy products than those who market individually.

- This hypothesis will be tested by comparing income levels between cooperative members and non-members.

H4: Positive cultural perceptions and awareness of the nutritional benefits of dairy products lead to higher dairy consumption rates in the Shashemene-Dilla area.

- This hypothesis will be assessed through surveys measuring consumer attitudes and consumption patterns.

H5: The establishment of strong cooperative organizations positively influences dairy production and marketing efficiency in the region.

- This hypothesis will be investigated by examining the performance metrics of cooperatives compared to non-cooperative producers.

1.4. Scope of the Study

The scope of this study encompasses the dairy production, processing, and marketing systems within the Shashemene-Dilla area of South Ethiopia. It focuses on understanding the current practices, challenges, and opportunities faced by dairy farmers in this region. The study will examine various aspects of dairy production, including feed availability, veterinary services, and the adoption of modern technologies, as well as the processing methods employed by local producers. Additionally, it will investigate the marketing channels utilized for dairy products, evaluating their effectiveness in ensuring fair pricing and access to consumers. The research will also explore cultural perceptions and consumer preferences regarding dairy consumption, aiming to identify factors that influence local demand. By concentrating on these areas, the study seeks to provide a comprehensive analysis of the dairy value chain, which will inform stakeholders and policymakers on potential interventions to enhance the sustainability and profitability of the dairy sector in the Shashemene-Dilla area. The time frame for the study will be limited to recent data and trends, focusing on current practices and conditions in the region.

1.5. Limitation of the Study

This study on the dairy production, processing, and marketing systems in the Shashemene-Dilla area of South Ethiopia faces several limitations that may affect the findings and conclusions drawn. One significant limitation is the reliance on self-reported data from farmers and stakeholders, which may introduce biases due to social desirability or recall errors. Additionally, the study is constrained by the availability of resources, such as time and funding, which may limit the sample size and geographic coverage. Although efforts will be made to include a diverse range of participants, the focus on a specific region may limit the generalizability of the findings to other areas of Ethiopia or similar contexts. Furthermore, the dynamic nature of agricultural practices and market conditions means that the results may quickly become outdated, as changes

in policy, climate, or consumer preferences could significantly impact the dairy sector. Lastly, potential language barriers and varying levels of literacy among respondents may affect the quality of data collected during interviews and surveys. Acknowledging these limitations is essential for contextualizing the results and providing a balanced interpretation of the study's implications.

CHAPTER TWO

2. Literature Review

2.1. Historical Events in Dairy Development in Ethiopia

According to Ahmed et al. (2003), dairying in Ethiopia was predominantly traditional during the early 20th century. The modern dairy industry began in the early 1950s when the country received its first shipment of dairy cattle from the United Nations Relief and Rehabilitation Administration (UNRRA). This introduction marked the start of large-scale commercial liquid milk production on farms in Addis Ababa and Asmara (Ketema, 2000). The government played a significant role by introducing high-yielding dairy breeds in the highland regions and near major urban centers. Additionally, it established modern milk processing and marketing facilities to support these production efforts.

In 1960, UNICEF set up a pilot processing plant in Shola, on the outskirts of Addis Ababa, aimed at fostering the growth of the dairy sector. Initially, the plant processed milk from large farms but soon expanded to include milk collected from smallholder producers, leading to further growth of large dairy operations. During the latter half of the 1960s, dairy production in the Addis Ababa area experienced rapid development due to the rise of large private dairy farms and the involvement of smallholder producers with indigenous cattle, facilitated by the establishment of milk collection centers (Ahmed et al., 2003). Following this, various dairy development projects were initiated across different regions of the country. The distribution of exotic dairy breeds, particularly the Holstein Friesian, in urban areas further propelled the advancement of the dairy sector in Ethiopia.

2.2. Overview of Dairy Production Systems in Ethiopia

According to Sere and Steinfield (1995), livestock production systems are a subset of farming systems, specifically when livestock contribute over 10% to total farm output or when intermediate contributions, like animal traction or manure, exceed 10% of the total value of purchased inputs. Dairy production systems can be classified using various criteria, such as integration with crops, land relations, agro-ecological zones, production intensity, and product type. Globally, livestock production systems are categorized into 11 different systems, with the mixed farm rainfed temperate and tropical highlands (MRT

system) being the most prevalent, covering 41% of arable land, 21% of the cattle population, and 37% of dairy cattle (Sere and Steinfield, 1995).

In Ethiopia, dairying is widespread, involving numerous small to large-scale farms that are either subsistence-based or market-oriented. Dairy production systems are categorized based on climate, land holdings, and crop integration into three main types: rural, 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 rural system, which includes pastoralists, agro-pastoralists, and mixed crop-livestock producers, accounts for 98% of the country's total milk production, while peri-urban and urban farms contribute only 2% (Ketema, 2000).

The rural dairy system primarily focuses on home consumption, with surplus milk dependent on household demand, herd size, production season, and market access. Surplus milk is often processed using traditional methods, with products like butter, ghee, ayib, and sour milk sold in informal markets after meeting household needs (Tsehay, 2001). Pastoralists manage about 30% of the indigenous livestock population, serving as the main milk production system for an estimated 10% of the lowland population. This system typically experiences low yields and seasonal milk availability (Zegeye, 2003).

Highland smallholder milk production occurs in central Ethiopia, where dairying is part of subsistence mixed crop-livestock farming. Local breeds in this system generally show low performance, with an average age at first calving of 53 months, a calving interval of 25 months, and an average lactation yield of 524 liters (Zegeye, 2003).

Peri-urban milk production is developing in densely populated areas where agricultural land is diminishing due to urbanization, especially around major cities like Addis Ababa. This system includes smallholder and commercial dairy farms, featuring animal types ranging from 50% crosses to high-grade Friesians. It primarily aims to generate additional income from milk sales and is expanding among mixed crop-livestock farmers in highland areas like Selale and Holetta, becoming a significant supplier to urban markets (GebreWold et al., 2000).

Urban dairy farming is characterized by highly specialized farms owned by the state or private businesses, primarily located in major cities where there is no access to grazing land. An increasing number of smallholder and commercial dairy farms are emerging in urban and peri-urban areas of the capital (Felleke and Geda, 2001; Azage, 2003). In Addis Ababa, the urban milk system comprises 5,167 small, medium, and large dairy farms producing 34.65 million liters of milk annually. Of this production, 73% is sold, 10% is for household consumption, 9.4% is allocated to calves, and 7.6% is processed into butter and ayib (cheese). Notably, 71% of producers sell milk directly to consumers (Tsehay, 2001).

2.3. Traditional Milk Handling and Processing Practices in Ethiopia

In Ethiopia, cows are the primary source of milk, with a particular emphasis on processing cow's milk (Layne et al., 1990). The dairy processing techniques typically involve producing ergo (fermented milk) without the use of defined starter cultures, relying instead on natural fermentation. Raw milk is usually stored at ambient temperatures or kept warm to facilitate fermentation before processing (Mogessie, 2002).

Dairy processing in the country is predominantly at the smallholder level, and the hygienic standards of the products are generally low (Zelalem and Faye, 2006).

According to their findings, approximately 52% of smallholder producers and 58% of large-scale producers use common towels to clean udders or do not clean them at all. Moreover, clean water is rarely used for washing udders and milk utensils. Among the small-scale producers surveyed, 45% did not treat milk prior to consumption, and the quality of dairy products is often assessed based on their organoleptic properties.

A study in the Boren region of Ethiopia highlighted that butter serves as an important energy source for human consumption, used for cooking and as a cosmetic. While butter's storage stability cannot match that of ghee, it typically lasts four to six weeks,

providing a time advantage over fresh milk for household use and marketing (Layne et al., 1990).

The efficiency of traditional butter production was evaluated through 28 instances where soured milk was churned by women in 20 households in the Boren region. Before churning, the milk had an average temperature of 20.0 ± 0.42 °C and an acidity of 1.06 ± 0.03%. The churning process lasted about 40.0 ± 2.5 minutes, resulting in a buttermilk temperature of 23.7 ± 0.32 °C. The sour milk contained approximately 46.8 grams of fat, while the buttermilk yielded only 7 grams of fat post-churning. This indicates that around 85% of the butterfat was successfully extracted during the churning process, with an average butter yield of 66.9 ± 5.6 grams; however, the moisture content of the butter was not measured (Layne et al., 1990).

2.4. Dairy Marketing Systems in Ethiopia

In the African context, agricultural product markets typically refer to physical marketplaces, or open spaces where commodities are exchanged. Conceptually, a market can be understood as a process through which ownership of goods is transferred from sellers to buyers, who may be either final consumers or intermediaries. Thus, markets encompass elements such as sales, locations, sellers, buyers, and transactions (Debrah and Berhanu, 1991).

2.4.1. Formal vs. Informal Dairy Marketing

The term "informal" typically refers to marketing systems where government intervention is minimal, often referred to as parallel markets. In contrast, "formal" describes government-regulated marketing systems (Debrah, 1990). In Ethiopia, a reliable system for marketing milk and dairy products has not been established (Zegeye, 2003). Fresh milk is distributed through both informal and formal marketing channels. In both rural and urban areas, milk is often delivered directly

from producers to consumers through informal (traditional) means. This informal market involves direct sales of fresh milk to individuals in the immediate vicinity or nearby towns (Debrah and Berhanu, 1991).

The initial efforts to promote formal dairy marketing began in 1947 with the establishment of a 300-dairy farm and a small milk processing plant under the UN Relief and Rehabilitation Program, located at what is now the Dairy Development Enterprise (DDE) (Sintayehu, 2003). By 1959, UNICEF assisted in setting up a processing plant with a capacity of 10,000 liters per day, along with milk collection and purchasing centers around Addis Ababa. This collection radius was later expanded to 70 kilometers around the capital. In 1969, the processing capacity was raised to 30,000 liters. The Dairy Development Agency (DDA) transitioned into the DDE in 1979, when the processing capacity was further increased to 60,000 liters per day, and the collection radius expanded to 150 kilometers with donor support.

Currently, the only organized and formal milk marketing and distribution system is provided by the two milk-processing plants located in Addis Ababa (Zegeye, 2003). According to various sources, farmers' milk marketing groups and dairy cooperatives play a crucial role in milk marketing outlets, which in turn encourages farmers to increase their production (Zegeye, 2003).

2.4.1.1. Role of Farmers' Milk Marketing Groups

According to Tsehay (1998), a milk marketing group is defined as a collective of smallholder farmers who each produce at least one liter of saleable milk and are willing to join together to collectively process and market their milk. To support smallholders with crossbred cows in their milk marketing efforts, the SDDP facilitated the formation of producer "milk groups" (also known as "milk units" or "mini-dairies") to process milk into butter, local cottage cheese (ayib), and yogurt-like sour milk (ergo), primarily in the northern Shewa zone, north of Addis Ababa. Two similar producer groups were established south of Assela in the Arsi zone with assistance from the Ministry of

Agriculture, while another group was formed in Bakel, near Debre Birhan. This last location is in the Amhara region, whereas the other four groups are situated in the Oromia region (Nicholson et al., 1998).

2.4.1.2. Role of Dairy Cooperatives in Facilitating Marketing

Berhane and Workneh (2003) highlighted the significant role of the Indian government in every aspect of dairy cooperative development, which has contributed to the success of the dairy sector in that country. They suggested that

the Anand model of dairy development could be applied in Ethiopia, particularly around major milksheds such as Nazareth, Dire Dawa, Harar, Bahir Dar, Gondar, Awassa (one of the study areas), Jimma, and Assela. As demonstrated in India, dairy marketing cooperatives can provide farmers with consistent outlets for their milk and easy access to essential inputs like artificial insemination (AI), veterinary services, and formulated feeds. Dairy cooperatives are expected to stimulate positive developments in the subsector by enhancing existing group marketing activities and establishing new cooperatives across various regions of the country (Berhane and Workneh, 2003).

Although not extensively documented in the literature, several dairy processing plants have recently been established in different parts of Ethiopia, such as in the 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 was launched to create a cooperative structure based on the Anand model (Matthewman, 1993). By 1980, approximately 12,000 village cooperative milk producer societies had been formed across 27 selected milkshed districts. This number grew by 1984 to 28,174 village producers in 155 milkshed districts, linked to markets in 147 towns. Uganda has also adopted similar milk collection schemes through cooperatives (Matthewman, 1993).

Cooperative selling institutions serve as catalysts for reducing costs, encouraging smallholder participation in the market, and fostering growth in rural communities (Holloway et al., 2000). Case studies from Kenya and Ethiopia demonstrate how dairy cooperatives help lower transaction costs (Staal et al., 1997). A notable example in Ethiopia is the Ada'a-Liben Woreda Dairy Association (Azage, 2003), which currently supplies milk to processing plants in Addis Ababa.

2.4.2. Dairy Marketing Channels and Outlets

Understanding terms related to marketing outlets, channels, and chains is essential for describing dairy marketing systems. A marketing outlet refers to the final market location where dairy products are delivered, which may involve various channels. A combination of these channels forms the market chain.

A study of the milk marketing system in Kenya identified at least eight different marketing channels, with the number of intermediaries varying from one to four (FAO, 1996). In the Addis Ababa milkshed, dairy producers utilized several primary marketing channels (Debrah, 1990; Mbogoh, 1990), which included:

1. Producer–Consumer (P–C) Channel: Direct sales to individual consumers, accounting for 71% of total channels (Mbogoh, 1990).

2. Producer–Catering Institution–Consumer (P–CI–C) Channel: This includes catering institutions such as itinerant traders, small private shops and kiosks, coffee and tea vendors, hotels, and supermarkets.

3. Producer–Government Institution–Consumer (P–GI–C) Channel: Sales to government institutions like the armed forces, schools, and hospitals.

For rural producers near Addis Ababa, the main outlets for cooking butter included:

- Restaurants in Addis Ababa and surrounding areas serving local foods,

- Itinerant traders,

- Individual consumers and butter wholesalers in Addis Ababa.

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

2.5. Common Challenges and Constraints of Dairy Production and Marketing in Ethiopia

The challenges and issues faced in dairy production vary across different production systems and locations. Generally, the structure and performance of livestock and its product marketing for both domestic consumption and export are viewed as inadequate in Ethiopia. Key factors contributing to the poor performance of this sector include underdevelopment, a lack of market-oriented production, insufficient information about livestock resources, inadequate permanent trade routes, and a lack of facilities such as feed, water, and holding grounds. Additionally, issues like limited transport availability, ineffective and insufficient infrastructure, disease prevalence, illegal trade, and inadequate market information (both internal and external) are frequently cited as significant obstacles (Belachew, 1998; Belachew and Jemberu, 2003; Yacob, as cited in Ayele et al., 2003).

In discussions about poverty reduction and the balance between small-scale and industrial production, there is a general agreement on the appropriateness of broad recommendations. However, there appears to be a lack of clarity regarding

the future roles and structures of current small-scale producers. While many donors are inclined to support and protect smallholders, few have a vision for the transformation of small-scale subsistence producers into commercial producers capable of supplying a modern, demanding food market (Kristensen et al., 2004).

According to the same report, small-scale farmers can be empowered through:

- Promoting farmer organizations and providing training.

- Developing infrastructure, such as roads and markets.

- Offering incentives and encouraging vertical integration with supply, processing, and marketing sectors.

- Improving access to information, agricultural, and veterinary services.

- Advocating for participatory methods in research and technology development.

- Supporting pro-poor research and advisory services focused on smallholders.

To implement such recommendations effectively, it is essential to understand the specific characteristics of dairy production and marketing systems in order to tailor strategies to particular production contexts.

CHAPTER THREE

3. Materials and Methods

3.1. Description of the Study Area

This study was conducted in the region stretching from Shashemené to Dilla, recognized as a high-potential area for milk production in southern Ethiopia. It is situated along the Addis Ababa–Moyale highway, approximately 250 to 375 kilometers south of the capital, Addis Ababa. The major towns selected for the study include Shashemene, Awassa, Yirgalem, and Dilla, each exhibiting distinct agricultural and social practices. Three primary local languages are spoken in the study woredas, determined by geographic location and ethnic groups: Gedio in the Dilla area, Sidama in Dale and Awassa, and Afan Oromo in the Shashemene area. Amharic, the federal working language, is commonly spoken across all towns.

Descriptions of each area are as follows:

- Shashemene: Located in the Oromia Regional State, West Arsi Zone, it lies 250 km south of Addis Ababa and 25 km north of Awassa, the regional capital of SNNPRS. The area is part of the Rift Valley with altitudes ranging from 1,700 to 2,600 meters above sea level (masl). It receives an annual rainfall of 700–950 mm and has a temperature range of 12–27°C (SWARDO, 2006). Major crops include cereals like teff, barley, wheat, maize, and sorghum, as well as root crops like potatoes and sweet potatoes, and vegetables such as cabbage, spinach, and onions. The total human population is 285,176, with land use classified as follows: 50% Kolla, 29% Woinadega, and 21% Dega. Of the total area of 76,888 ha, cropland accounts for 48,975 ha, with the rest designated for forest, grazing, and other uses. The cattle population in the woreda is 184,549.

- Awassa: As the regional capital of SNNPRS, Awassa is located 275 km south of Addis Ababa along the same highway. It has an altitude of 1,750 masl and coordinates of 6°83’

to 7°17’ N and 38°24’ to 38°72’ E (AWARDO, 2006). The area receives an average annual rainfall of 955 mm and has a mean temperature of 20°C (SNNPRS–RSA, 2006). Predominantly, food crops like cereals are grown rather than cash crops. The total urban and rural population of Awassa woreda is 498,534, with a cattle population of 261,365.

- Dale: Currently divided into three new woredas, Dale is located 40 km south of Awassa at coordinates 6°44’ to 6°84’ N and 37°92’ to 38°60’ E, with altitudes ranging from 1,001 to 2,500 masl (average 1,624 masl). This woreda experiences an average annual rainfall of 1,170 mm (SEDPSZ, 2004) and an average temperature of 19°C. The area has diverse agro-ecological zones and various soil types, including Haptic Luvisols and Chromic Luvisols (IPMS, 2005). The total population is 428,648, with 41,270 in urban centers and 387,378 in rural areas, and a cattle population of 215,924.

- Dilla: Located 90 km south of Awassa, Dilla is positioned at coordinates 6°22’ to 6°42’ N and 38°21’ to 38°41’ E, with an altitude range of 1,300 to 2,500 masl. The area receives an annual rainfall of 849.8 mm, with average temperatures ranging from 12.5°C to 28.0°C. Most of the land is used for perennial cash and food crops, with significant cultivation of cash crops like coffee and food crops such as enset, maize, and sorghum. The area faces land shortages, leading to diversified cropping practices within small plots. The total population is 267,867, with 66,200 in urban towns and 201,667 in rural areas. The cattle population in Dilla is 16,516 (DiWARDO, 2006).

3.2. Sources and Methods of Data Collection

3.2.1. Dairy Production and Processing Systems

To characterize the dairy production systems in the study area, interviews were

conducted with farmers/producers using a structured questionnaire that was pre-tested and translated into Amharic. Enumerators, who held diplomas in Animal Science, were recruited and trained before data collection began.

A multi-stage sampling procedure was employed, consisting of four stages. In the first stage, a primary sampling unit representing two categories of producers (rural and urban) was selected within each study woreda. In the second stage, kebeles were identified for rural producers and groups of urban kebeles for urban producers after conducting a livestock census in each town. In the third stage, individual households with dairy cows of any breed and size were listed. The fourth stage involved randomly selecting individual dairy cow owner households for interviews.

Since there was no formal marketing or milk collection scheme for rural producers in the area, two rural kebeles were randomly chosen within a 3 to 10 km radius of each woreda, which was considered an ideal distance for dairy marketing to neighboring towns. Prior to data collection, dairy cow owners were identified from each rural kebele by data collectors from the respective administrative areas, and households were randomly selected from the list. Due to a lack of reliable, up-to-date information on livestock holdings in each town, a census was conducted from October to November 2007, focusing on dairy cattle owners in Shashemene, Awassa, Yirgalem, and Dilla. The census results were also used to estimate total milk production from these towns. Information on lactation length and daily milk yield for both zebu and their crosses was obtained from producers, enabling the calculation of total annual milk production.

A total of 240 households were interviewed, with 60 from each woreda, including 30 from rural and 30 from urban kebeles. In addition to the main survey, participatory rural appraisal (PRA) methods, including group discussions, were employed to gather qualitative data on dairy production parameters (Bayemi et al., 2005). Personal observations during visits and supervision were also made to complement the survey findings, particularly to document routine dairy activities practiced by producers.

3.2.2 Dairy Marketing System

The marketing of potential marketable dairy commodities, such as whole milk, butter, yogurt (ergo), cheese, and sour buttermilk (arera), was studied as a secondary activity. A Rapid Market Appraisal (RMA) (Holtzeman, 1986; Menegay and Molina, 1988; Miles,

2000) was utilized to collect relevant data from key informants at various stages, including milk producers, dairy traders, and consumers. Separate semi-structured informal interview guidelines and checklists were used for each group of key informants. Prior to conducting the RMA with different marketing agents, a census was performed to count the number of permanent butter traders and ergo sellers in each of the four towns: Shashemene, Awassa, Yirgalem, and Dilla.

3.3. Statistical Analysis

Data collected for the characterization of dairy production and handling systems were analyzed using appropriate statistical software, including Statistical Procedures for Social Sciences (SPSS, 2001) and Statistical Analysis System (SAS, 1997). Survey results were reported using both descriptive and inferential statistics. Statistical analyses, including correlations and mean comparisons, were conducted for relevant variables. Mean comparisons were carried out using Duncan's multiple range tests, with significance levels set at $\alpha = P < 0.01$, $P < 0.05$, and $P < 0.001$. Data related to pricing, collected for characterizing the dairy marketing system, were analyzed using descriptive statistics from SPSS, while data gathered through RMA were presented using flowcharts and summarized discussions.

CHAPTER FOUR

4. Results and Discussion

4.1. Dairy Production and Handling Systems

4.1.1. Production Systems Identified

Two primary dairy cattle production systems were identified: the mixed crop-livestock production system in rural areas and the urban dairy cattle production system within cities or towns. Although a third system, the pastoral production system, was noted, its characteristics were not studied as it falls outside the 3–10 km radius of this research.

Each of these two production systems was further subdivided into subsystems based on the major crops produced in the area, categorized as cereal-based and enset-coffee-based dairy cattle production systems. Sere and Steinfield (1995) also characterized cattle production systems based on land and resource use. Thus, this study primarily focused on the detailed characterization of these two systems, as presented in the following sections.

4.1.1.1. Mixed Crop-Livestock Dairy System

The mixed crop-livestock agricultural system was identified in the rural areas of the studied regions. This system is characterized by the interdependence of crop and livestock outputs and by-products. The types of vegetation and crop farming practices influence livestock production generally, and dairy production specifically. The primary feed types provided to cattle vary across different production systems, with the main purpose of keeping cattle differing by area. Based on these criteria, the crop-livestock production system in the studied areas is categorized into cereal crop-based and enset-

coffee-based subsystems. Adugna and Said (1992) in Wolaita, Agajie et al. (2002), Tessema et al. (2003) in the mid-highlands of Ethiopia, and Talew (2006) in Yirgachefe identified similar mixed crop-livestock production systems in the country with common characteristics in resource use.

Cereal Crop-Based Dairy Subsystem

This subsystem was identified in the rural areas of Shashemene and parts of Awassa. The predominant cereal crops produced in these neighboring rural areas include maize, teff, sorghum, wheat, and barley. Crop farming in this area is mainly conducted using oxen for draught power, and oxen are prioritized over other cattle types. The size of farmland and communal grazing areas, particularly in Shashemene, are relatively more favorable. Bull calves are preferred over heifer calves, a preference echoed in the Dilla area, although in Dilla, bull calves are primarily fattened for beef rather than used for plowing. In most rural areas of Awassa and Dale, however, heifer calves are favored over bull calves. Milk production comes from animals kept for multiple purposes, with feed production and utilization largely limited to communal grazing lands and crop residues. Dairy products are produced as a source of income to purchase farm inputs and meet family needs, with cattle serving as assets during emergencies.

Enset and Coffee-Based Dairy Subsystem

The enset and coffee-based dairy cattle production system is the other subsystem identified within the mixed crop-livestock production system in the rural parts of Dale and Dilla. This system is characterized by the production of perennial cash and food crops, with farmers primarily focused on cash crop production rather than livestock rearing. Due to small farm sizes in these areas, highly diversified cropping practices are common within single farmlands. Commonly grown cash and food crops include enset, coffee, various fruits (such as banana, avocado, mango, and pineapple), yam, cassava, taro, chat, and annual crops like maize and sorghum. Crop farming in this subsystem mainly relies on hand tools, with draught oxen used only occasionally.

4.1.1.2. Urban Dairy Production System

The urban dairy production system has been identified in four towns: Shashemene, Awassa, Yirgalem, and Dilla. Similar to urban dairying in other East African countries, this system is characterized by its market orientation and the types of inputs, particularly feed. The feeds consist of purchased concentrates and both conventional and non-conventional roughages. Most dairy producers in these towns are smallholders, with a higher proportion of Holstein Friesian crosses compared to rural areas. This finding aligns with observations from urban dairying in Addis Ababa and Mekele (Yosef et al., 2003; Nigussie, 2006).

Literature documents the spatial growth and economic significance of urban agriculture and urban livestock production in various African cities. For instance, studies by Mosha (1991) in Tanzania, Lee-Smith and Memon (1994) in Kenya, and Azage and Alemu (1998) in Addis Ababa, Ethiopia, reflect these trends.

In subsequent sections, key production parameters will be compared between mixed crop-livestock systems and urban dairy systems. Some production and reproduction parameters will categorize the four woredas into cereal crop-based and enset-and-coffee-based urban and rural systems, forming a total of four systems. Socio-economic characteristics of respondents will also be summarized for discussion.

4.1.2. Household Characteristics and Socio-Economic Profile of Respondents

Among the 240 interviewed dairy cattle producers, 77% were male and 23% were female household members of various ages and educational backgrounds. Most (87%) of the respondents were heads of households, while the remainder were primarily wives. The

majority of respondents were aged between 25-40 years (31.5%) and 41-50 years (32%). In total, 211 households (88%) were male-headed.

Regarding educational attainment, most urban dairy producers were literate beyond elementary school, with only 19% illiterate. Approximately 29% completed grades 1-6, and 7% completed grades 7-10, while 20% had education beyond 10th grade, and 25.6% held diplomas or higher qualifications. These results indicate that dairy cattle owners in the study areas are predominantly literate, suggesting that with effective extension and training programs, they could enhance their dairy production and marketing.

The average family size by age group indicates that 58.84% of household members fall within the productive age category in both urban and mixed crop-livestock systems. For example, the average number of family members aged 11-25 years was 3.17 (±0.17) in urban areas and 1.63 (±0.16) in rural areas, while those aged 25-40 years averaged 2.54 (±0.16) and 1.53 (±0.10), respectively.

Dairy cattle owners generate income from various sources, but for many rural producers, dairying is not their primary income source. Although butter and sour buttermilk are marketed throughout the year, the income from these products is limited in rural communities. In contrast, urban producers derive a significant portion of their total income (50%) from dairying. Conversely, dairying contributes only 1.6% to the total income of rural families (see Table 1). Studies in Ethiopia's mid-highland crop-livestock systems have shown that the income share from dairying increases with proximity to urban centers, ranging from 0.07% to 44% of farmers' total income (Zelalem and Ledin, 2000). Similar research on market-oriented dairy producers near Holleta indicated that dairying contributed an average of 34% to farmers' total income (Ahmed et al., 2002). Thus, this study highlights the relatively minor contribution of dairying to rural families' income.

In contrast, urban producers in the study areas generate substantial income from dairying, indicating a promising opportunity for further development of the sector.

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

Studyarea	Productionsystems	n	Incomesourcesandlevelpermonth(ETB)*		
				Sharefromdairying	
			Mean±SE	Mean±SE	Percent
Shashemene	Mixedcrop-livestock	30	238.8±3.73	2.3± 2.33	0.98
	Urbandairying	29	687.2±0.20	383.1±76.63	55.8
Awassa	Mixedcrop-livestock	28	209.5±49.01	44.1±23.28	21.1
	Urbandairying	27	2126.7±1.98	1071.4±260.37	50.4
Dale	Mixedcrop-livestock	21	174.0±41.58	17.1±6.44	9.9
	Urbandairying	30	1168.4±188.41	415.3±153.94	35.6
Dilla	Mixedcrop-livestock	30	278.8±59.63	55.7±9.11	19.97
	Urbandairying	29	961.3±211.17	554.3±42.14	57.66
Overallrural		109	229.78±23.99	30.6±6.87	1.6%
Overallurban		115	1219.83±124.53	596.3±86.38	48.88%

Totalofdifferent

*InJanuary2024,USD 127.32EthiopianBirr(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 animal sowned (high yieldervs.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 small holder 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 milk shed (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. . Farmland 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, notabledifferences were also observed among the considered towns. For instance, both livestock 22 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 23 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), estimatedannualmilkproduction

Cattleclassbybreed	Cattleheadsateachtowns				
	Shashemene	Awassa*	Yirgalem	Dilla	Overallsum(%)
Localbreeds					
Lactatingcows	771	1482a	255	336	3901(31.3)
Drycows	557		270	230	
Heifers	466	306	214	221	1207(9.7)
Bulls/oxen	474	240	46	97	857(6.9)
Malecalves	563	205	180	169	1117(8.9)
Femalecalves	382	250	131	188	951(7.6)
Crosseswithexoticbreeds					
Lactatingcows	609	1110a	185	87	2420(19.4)
Drycows	305		99	25	
Heifers	380	76	130	58	644(5.2)
Bulls/oxen	105	7	36	17	165(1.3)
Malecalves	310	34	96	76	516(4.1)
Femalecalves	378	56	105	168	707(5.7)
TotalTCU[a]	3640	4144	1129	959	9872
Numberofcattleowning households	1882	1470	587	490	4429
TotalTLU[a]	4272	5115	1197	1035	11,620
Estimatedoverallmilkproduc-tion/year(litres)[b]	3,587,938	4,257,111	1,128,915	671,056	9,645,020

Source:Own survey,2024 and secondarydata (*Wuletaw2024).

TLU=Tropical Live stock Unit,TCU Tropical Cattle Unit.

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 practices are crucial components of dairy operations. In the studied areas, common feed resources varied by production system. In mixed crop-livestock systems, particularly those based on cereal crops and enset and coffee, grazing serves as the primary feed source. A significant 53.7% of households rely on animal feeds from their own farms, while 23.7% utilize a mix of private and communal grazing, and 15.8% use a combination of homegrown and purchased feeds. Only about 7% source their feeds from other means. In contrast, 76% of dairy producers in urban systems predominantly use purchased feeds from various suppliers, with the remaining 16% and 1.7% relying on roadside grazing and their own feed resources, respectively.

Both conventional and non-conventional feed resources are utilized, including grazing land, hay, purchased succulent grasses, cereal crop residues, and by-products such as brewery waste (attella), kitchen scraps, and leaves from agroforestry plants. Maize stover is the most commonly used roughage, with 77.5% of households employing it during the wet season and 45.4% during the dry season. The cereal crop-based system, primarily in rural Shashemene and parts of Awassa, shares similarities in feed resource use with most mixed crop-livestock systems in Ethiopia.

In enset and coffee-based systems, cattle are often grazed along roadsides or tethered in backyards, with additional feed provided from well-chopped enset pseudostems, whole maize plants, and various tree leaves. A distinguishing feature of these areas is the year-round availability of succulent roughage, especially during dry seasons when other systems may not have such resources. Urban dairy producers mainly utilize purchased roughage and concentrates, with 35.8% practicing haystacking for the dry period. In towns like Awassa, Yirgalem, and Dilla, smallholders without space for hay storage incur extra costs for purchasing alternative feeds during dry seasons.

Cattle, predominantly local breeds, often roam marketplaces for food waste. The feed resources identified in this study align with those found in other urban dairy systems in the country. Supplementary feeds are primarily given to lactating cows, with 58% of respondents prioritizing their care.

4.1.6.2. Water Resources and Watering Practices

The main water sources in the study areas include rivers, piped water, dams, wells, lakes, springs, and boreholes. In mixed crop-livestock systems, 45.8% of households obtain water from rivers, while 24.2% use piped water. Urban producers heavily rely on piped water (71.8%). All interviewed dairy producers believe they provide good quality water for their cattle.

Watering frequency varies by production system due to factors like season, accessibility, cow performance, and feed type. During the wet season, 35.6% of households water their cattle once a day, while in the dry season, this increases to 47%. Urban producers often incorporate water into liquid feeds, resulting in some households not providing free water.

4.1.6.3. Housing Systems

In mixed crop-livestock systems, 70% of households keep cattle within their residence compounds, while 27% use open barns or sheds. In urban areas, sheltering cattle with families or in kitchens is uncommon, practiced by only 6% of households. Most urban dwellers (85%) use separate shelters, which help protect animals from environmental hazards and facilitate management practices.

4.1.6.4. Breeding Practices

Most households in mixed crop-livestock systems (81.7%) use local bulls for mating, with only 10% employing artificial insemination (AI) and 4.2% using bulls with exotic bloodlines. In urban systems, 50% use AI exclusively for genetic improvement, while 20% that opt for natural mating use only local bulls.

The type of crop farming affects the availability of breeding bulls. In cereal-based systems, male animals are typically used for draught power before castration. In enset-coffee systems, lower proportions of bulls are observed, complicating breeding availability. A majority (53.9%) of households prefer AI for breeding, which, while not cost-free, offers long-term benefits once established.

4.1.6.5. Milking Practices

Of the interviewed dairy producers, 96.3% milk their cows twice a day, with very few milking three (3.3%) or once (0.4%) daily. The high incidence of twice-daily milking reflects practices in many regions. Timing varies, with rural farmers often less strict about regularity compared to urban producers, who aim for specific delivery times. Most milking is performed by women (79.3%).

4.1.6.6. Calf Rearing Practices

All dairy producers in mixed crop-livestock systems practice partial suckling before milking, with colostrum provided freely. In urban systems, 31.6% follow early weaning, while 68.4% practice partial suckling. Colostrum feeding for early weaned calves typically lasts 4 to 7 days. Supplementary feeding practices vary, with many urban producers starting within 7 to 15 days after birth.

4.1.6.7. Waste Management

Waste disposal presents a significant challenge for urban dairy producers. In mixed crop-livestock systems, 97.4% use animal dung primarily as fertilizer, while 2.6% use it for fuel. A majority of urban producers (46.5%) spend extra on waste disposal, and many do not market dung for these purposes, focusing instead on organic fertilization.

4.1.6.8. Record Keeping

Record keeping is underutilized, with 79% of urban and 94% of mixed crop-livestock producers lacking any formal system. Only a small percentage maintain informal records, highlighting the need for training to improve management practices.

4.1.7. Milk Utilization, Handling, and Processing

Daily milk production in mixed crop-livestock systems ranges from 1.97 to 2.84 liters, while urban systems yield between 10.21 to 15.90 liters. Urban producers significantly benefit from dairying, but overall annual milk production is low compared to other urban areas like Addis Ababa.

In mixed systems, 61.7% of households use whole milk for home processing, while urban households predominantly produce milk for sale (79.2%). Handling practices vary, with urban producers more likely to use high-quality utensils and cleaning methods than their rural counterparts.

In terms of processing, 54.5% of urban households churn butter primarily when surplus milk is available, while 66% of mixed system households churn all their milk. The main dairy products vary, with butter being the leading product in both systems.

The majority of dairy producers use traditional clay pots for churning, reflecting regional preferences. Proper milk handling and processing are essential for ensuring product quality and hygiene.

4.1.7.1. Milk Handling

The quality of dairy products is significantly influenced by milking utensils. The type and quality of these utensils, as well as their cleaning methods and frequency, play crucial roles in determining milk quality. In the studied areas, a notable difference exists in the types of milking utensils used: 92% of urban producers relied on plastic utensils, whereas approximately 43.3% of rural producers used clay pots and plastics, with only 12.5% utilizing locally made grass utensils.

Most urban producers (73.5%) typically clean their milking utensils before and after use, while others clean them twice a day (13.3%), once a day (7%), or every two days (6%). In contrast, nearly half (43.3%) of rural producers clean their utensils every two days, with 30% cleaning

them before and after milking, 16.7% twice a day, and 10% once a day. The primary differences in milking utensils among producers are the materials used and the cleaning methods employed.

Cleaning practices vary widely, with 70% of households washing utensils with or without hot water, followed by smoking them using aromatic plants like Woira (Olea africana) and Tid (Juniperous procera). Additionally, 22.7%, 6.4%, and 4.7% of households used water and detergents, smoked with aromatic plants, or washed only with water, respectively. Smoking utensils before milking and churning is a common traditional practice across various regions.

Proper cleaning methods and materials used by urban dairy producers tend to promote better hygiene. Nonetheless, it's essential to consider consumer preferences for dairy products in both areas. Effective milk handling is crucial before consumption, marketing, or further processing, as milk can harbor pathogenic and spoilage microbes. Therefore, training should be provided to producers to improve their knowledge and practices in milk handling.

4.1.7.2. Milk Processing

Among urban dairy producers, 54.5% only churn butter when they have surplus milk that is not sold, while the remaining 37.3% do not churn at all, and 8.2% churn continuously as they do not sell milk. In mixed crop-livestock systems, 66% of households churn all the milk produced, with 37.3% doing so intermittently and only 1.7% not churning at all.

The primary dairy product processed in urban systems is butter, produced by 71.6% of households, followed by fermented whole milk (ergo) at 24% and cottage cheese at 4.5%. In mixed systems, butter is the main product for 87.7% of households, with ergo and cottage cheese constituting 9.6% and 2.6%, respectively. Among mixed crop-livestock producers, 58.8% prefer churning for butter and using buttermilk for household consumption, while 14% lack access to whole milk markets, and 12.3% are restricted by traditional taboos against selling whole milk.

In urban settings, the majority (41.8%) churn during fasting periods when demand for dairy products is low, with others churning based on butter preference, unsold milk, taboos against selling whole milk, and other reasons. Most dairy producers (96.5%) use traditional clay pots for churning, while others utilize wooden, ‘Kell’, or metal utensils.

4.2. Dairy Marketing Systems

4.2.1. Producer Involvement in Dairy Marketing

In the mixed crop-livestock system, the majority of dairy farmers (62.5%) primarily produced butter for sale, while 20.6% produced sour buttermilk, and 14.3% sold whole milk, with the remainder selling cottage cheese and ergo. The income generated from whole milk sales was minimal, with butter and sour buttermilk being the main sources of revenue. Of the sour buttermilk produced, a significant portion (74.4%) was consumed at home, leaving only 24.5% for sale.

In contrast, urban dairy farmers predominantly (89%) focused on whole milk production, with a small percentage (7.3%, 1.8%, and 1.8%) producing ergo, butter, and sour buttermilk, respectively, for sale. Among the crop-livestock producers, only 18.5% were market-oriented, whereas a substantial majority (78.2%) of urban producers were market-focused. Many dairy producers have recently engaged in market-oriented dairy business practices; for instance, those in mixed crop-livestock systems have been adopting these practices for about 6.6 years, while urban producers began around 11.6 years ago. The average capital investment for establishing dairy businesses was ETB 11,127 per farm in the mixed crop-livestock system and ETB 1,750 per farm in the urban system.

Marketing Systems and Channels

The primary dairy marketing system identified in the study was informal marketing, where milk was often sold on a contract basis to customers. In towns like Shashemene, Awassa, and Yirgalem, cooperatives and producer groups aimed to set prices for milk collection based on its organoleptic qualities. Dairy producers typically determined the prices of milk and dairy products when selling directly to consumers or negotiating with traders, with the government playing a minimal role in regulating or trading dairy products in the area.

Producers, cooperatives, traders, and consumers established the marketing channels, but a formal marketing system is lacking. This absence mirrors findings by Nigussie (2006) regarding Mekelle's urban dairy system. However, in Addis Ababa, the presence of milk processing plants has led to the emergence of more formal marketing systems (Sintayehu, 2003).

Selling Outlets and Criteria

The primary selling outlets and criteria for selecting them in the two production systems are summarized in Table 6. Most producers in both urban (52%) and crop-livestock systems (68%) sold their milk directly to consumers, either at the farm or consumer's gate. Catering institutions were significant recipients of milk, accounting for 33.3% in urban areas and 22.7% in mixed crop-livestock systems.

In the urban production system, proximity (47%), better pricing (17.7%), or a combination of both (13.5%) were the main criteria for selecting selling outlets. In the mixed crop-livestock system, proximity was also the primary factor (45.5%), but a notable percentage (22.7%) cited a lack of alternatives as a reason for using available outlets. This highlights the need for improved market options in the mixed crop-livestock system to support rural producers and enhance dairy operations. Among urban producers, 77% reported no issues with selling agreements, while 23% encountered problems. Additionally, 92.5% of urban dairy producers adhered to flat pricing, while only 7.5% utilized 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

4.2.2. Marketable Dairy Derivatives and Prices

Data from the Rapid Market Appraisal (RMA) identified several marketable dairy products in the studied areas, including whole milk, traditionally processed butter, ergo (fermented whole

milk), cottage cheese, and sour buttermilk. Additionally, supermarkets in Awassa featured imported dairy products and processed items from processing plants in Addis Ababa, such as pasteurized milk, various types of locally produced and imported cheese, yogurt, table butter, cream, and imported milk powder (see Table 7).

The availability of marketable dairy products in a specific locality is influenced by various factors, including the production system, consumers' purchasing power, taste preferences, overall country development, and advancements within the dairy sector. The prices of each dairy derivative were documented along with the factors affecting demand and pricing in the studied regions.

Price data were gathered from 484 ergo sellers, 145 butter sellers, 240 milk producers, 10 sour buttermilk producers, and 3 supermarkets, with averages calculated for each town (see Table 7). Notably, the prices of some dairy products showed significant variation, with whole milk priced between ETB 2 to 4 per liter and butter ranging from ETB 25 to 50 per kilogram across the four towns. Overall, dairy product prices exhibited considerable differences both between and within towns. Given that informal marketing was the sole method of dairy distribution in the area, no fixed prices existed for any dairy product. This highlights the need for regulations to control quality and pricing, ensuring that dairy producers are not disheartened by substantial price and demand fluctuations.

Table7. Averagepricesofmilkandmilkproducts

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 primary factors influencing the prices and demand for dairy products in the examined areas include seasonality (dry and wet seasons), market accessibility (proximity to urban consumers), fasting and non-fasting days (related to the Orthodox Christian calendar), holidays and festivals, the balance of dairy supply versus the purchasing power of urban residents, and the quality and origin of the products. Prices and demand for milk and dairy items, particularly butter, are highly susceptible to these factors.

Seasonality

Wet seasons yield better vegetation cover, enhancing the supply of roughage for dairy cattle and resulting in higher milk yields. However, this time also coincides with limited cash flow for rural farmers engaged in real and cash crop production, compelling them to sell a significant portion of their dairy products for immediate cash. Surveys indicated a higher availability of

butter and buttermilk in rural open markets during this period, leading to lower prices for these products.

In contrast, the dry season presents a shortage of nutritious roughage, negatively impacting cattle performance. Early in the dry season, farmers prefer to consume dairy products at home rather than sell them, resulting in reduced market supply and elevated prices. Butter prices are particularly influenced by seasonal changes. Additionally, traditional and religious holidays occurring during the dry season further exacerbate butter prices. Although urban producers experience less impact, prices in nearby rural towns can still affect overall pricing during this season.

Market Accessibility

The freshness of milk limits its storage time before consumption or processing. Distance from markets significantly hinders farmers from selling fresh milk to urban consumers. In some regions, traditional taboos also restrict rural producers from selling milk, leading to lower dairy prices in rural areas compared to urban markets. Even larger towns, like Awassa, often have higher dairy product prices than smaller ones, indicating that market distance plays a crucial role in determining dairy product types and prices.

Fasting vs. Non-Fasting Days

The demand for dairy products, especially butter and whole milk, is significantly impacted by the long fasting periods observed by followers of the Orthodox Christian faith. During these times, demand decreases, forcing urban dairy producers to process unsold milk into butter or cottage cheese, which has a shorter shelf life. Consequently, milk is predominantly converted into butter, which traders often store until the fasting period ends to sell afterward.

Festivals and Holidays

Dairy products experience heightened demand during religious and cultural festivals, leading to inflated prices, particularly for butter. Major Ethiopian Christian celebrations, such as ‘Enkutatash’ (Ethiopian New Year), ‘Meskel’ (Finding of the True Cross), ‘Genna’ (Ethiopian Christmas), and ‘Fasika’ (Ethiopian Easter), significantly boost the demand for animal products, driving prices higher. Additionally, local festivals like ‘Fiche’ (Sidama New Year) also substantially increase the demand for dairy and other animal products.

Supply Levels vs. Urban Purchasing Power

The relatively low supply of milk compared to high demand in towns like Dilla and Awassa results in higher milk prices than in Shashemene and Yirgalem. The rapid urbanization of Awassa has led to an increased consumption of dairy products, contributing to the overall rise in dairy prices in the region due to this supply-demand imbalance.

Quality and Sources of Dairy Products

Locally produced dairy products vary in price based on their origin. Imported goods and those from Addis Ababa's processing plants tend to be more expensive due to value addition, quality, and safety considerations compared to local products. For instance, butter from Wolaita and Kucha is perceived as high quality, fetching better prices. Additionally, the fermentation level of butter affects its price, with fermented butter typically being less expensive than fresh butter. Adulteration is another significant factor influencing prices, particularly for butter, where vegetable oils are often mixed in by retailers sourcing from rural markets. In Dilla and Shashemene, adulterated Wolaita butter is sold at reduced prices compared to pure varieties.

4.2.4. Stakeholders in Dairy Production and Marketing

The key stakeholders involved in the development of dairy production and marketing in the studied areas include the Offices of Agriculture and Rural Development (OoARD) from the respective woredas, dairy cooperatives, various governmental and non-governmental dairy development projects, dairy traders, higher educational and research institutions, private input suppliers, and both commercial and non-commercial dairy producers, including parastatal farms.

The OoARD is responsible for providing services related to veterinary care, extension, artificial insemination (AI), and sometimes training. Among the interviewed dairy producers in urban and mixed crop-livestock systems, 75% and 34% respectively had access to AI services, while 84.2% and 67.5% received veterinary services, and only 12.5% and 35% accessed extension services from the OoARD. This indicates a lower proportion of producers in the mixed system receiving AI services, and the overall access to extension services is limited, particularly in urban production systems. Furthermore, none of the interviewed dairy producers received credit or training services, and there were no designated institutions responsible for providing these services to dairy producers in the area.

4.3. Constraints, Opportunities, and Prospects

4.3.1. Constraints in Dairy Production and Marketing

Dairy production and marketing in the studied regions face various challenges. Dairy producers have identified several key issues, including:

Feed Availability and Costs: Shortages and high prices of feed are the most pressing concerns for dairy producers, particularly in mixed and urban systems. Approximately 55% of producers in mixed crop-livestock systems and 73% in urban settings highlighted the seasonal variability and high costs associated with feed. While some roughage, like maize stover and sugarcane, is available in urban markets, a lack of integration between rural agricultural systems and urban dairy production creates significant feed shortages for urban producers. In contrast, towns like Shashemene benefit from nearby cereal crop residues that satisfy roughage needs during the dry season. Overall, the high costs of concentrate feeds are a major challenge across all systems.

Land Limitations for Sustainable Development: Access to farmland is the second most significant constraint, affecting 57.5% of urban producers and 48% of those in mixed systems. Many urban producers keep their cattle in small residential areas, limiting their ability to expand operations despite interest in doing so.

Waste Disposal Issues: Urban producers, especially in Awassa, face significant waste disposal challenges due to rapid urbanization and a lack of appropriate facilities for managing animal waste. This leads to additional costs for labor to dispose of manure, with no designated disposal sites available. Rural producers do not experience these waste disposal problems.

Discouraging Marketing Systems: Seasonal fluctuations in demand for milk and dairy products are a concern for 10.5% of rural and 75% of urban producers. The absence of a strong market link between rural producers and urban consumers, particularly in potential areas like Shashemene and Yirgalem, discourages producers. This situation is exacerbated by high input costs and low milk prices. Additionally, the adulteration of milk and dairy products, particularly butter, poses a significant marketing challenge.

To address these issues, implementing processing technologies to extend the shelf life of dairy products could help mitigate seasonal demand problems. For areas lacking market access, establishing milk collection schemes through marketing groups may also alleviate some constraints.

4.3.2. Opportunities for Dairy Development

Despite the numerous challenges and constraints identified in the area, a significant majority of dairy producers in both mixed crop-livestock (67.5%) and urban (86.6%) systems expressed a willingness to continue, expand, or engage in dairying in the future. Conversely, some producers were hesitant to expand due to various reasons. Approximately 27.5% of respondents in the mixed crop-livestock system indicated they would maintain their current stock or cease dairying altogether, while 11% of urban producers expressed similar intentions. Overall, urban producers showed a greater inclination to continue and expand dairying, largely due to market opportunities available in urban areas. Rapid urbanization, population growth, and improved living standards are driving an increasing demand for high-quality dairy products. For instance, supermarkets in Awassa have noted a significant demand for quality milk and dairy products that they struggle to meet.

Dairying offers smallholder farmers the chance to utilize land, labor, and feed resources, generating consistent income. While market opportunities and linkages are crucial for smallholder dairy development, access to adequate land, organized input supplies (such as improved genetic material, feed, AI, and veterinary drugs), as well as credit, extension, and training services are essential for success.

CHAPTER FIVE

5. Summary and Conclusion

This study examined dairy production systems in the Shashemene-Dilla area of southern Ethiopia, focusing on four major towns along the Addis Ababa-Moyale highway: Shashemene, Awassa, Yirgalem, and Dilla. Two primary dairy production systems were identified: urban and mixed crop-livestock systems, with the latter further divided into cereal and enset-coffee based subsystems. Dairying was found to be a significant income source for urban producers, contributing 48.8% to their total income, while crop-livestock producers earned only a small share from dairy activities. Family labor played a critical role in dairy operations, with women primarily responsible for milk-related tasks.

Cattle in the cereal-based mixed crop-livestock system served multiple purposes, though in both systems, cows were mainly kept for milk production. Most foundational stock for both urban and mixed crop-livestock producers was acquired from open markets, indicating a lack of interest or access to better cattle selection. Producers had varied perceptions regarding the adaptation and production traits of their cattle, prioritizing attributes that maximize resource utilization and output. Consequently, due to differences in production systems, breed types, and management conditions, reproductive and productive performance varied significantly across the study areas.

Key feed resources included grazing land, hay, purchased succulent grass, cereal crop residues, and various unconventional feeds. Urban producers primarily relied on piped water, while rivers were the main water source for mixed crop-livestock systems. Most rural producers (81.7%) used natural mating with local bulls, whereas half of the urban producers relied solely on AI for breeding improvement. Milking frequency was predominantly twice a day in both systems, with animal dung mainly employed as fertilizer in mixed systems, while urban producers often incurred costs to dispose of it.

An estimated total of 9,645,020 liters of milk were produced annually from 4,463 small and medium farms in the area. Most producers in the mixed crop-livestock system (61.7%) used milk for home processing, while a majority of urban producers (79.2%) produced milk for sale. Urban producers typically preferred not to churn milk unless market issues arose. Marketable dairy commodities included whole milk, butter, fermented milk, cheese, and sour buttermilk, sourced from both local producers and dairy processing plants in Addis Ababa. Butter and

whole milk were the primary products sold in the mixed and urban systems, respectively. Informal marketing was the predominant means of selling dairy products, with no formal processing plants in the region.

Factors influencing dairy commodity prices included seasonality, market access, fasting and non-fasting days, festivals, supply levels relative to urban purchasing power, and product quality and sources. Key constraints for dairy development included feed availability and costs, farmland shortages, ineffective marketing systems, waste disposal challenges, lack of improved dairy animals, inadequate extension and animal health services, and gaps in knowledge regarding improved dairy production, processing, and marketing.

Rapid urbanization in Awassa, along with population growth in nearby towns like Shashemene, Dilla, and Yirgalem, presents an opportunity for dairy development. Encouraging private investment in dairy processing plants could facilitate milk collection schemes for both rural and urban producers. Additionally, smallholder dairy producers should receive support in areas such as feed supply, land access, marketing systems, waste disposal, veterinary care, AI, credit, and training.

In conclusion, enhancing dairy production and marketing in the studied areas requires the collaboration and integration of various stakeholders in a sustainable manner. Urban producers have consistent buyers through informal marketing channels, while rural producers lack reliable markets for their milk. However, high-potential areas like Shashemene and Yirgalem remain underutilized and disconnected from strong market chains with potential consumers in major towns. Since market demand drives sector development, stakeholders should focus not only on improving dairy production and livestock productivity but also on exploring dairy marketing opportunities.

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