St. MARY'S UNIVERSITY
SCHOOL OF POST GRADUATE STUDIES

DETERMINANTS OF MILK PRODUCTION AMONG SMALLHOLDER DAIRY FARMERS: THE CASE OF WACHALE DISTRICT, NORTH SHEWA ZONE, OROMIA REGIONAL STATE, ETHIOPIA

DEME DEBELA

JUNE 2023
ADDIS ABABA, ETHIOPIA

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A THESIS SUBMITTED TO ST. MARY'S UNIVERSITY SCHOOL OF GRADUATE STUDIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTERS OF ARTS IN DEVELOPMENT ECONOMICS

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DECLARATION

I declare that this thesis study entitled "**Determinants of Milk Production among Smallholder Dairy Farmers**: the case of Wachale district, North shewa zone, Oromia regional state, Ethiopia" is my own work, prepared under the guidance and support of the Research Advisor. All sources of materials used for the thesis have been duly acknowledged. I further confirm that the thesis has not been submitted either in part or in full to any other higher-learning institution to earn any degree.

Declared by
Name: Deme Debela
Signature: _____
Date: June, 2023

Place: Addis Ababa, Ethiopia

ENDORSEMENT

This is to certify that Deme Debela has done the study on the topic "Determinants of Milk Production among Smallholder Dairy Farmers: the case of Wachale district, North shewa zone, Oromia regional state, Ethiopia". The study is authentic and has not been done before by any other researcher.

Advisor: Paulos Asrat (PhD)
Signature: _____
Date: _____

APPROVAL OF BOARD OF EXAMINERS

This is to certify that the thesis prepared by Deme Debela entitled: "**Determinants of Milk Production among Smallholder Dairy Farmers: The Case of Wachale District in the North Shewa Zone**" and submitted in partial fulfillment of the requirements for the Degree of Master of Development Economics complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

APPROVED BY THE BOARD OF EXAMINERS

Dean Graduate studies _____Signature_____ Date _____

Advisor_____ Signature_____ Date_____

Internal Examiner_____ Signature_____ Date _____

External Examiner_____ Signature_____ Date_____

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First and foremost, I would like to thank God for everything. My deepest gratitude and appreciation go to my advisor Paulos Asrat (PhD) for his diligent guidance, supervision, encouragement, and inspiration from the start of the study to the completion of the thesis. I want to express my gratitude to my wife and to my coworkers for their support and for giving me the data I needed for this research.

Last, but not least, it would be dishonest to not highlight the contribution made by the dairy farmers in the Wachale district for devoting their valuable time and effort to answering tirelessly despite the protracted interview and on-farm monitoring.

LIST OF ABBREVIATIONS AND ACRONYMS

AFS	**Age at first service**
AFC	Age at first calving
AI	Artificial insemination
CSA	Central Statistical Authority
ETB	Ethiopian birr
FAO	Food and Agriculture Organization
FGD	Focus group discussion
IGAD	Intergovernmental Authority on Development
MOA	Ministry of Agriculture
NGOs	Non-governmental Organizations
SE	Standard error
PA	Peasant association
LHS	Land Holding Size

Lists of Tables and figures

Abstract

The study aims at assessing the "Determinants of Milk Production among Smallholder Dairy Farmers in the Wachale district of the North Shewa Zone in Oromia National Regional State. The study was conducted in four purposely selected local administrations of the Wachale district: Bosoke Jate, Mukaturi, Galmo Gora, and Bidaru kebeles. Dairy Farmers from each local administration were selected using systematic random sampling. Data were collected from 330 dairy-producing households and cooperatives using structured questionnaires, discussions, and in-depth interviews with key informants. The Ordinary least-squire econometric estimation technique was employed to identify determinants that affect dairy production. The model result showed that dairy production was strongly and significantly affected by the use of Age, experience in milk production, land holding size, and milking frequency. Shortage of feed & its high price, seasonality of demand particularly in fasting time and lack of appropriate milk handling equipment's and cooling facilities were the major challenges of dairy production and marketing in the area. Milk was the most important dairy products marketed in the areas. Dairy cooperatives, retailers, and consumers were found to be the main milk market channel of the study areas. The dairy market in the study area uses informal marketing system, which shows the underdevelopment of dairy marketing. Thus, dairy development interventions should be aimed at addressing both dairy production technological gaps and marketing problems. The study shows that there is a high demand for dairy products. Therefore, strengthening dairy producers and cooperatives, and improving access to services should receive due attention in order to improve dairy production and marketing in the study area by all dairy development stakeholders.

CHAPTER 1: INTRODUCTION

1.1. BACKGROUND OF THE STUDY

1.1.1. Global Milk Production

World milk production in 2022 was forecasted at around 930 million tons, up by 0.6 percent from 2021, principally driven by volume expansions in Asia with a small gain in Central America and the Caribbean, offset by a sizable decline expected in Europe. Outputs in South America, Oceania and Africa are also expected to fall moderately, while production may remain steady in North America(FAO, 2022b). World milk production (roughly 81% cow milk, 15% buffalo milk, and 4% for goat, sheep and camel milk combined) increased by 1.1% to about 887 Mt in 2021, primarily driven by an expansion in output in India and Pakistan due to a continued increase in dairy herd numbers and fodder availability helped by favorable monsoon rains. Milk production in the three major dairy exporters, New Zealand, the United States, and the European Union varied from a marginal to modest increase to a slight decline, respectively. Increases in dairy world trade were mainly driven by strong demand in the People's Republic of China (hereafter "China"), the world's largest importer of dairy products.(FAO, 2022a)

In Asia, the world's largest milk-producing region, milk output in 2022 is expected to reach nearly 419 million tons, up by 2.1 percent year-on-year, with much of the output growth anticipated in India, Pakistan, China, Uzbekistan, Kazakhstan and Japan, among others(FAO, 2022b).

World milk production is projected to grow at 1.8% p.a. (to 1060 Mt by 2031) over the next decade, faster than most other main agricultural commodities. The projected growth in the number of milk-producing animals is expected to be strong (1.2% p.a.), especially in regions such as Sub-Saharan Africa and in major milk-producing countries such as India and Pakistan – where yields are low. While yields across the world are expected to grow steadily over the next decade, there is considerable regional variation of growth rates. The strongest growth expected in Southeast Asia and North Africa where average yield growth is around 1% p.a., whereas yields in high income countries are expected to increase by only 0.5% p.a.. In almost all regions of the world, yield growth is expected to contribute more to production increases than herd growth which include optimizing milk production systems, improved animal health and feed efficiencies, and improved genetics. (FAO, 2022a)

Environmental legislation could have a strong impact on the future development of dairy production. GHG emissions from dairy activities make up a high share of total emissions in some countries (e.g. New Zealand and Ireland) and more stringent environmental policies and initiatives such as the Pathways to Dairy Net Zero launched in September 2021 by the dairy industry could affect the level and nature of dairy production in order to curb such emissions. Animal diseases and their spread could impact milk production, especially low-, and middle-income countries. Mastitis is the most common infectious disease in dairy cattle worldwide and across all types of farm sizes. It is also the most damaging from an economic point of view, with a significant impact on milk yield and milk quality. Future improvements in awareness, identification, and treatment of this disease could lead to significant increases in milk production through smaller losses. Treatments to control many diseases, including mastitis, are based on commonly used antimicrobials. This has raised increasing concerns on their overuse and the risk of antimicrobial resistance, which would reduce the effectiveness of existing treatments, impact on yields and milk supply, and depend on the development of new treatments and herd management practices.(FAO, 2022a)

1.1.2. Milk Production in Africa

In Africa, milk production remained stable, at 49 million tons. Algeria registered a significant output increase, whereas Kenya, Ethiopia and South Africa, among others, registered declines. Algeria's output increased by 3.8 percent to 3.3 million tons, helped by the farm modernization program granted land for dairy production, pasture development and opportunities for importing genetic materials. Algeria's prohibition of subsidized milk powder for manufacturing pasteurized milk, milk products or derivatives also boosted output.(FAO, 2020)

In Kenya, following three years of expansions, milk production fell marginally, owing to drier and warmer weather in 2020's last quarter, which constrained animal feed availability. Ethiopia also faced dry weather conditions, especially in the Southern parts of the country, constraining production. South Africa's production declined slightly due to dry weather conditions and feed price increases that lowered farm profits. Elsewhere in Africa, adverse market conditions were prevalent, stemming from economic downturns, conflicts and displacements, droughts, and floods in some regions, limiting milk production.(FAO, 2020)

1.1.3. Dairy Sector in Ethiopia

Ethiopian modern dairy development activities date back to the 1940s, soon after the end of the Second World War. Its development over these years was highly influenced by the nature of the political system that the country was in. The sector registered a relatively better pace in recent years than the majority of its past. The number of smallholders, commercial farmers, cooperatives, processors, retailers increased significantly(Lee, 2013).

The Ethiopian dairy systems can be categorized under five systems of operation; pastoral (traditional pastoral livestock farming); agro-pastoral (traditional lowland mixed crop- livestock farming); mixed crop livestock-system (traditional highland mixed farming), urban and peri-urban (emerging smallholder specialized dairy farming), and specialized commercial intensive dairy farming (Ethiopian Dairy Policy Inventory, 2009). In the Ethiopian context, the type of milk and dairy products that needs to be considered are: whole, liquid milk and other dairy products from fermented processing (butter, ergo, ayib, metata ayib, ititu, buttermilk etc.)(Lee, 2013).

Ethiopia is known for its highest livestock population in Africa. The estimated domestic livestock population is 70.29 million cattle, 42.9 million sheep, 52.46 million goats, 8.14 million camels, 57 million poultry, 2.14 million horses, 0.38 million mules, and 10.79 million donkeys. The results obtained indicated that 97.4 percent of the total cattle in the country are local breeds. (CSA, 2021). Despite the largest cattle population in Ethiopia, dairy cows' production performance was low. Dairy production in Ethiopia is subsistence smallholder-based and characterized by low production and productivity. The annual production of livestock and livestock products in the country is too low to meet the current and projected demands of the growing human population (Alemneh, 2019).The average lactation period per cow during the reference period at country level is estimated to be about seven months, and average milk yield per cow per day is about 1.482 liters.(CSA, 2021)

1.1.4. Dairy production status in Oromia Regional state

The Oromia national regional state has the largest cattle-populated region in the country. It is the home of 25,506,409 cattle(CSA, 2021). In spite of this huge resource, little work has been done about dairying in the region. Lack of management in relation to feeds, healthcare, housing, and watering was which may lower the performance of dairy cattle production practices. Hence, the producer may not get reasonable benefits dairy activity unless appropriate improvement strategies

have to be introduced. In order to meet the need of producers, it is essential to explore the existing dairy cattle production, handling practices of milk and milk products, analyze challenges and opportunities of dairy production for sustainable dairy development in the area (Benti et al., 2021).

The dairy value chain in Oromia is also poorly organized. Dairy producers and downstream actors in the value chains face many challenges in getting milk to formal markets. Milk collection, chilling and transportation systems and facilities are lacking, price information is hard to obtain, producer-buyer relationships are largely informal, and supply contracts are rarely used and difficult to enforce (Ferede Abebe, 2022).

Dairy cattle under such systems totally depend on purchased feed mainly in the form of hay as basal diet and agro-industrial by-products like bran and oil-seed-cakes or commercially processed formulated rations. Other inputs are a bit expensive but all are accessible in this labor-intensive dairy farming system. High feed costs and lack of waste disposal system is among the headaches of farmers in such system. Under such high input system crossbred and/or pure exotic dairy cows yield up to 30 liters/day/cow, a potential reached while answering market demand through better care and selection of dairy animals. Production efficiency of smallholder dairy producers in central highlands of Ethiopia, where Addis Ababa milk shed is centrally located, is 79% based on a study by Gebregziabher Gebreyohanes (2021) indicating room for improvement by 21% to get the best out of the abovementioned production system.

Milk has a complex biochemical composition and high water activity. Due to its high nutritive value, raw milk serves a good medium for microbial growth that degrades the milk quality and shelf-life. The demand of consumers for safe and high quality milk has placed a significant responsibility on dairy producers, retailers and manufacturers producing and marketing safe milk and milk products(Tadele, 2015).

Ways to ensure the quality and safety of milk include good hygiene of the milking environment, using food grade containers (for example, stainless steel which is easy to clean), cooling the milk immediately after milking, and boiling or pasteurization before consumption. To work towards raising awareness and designing acceptable interventions to bring about change in the behavior of people involved in milk production and handling, it is important to understand the local context of milk production, handling, and processing.(FAO, 2021).

1.1.5. Dairy Production status in North Shewa Zone-Oromia

North Shewa Zone is the most densely populated zone in the regional state of Oromia. It has 13 administrative districts that are further divided into 267 peasant associations, locally called kebeles, and one administrative town of the zone. Fiche town is the seat of the zonal government offices. North Shewa zone holds 1,323,045 of cattle population and has the largest crossbred dairy cow's population in Ethiopia amounting to 49,738 heads a figure even larger than that of the Southern Nations, Nationalities and Peoples State(CSA, 2021).

The area is known for having long history of dairy development ever since the introduction of modern dairy cows some 50 years ago. Production function in North Shewa dairy value chain is mainly characterized by subsistence smallholder level, in a typical highland mixed crop-livestock farming system. Farms can be categorized into; urban, peri urban and rural based on intensity of input use and market availability for the produce. Urban dairy farmers lack grazing land and enough space but are blessed with ever increasing market demand for milk. High-grade dairy cattle are kept indoors, with some roadside grazing in few case(Gebregziabher Gebreyohanes, May 2021).

Wachale district is one of the districts in the North Shewa zone among the potential area for dairy production. Although the district is known for potential milk production, productivity of milk among smallholder dairy producers in the area was low. (North Shewa zone Livestock resource development report in 2020). The district was well known in livestock population, well suited agro-ecology and vegetation cover for many years, however, the productivity of milk is low and it is known that there is little information in dairy production system, marketing and handling practices in the area.

Identification of contributing factors and understanding of the existing dairy production and marketing system in the area is paramount importance to make future improvement interventions. (North Shewa zone Livestock resource development report in 2020)

Therefore, this study analyze determinants of milk production, milk handling and marketing practices among smallholder dairy farmers in the Wachale district of the North Shewa Zone.

1.2. Statement of the Problem

1.2.1. Review on milk production

The highest source of milk in Ethiopia is traditional dairy cattle production while cattle are kept for drought power without giving any focus to improve the milk production potential of the dairy cattle and focuses on butter production rather than fluid milk. From the total national milk production, 97 % from rural milk production system which is produced by smallholders(Abebe, 2021). The rural milk production system is highly reliant on the low productivity of the indigenous zebu cattle breeds that can produce 400–680 liters of milk per cow per lactation period. Pastoralists, agro-pastoralists and mixed crop-livestock producers are grouped under the rural dairy cattle production system (Gebresellasie, 2019). Demand for dairy products is flourishing in Ethiopia. In the well-connected regions, there is high adoption of cross-bred cows and commercial feeds and better access to animal health and dairy-related extension services, contributing to higher milk yields per dairy cows. In more remote areas, we see stagnation–or even a decline–in milk yields.(Minten et al., 2020). Poor management of locally available feed resources such as crop residues also affects feed supply (Abebe, 2022) .With its conducive climate and topography, high concentration of livestock, and proximity to Addis Ababa and other urban markets, the central part of the Oromia region has emerged as the main hub for dairy processing in Ethiopia and holds great potential for attracting investment to take advantage of growing demand and further develop and transform the dairy sector. Major constraints affecting milk production potential of dairy cattle in most parts of Ethiopia are shortage of grazing land, Infectious and parasitic diseases, shortage of land for cultivation of improved forage, inadequate veterinary service, low milk production potential of local zebu cattle, inadequate Artificial Insemination (AI) service and labor shortage(Alemneh, 2019).

1.2.2. Milk handling practices

The handling and safety of milk and milk products was of great concern around the world, this was especially true in the developing country where production of milk and various dairy products takes place under unsanitary condition and poor production sale must consider the health of consumer(Abunna, 2019).In Ethiopia, there was no standard hygienic condition followed by producers during milk production. The hygienic conditions are different according to the production system, adapted practices, level of awareness, and availability of resources (Guya et

al., 2019). Milk was widely consumed in raw form and makes a substantial contribution to protein and micronutrient requirements of the community. The trade-offs, however, are health risks that come with poor hygienic practice of milk handling and consumption. Ways to ensure the quality and safety of milk include good hygiene of the milking environment, using food grade containers (for example, stainless steel which was easy to clean), cooling the milk immediately after milking, and boiling or pasteurization before consumption. Such practices are not common in traditional smallholder or extensive livestock production in developing countries like Ethiopia.(Amenu et al., 2019).

1.2.3. Milk marketing situations

Milk production has great development potential if all levels of members contribute to market oriented farms (Tadesse Guadu and Mengistie Abebaw, 2016). Milk marketing system in Ethiopia is mainly characterized by informal marketing system in which the majority of the raw milk produced is directly sold to consumers or middlemen that sell raw milk to consumers without passing through processing plants and in the absence of legal processes such as government tax and trade related regulations(Tadele Mamo, 2021). The limited market information to the smallholder milk producers allows the brokers to manage information in their favor. (Abebe, 2022) Cooperative-run dairy processing units often depend on external support and struggle to guarantee sufficient milk supply. Weak leadership of cooperatives and a lack of capacity to provide business, technical and management support on the part of the Woreda Cooperative Agencies (the government agencies mandated to support cooperatives) contribute to low levels of farmers' trust and interest in working collectively (Abebe, 2022). Past studies also revealed that distance from point of milk production to milk market had significant impact on the decision to choose milk market channel.(Tadele Mamo, 2021)

The milk marketing system was not well developed giving the large majority of smallholder milk producers a limited access to milk market. Assessment of determinants of milk market supply is important to design new development interventions strategies by responsible bodies. (Guya et al., 2019).

1.2.4. Gap Identification

I reviewed various literatures concerning dairy production systems in Ethiopia. The livestock research conducted an assessment on the Major Ethiopian milksheds in December 2013 and Selale

milk shade (North Shewa) was one of the study area. Even though milk production represents an essential part of the livelihood of the rural and urban community in the targeted areas, there are no recent documented data on milk production, handling practices, and marketing in the area. Identifying the updated practices of milk production, handling and marketing practices was paramount importance to make future improvement interventions. Smallholder's dairy farmers in the study area uses mostly Plastic containers for milk collection and storage. Such utensils can contribute for the rapid spoilage of milk, and most of the farmers are not providing quality milk to the market. The recent milk market information in the study area was lacking which requires an assessment to indicate the leverage point of interventions strategies of milk production and marketing by milk producers and service providers and thereby to enhance the involvement of producers into milk subsector development. Therefore, the objectives of this study was to assess milk production system, handling practices, and marketing systems and to identify determinants of small holder milk production in Wachale district. A specific study that identifies and highlights the associated factors contributing for milk production and productivity can help to find entry points to engage them. The purpose of this assessment was therefore, to provide relevant information about determinants of milk production, milk handling and marketing practices of smallholder milk producers in the study area.

1.3. Objectives of the Study

1.3.1. General Objective

The general objective of the study was to identify factors affecting milk production in small holders' dairy farmers in the Wachale district, North Shewa Zone, Oromia Regional state of Ethiopia.

1.3.2. The specific objective of the study

1.3.2.1. To identify factors that affect of milk production in the Wachale district;

1.3.2.3. To assess milk handling practices in the Wachale district

1.3.2.4. To assess milk marketing channels in the Wachale district;

1.3.2.5. To assess the main challenges of milk production, handling and marketing in the Wachale district

1.4. Research Questions or Research Hypothesis

1.4.1. What are the factors affecting milk production in the study area?

1.4.2. How is the practice of milk handling?

1.4.3. How do the milk marketing channels operate?

1.4.4. What are the main challenges of milk production, handling and Marketing in the study area?

1.5. Significance of the Study

The study attempted to assess determinants of dairy production, milk handling and marketing practices. Besides, the study identified the factors that affect dairy production significantly which will be an important input for designing appropriate intervention policy and strategies in order to satisfy the demand for dairy products. The study generated valuable information on milk production, milk handling and milk marketing that would assist policymakers in designing appropriate policies for intervention. Governmental and nongovernmental organizations that are engaged in the development of livestock sub-sector would benefit from the results of this study.

1.6. Scope and Limitations

1.6.1. Scope of the study

The study was conducted on smallholder dairy farmers as well as dairy cooperatives in Wachale district of the North Shewa Zone of the Oromia regional state. Dairy Production in Wachale district was mainly characterized by subsistence smallholder level, in a typical mixed crop-livestock farming system. The study focused to analyze the determinants of milk production, marketing system, and milk handling practices in the Wachale district.

1.6.2. Limitation of the study

The researcher was limited only to the actual dairy producers not the potential entrants to dairy production. The study tries identified only the major variables that affect dairy production not every factor which possibly affect the dairy production.

1.7. Organization of the thesis

This proposal was organized into five main sections. Section one was the introduction part which includes the background of the study, problem statement, research questions, objectives,

significance of the study, scope of the study and organization of the study. Section two contains review of literature; both theoretical and empirical evidences for the study. Section three contains the research methodology which includes description of the study area, types of data and their sources, data collection method, sample size and sampling techniques and method of data analysis. Section four was the findings of the study and section five describes the conclusion and recommendation.

CHAPTER TWO: LITERATURE REVIEW

2.1.Operational Definition of Key Terms

Milk production: It is a continuous measured in liters, which is the volume of milk produced by farmers. Smallholder dairy farmers who produce more expected to sale high volume of milk.

Milking cow: Refers to cows actually milked during the year

Marketing: Marketing is a societal process in which individuals and communities obtain what they need and require by creating, offering, and freely exchanging valuable goods and services with others (Kotler et al., 2009: 7)

Marketing Channel: is a business structure of interdependent organizations that facilitate the transfer of ownership as products move from producer to business user or consumer (Kotler, P and Armstrong, 2003).

Value chain: a value chain defines the overall range of activities needed to take along a product or service through the different phases of production, including physical transformation, the input of various producer services, and response to consumer demand which include the vertically linked interdependent processes that generate value for the consumer (Kaplinsky, and Morris 2000).

Supply chain: the supply chain is the arrangement of facilities (factories, warehouses, terminals, ports, stores, and homes), vehicles (planes, trains, trucks, and ocean vessels), and logistics information systems (LIS) connected by an enterprise's supplier's suppliers and its customer's customers (Edward Frazelle, 2002).

Cross-sectional data: The cross-section data give information on the variables concerning individual agents (e.g., consumers or produces) at a given point of time.(Shalabh, IIT Kanpur)

Discrete variables (or categorical variables): Variables that have only a limited number of different values (e.g region, sex, type of roof, and occupation). Nicholas Ndiwa, 2018.

Continuous variables: Variables whose values are not limited. Examples: per capita expenditure, farm size, number of trees. Usually expressed in some units such as shillings, kilometers, hectares, or kilograms. Also, may take fractional values. Nicholas Ndiwa, 2018.

2.2. Empirical study

2.2.1. Milk Production system in Ethiopia

In Ethiopia, dairy production is one of the subsectors of livestock production that contributes to the live of the owners through important sources of food and income; even though dairying has not been fully exploited and promoted in the country. Like most dairy production systems found in the tropics, the Ethiopia dairy production system includes large number from small to large sized and subsistence to market oriented farms. Though different classifications have been used to characterize the dairy production system in the country; milk production system can be classified into three broad categories, namely, urban, peri-urban and rural dairy production(Abebe, 2021).

2.2.2. Rural household dairy production system

The highest source of milk in Ethiopia is traditional dairy cattle production while cattle are kept for drought power without giving any focus to improve the milk production potential of the dairy cattle and focuses on butter production rather than fluid milk (Alemayehu et al., 2012). Most dairy farmers in Ethiopia are widely dispersed in rural areas while majority of dairy markets are in urban areas. Due to highly perishable nature of dairy products and its potential to transmit zoonotic disease and other pathogens and toxins, it is difficult for dairy farmers to exchange in urban markets (Bekuma et al., 2018). Thus, a whole chain approach is basically needed, which includes education of consumers. Unless milk and milk products find a market outlet, they are retained for household consumption and the level of production is kept low (Seifu and Tassew, 2014). Over 85% of the milk produced by rural households is consumed within the producer households with the proportion marketed being less than 7% (Bereda et al., 2014). From the total national milk production, 97 % from rural milk production system which is produced by smallholders. The rural milk production system is highly reliant on the low productivity of the indigenous zebu cattle breeds that can produce 400–680 liters of milk per cow per lactation period. Pastoralists, agro-pastoralists and mixed crop-livestock producers are grouped under the rural dairy cattle production system (Abebe, 2021).

2.2.3 Peri-urban or small scale dairy production system

The peri-urban dairy cattle production systems are mainly located at the edge of the town areas which have comparatively better access to urban centers in which dairy cattle products are

extremely wanted (Tegegne et al., 2013). This production system is categorized as semi-intensive crop-livestock farming system. Because of steadily increasing demand in milk consumption, peri-urban dairy farms are growing around cities and towns (Galmessa et al., 2013). Most of the dairy cattle producers depend on hybrid cows and they practiced supplementary concentrate feeding (Gebresellasie, 2019). It possesses animal types ranging from 50% crosses to high grade Friesian in small to large sized farms, and contributed only 2% of the total milk production of in Ethiopia. This sector owns most of the country‘s improved dairy stock (Gobena, 2016). As related to the rural dairy cattle production system, peri-urban dairy cattle production systems is typically located along roads within reasonable distance to urban centers and keepers are involved in fluid milk market (Nigatu et al., 2012).

2.2.4. Urban or commercial dairy production system

In most towns of Ethiopia, the urban dairy cattle production systems are practiced with little or no land resources for the production and sale of milk. It is the most market oriented dairy cattle production system compared to other production systems (Bekele et al., 2015). Urban areas producers use crossbred, as well as high grade, dairy animals. However, only 1% of the dairy cattle from the total population of dairy cattle of the country are kept under urban dairy cattle production system (Gezu and Zelalem, 2018). Cattle are housed in improved shelters made of locally available materials. Concentrates, roughages and non-conventional feeds are the main feed resources which are used in urban dairy cattle production system. Moreover, road side grazing, fruits of plants and wastes also used in urban dairy cattle production system (Gurmessa et al., 2015). Under the use of intensive management system urban dairy cattle production systems has better access to inputs and services providing by the public and private sectors as compared to other dairy cattle production systems (Gebresellasie, 2019, Gobena, 2016). They have also access to animal health services, use more intensive systems. Milk is sold to consumers and processing plants through informal market. But milk supply is low due small number of dairy cattle population kept under this system(Abebe, 2021).

Ethiopia is believed to have the largest livestock population in Africa. This livestock sector has been contributing a considerable portion to the economy of the county and still promising to rally around the economic development of the country. (Gebregziabher Gebreyohanes (May 2021). It is eminent that livestock products and by-products in the form of meat, milk, honey, eggs, cheese,

and butter supply, etc. provide the needed animal protein that contributes to the improvement of the nutritional status of the people. Livestock also plays an important role in providing export commodities, such as live animals, hides, and skins to earn foreign exchanges to the country. On the other hand, draught animals provide power for the cultivation of the smallholdings and for crop threshing virtually all over the country and are also essential modes of transport to take holders and their families long-distances, to convey their agricultural products to the market places and bring back their domestic necessities. Livestock as well confer a certain degree of security in times of crop failure, as they are a "near-cash" capital stock. Furthermore, livestock provides farmyard manure that is commonly applied to improve soil fertility and also used as a source of energy. Despite the large amount of agricultural products, the country remains dependent on imports of substantial amounts of semi-processed and processed food; products that have the potential to be - and in a limited amount of instances are - produced locally(FAO, 2021).

The Ministry of Agriculture has formulated a strategy to improve milk marketing and processing in the villages. The strategy is to develop an environment for smallholder dairy farmers, which enables farmers to immediately respond to the market demand. That is, at village level, to develop the market for the existing sellable surplus, regardless of the quantity, so that the producers will be stimulated gradually to satisfy the market. It is believed that, development of a marketing structure will create the incentive to improve production(Benti, 2022).

The major constraints on intensification of livestock in general and dairy are unavailability of adaptable high-yielding improved genetics, lack of feed, animal diseases and poor animal health, extension and market services. In Ethiopia, genetic improvement of indigenous breeds through crossbreeding and upgrading, and the accelerated production of crossbred cows from farmers' indigenous breeds through artificial insemination (AI) started more than 40 years ago following the establishment of the National Artificial Insemination Center (NAIC). However, the number of improved breeds in the country is still too small to transform the current subsistence-based smallholder dairy system to market oriented commercial dairy production and boost milk production to meet current and predicted future domestic demands (Gebregziabher Gebreyohanes, May 2021).

2.3. Productivity of Milk cattle in Ethiopia

Ethiopia has huge potential for dairy development. According to Tsegay et al., (2015) the major opportunity to suitable conditions to improve dairy production and productivity for the future such

as marketing accessibility, veterinary and artificial insemination service (AI), and infrastructure. 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(Sintayehu Yigrem, 2008).

2.4. Constraints in milk production

Ethiopia was first in cattle population in Africa and 5th from the world. The dairy production system in the country was grouped under rural, peri-urban, and urban dairy production systems. Most of the milk production of the country comes from traditional milk production system which was most from low productive indigenous dairy cattle. There are technical and non-technical dairy production constraints of Ethiopia dairy production.(Yassin, 2022). Dairy production is constrained by multifaceted factors, though the nature and magnitude of the problems vary between production systems and agro-ecologies. Some are cross-cutting that can have influence on dairy production regardless of dairy production system and agro-ecologies; others are system specific. The major constraints are described below.

2.4.1. Genetic limitation:

The main problem of milk production in the country is that of the poor genetic potential of the indigenous cattle, which gives rise to low milk output. Milk production is as low as 0.5 to 2 liters per day over a lactation period of 160 to 200 days. Improving the feeding, water availability and health care of the indigenous cattle did not increase the quantity of milk per day to allow the animals to be used for commercial market-oriented milk production. The currently specialized dairy breeds are a result of a long period of selection program. If improvement of the local Ethiopian breeds for milk production is targeted, then it is important to have a well-designed selection program in place for a few selected promising breeds (Gebreselassie, 2020)

2.4.2. Inadequate Animal feed and Water resources:

The primary constraints to increased milk production under all dairy production systems are inadequate feed resources, poor pasture development and the ever increasing feed prices. Farmers tend to keep cattle at stocking rates that far exceed the carrying capacity of their grazing lands

(Gebreselassie, 2019). This has resulted in degraded pastures and eroded soils. Stock numbers are not normally reduced in the dry season leading to grazing lands becoming progressively overgrazed. In the dominating crop/livestock production system, producers supplement the feeding of their dairy cows with crop residues and farm by-products from their farms. In some cases, during the dry season, these feedstuffs can be the only feeds available to the animals. However, the improvement of the utilization of these feedstuffs through physical and chemical processing methods to increase the availability of nutrients is only practiced on a limited number of farms. the main reasons of feed shortage is cultivation of grazing lands, declining yields of grazing land and increase of livestock population(Abebe, 2021).

2.4.3. Limited access and high cost of dairy heifers/cows:

The improved crossbreed, grade and pure exotic dairy cattle are usually in short supply and when available, the high cost is a major problem. The few government crossbreed heifer multiplication centers that used to distribute in-calf crossbreed heifers to producers at reasonable prices have been sold after the introduction of the privatization policy. Prices of crossbreed cows and heifers are now unaffordable by the poor and the average smallholder farmers that would have liked to engage in the dairy business (Gebreselassie, 2020).

2.4.4. Inadequate Veterinary service provision:

The prevalence of various animal diseases, tick borne diseases, internal parasites and infectious diseases affect dairy development programs in varying scales, depending on ecological zones and management levels. The animal health services provided are inadequate; the cost of drugs and ascaricides is very high, while the diagnostic services are not readily available to the dairy farmer. This is partly attributed to the insufficient budget allocated to veterinary services (GRM International BV, 2007). Lema et al., (2000) also reported that an overall disease occurrence of 46.8 and 33.6 percent in urban and peri-urban dairying in the central highlands, respectively. The same authors also reported overall disease prevalence rates of 20.8, 13.1, and 10.7 percent during the dry, short rainy, and long rainy seasons, respectively with an overall annual mortality rate of 4.2 percent(Gebreselassie, 2019).

2.4.5. Lack of market orientation in the dairy sector

A large proportion of the national cattle population is kept by smallholder farmers. In the mixed crop-livestock production system, cattle are kept for the purpose of producing draft oxen to support crop production. These animals are used only for an average of 45 days, and maximum of 70 days in a year (Gryseels and Anderson 1983), yet they are fed and managed daily for the rest of the year. Farmers prioritize feeding draft oxen followed by milking cows. The resources used on such oxen could be released to support more commercial beef and dairy production if they were to be replaced by small, mechanized alternatives. In areas where market access for fluid milk is lacking, milk is sold as butter, which is an option for coping with the market challenge but is economically unprofitable compared to selling fluid milk because a large amount of milk (16 to 18 liters) is churned to produce a kilo of butter(Gebregziabher Gebreyohanes, May 2021).

2.5. Milk Marketing channels and constraints in Ethiopia

Much of the milk produced in Ethiopia by rural stallholder farmers are either sold and/or consumed as fresh milk, fermented milk and milk product such as butter, ghee, cottage type cheese where it is processed on farm using traditional technology(Abunna, 2019).In Ethiopia, milk and milk products are marketed through both informal and formal marketing systems. In the dominant informal marketing system, producers sell to consumers directly or to unlicensed traders or retailers. Price is usually set through negotiation between the producer (seller) and the buyer; this system is predominant in the rural dairy production system. In the formal marketing system there are cooperatives and private milk collecting and processing plants that receive milk from producers and channel to consumers, caterers, supermarkets and retailers. Informal market involves direct delivery of fresh milk by producers to consumers in the immediate neighborhood and sale to itinerant traders or individuals in nearby towns. In Ethiopia, dairy products (fresh milk, butter, buttermilk and cottage types of cheese) are distributed through the informal and formal marketing systems. The informal market involves direct delivery of dairy products by producers to consumers in the immediate neighborhood and sales to itinerant traders or individuals in nearby towns (Alemneh, 2019).

Dairy producers and downstream actors in the value chains face many challenges in getting milk to formal markets. Milk collection, chilling and transportation systems and facilities are lacking, price information is hard to obtain, producer buyer relationships are largely informal and supply contracts are rarely used and difficult to enforce(Ferede Abebe, 2022).

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(Sintayehu Yigrem, 2008).

Knowledge of the specific characteristics of dairy production and marketing systems is vital to be able to target recommendations to specific production systems and the purpose of this study is to identify milk marketing channels in the study area and indicate recommendation for smallholder farmer's empowerment.

2.6. Milk Handling and preservation practices

The handling and safety of milk and milk products was of great concern around the world, this was especially true in the developing country where production of milk and various dairy products takes place under unsanitary condition and poor production sale must consider the health of consumer(Abunna, 2019).In Ethiopia, there is no standard hygienic condition followed by producers during milk production. The hygienic conditions are different according to the production system, adapted practices, level of awareness, and availability of resources (Guya et al., 2019). Milk is known as the most nutritious food due to its rich nutrient content. It is a good source of proteins, minerals (especially calcium and phosphorus), and vitamins (Michel, 2006). In addition to being a nutritious food for humans, milk provides a favorable environment for the growth of microorganisms (O'Mahoney, 1988). Bacteria, yeasts, molds, and viruses are the most common microorganisms found in the dairy industry. There are few bacteria in fresh milk. Lactic acid bacteria, for example, are beneficial in milk processing because they cause milk to naturally sour, resulting to have fermented products which are base for further processing(Benti et al., 2021).

Milk is consumed either raw or after it has been processed into various products. Due to the high cost of refrigerators and/or electricity, as well as the lack of electricity in some rural areas, a significant proportion of the country's households did not use refrigerators to store milk and its derivatives. Because of this, these people process whole milk into more shelf-stable milk products by using various spices as preservatives. (Melesse, 2013).

The most common dairy products are fresh whole milk, Ergo (naturally fermented sour milk), Arera (defatted sour milk), butter, Ayib (traditional cottage cheese), Metata Ayib (traditional fermented cottage cheese), and Zure. (Seifu and Tassew, 2014; Derese et al, 2016). Adulteration

is an act by which the quality of food offered for sale is purposely compromised either by combining or substituting inferior substances or by eliminating some important ingredients. Various authors indicated in their studies that a variety of extraneous substances were added to milk and its derivatives depending on the technological level at which these criminals arrived and the availability of adulterants in the specific area (Benti et al., 2021).

The aim of this review is to understand the existing scenario of the milk handling and preservation method and the existence of milk handling practices in the study area.

The gap in knowledge was a lack of comprehension of the real issues that curtail enhanced adoption of dairy farming in developing nations like Ethiopia. To furnish such knowledge, this study will poses the question: what are the contributing factors for milk production, milk handling and marketing system, in the Wachale district of the North Shewa Zone.

2.7. Theoretical Framework

A theory as defined by Mugenda (2003) is a set of concepts and interrelations that are assumed to exist among those concepts. It provides the basis for establishing the hypothesis to theories — a reasoned set of prepositions, which are derived from and supported be tested in the study. A theoretical framework is a collection of interrelated ideas based on by data or evidence (Kombo and Tromp, 2006).

Milk producers in Ethiopia are constrained from investing in forage and forage seed production, which does not meet the current demand. In addition, there is limited awareness of producers on growing natural feed, such as alpha-alpha, to improve productivity of dairy cows. Limited availability of forage results in high demand for manufactured feed, which results in ever-increasing prices especially during the dry season. Manufactured feed is hardly accessible by producers in the rural system, due to its cost (Sebsibe, A., 2011.). Animal health is another factor that affect significantly production and productivity in the two milk sheds. Diagnostic services and treatments are not readily available to dairy producers in the rural system; one of the consequences is very high calf mortality. In addition, the price of veterinary drugs, ascaricides, etc. is constantly increasing. The limited access to adequate and affordable inputs contributes to the very low returns of dairy producers in the rural system. (Ethiopia Dairy Value Chains, End Markets and Food Security Land O' Lakes 2010)

One of the major issues was the lack of modern technologies for dairying. In the rural system especially, standard milk containers are not widespread and producers do not have any basic equipment (e.g. thermometers, etc.) nor machinery. In addition, most producers have limited knowledge of product handling. The lack of equipment, which couples with the inadequacy of infrastructure, prevent rural producers from reaching out collectors and processors located in the urban centers (Brasesco et al., 2019).

The constraints of dairy cattle production differ with in the three production systems and among different locations (Kassa, 2019). As indicated by Gebresellasie (2019) high feed cost, land shortage and space limitation, feed quality, availability and cost problems as well as inadequate extension and veterinary services were the major dairy production system constraints in the Urban and Peri-Urban areas of central Highlands of Ethiopia.(Abebe, 2022). The literature reveals that the involvement of dairy cooperatives in facilitating milk marketing was limited. As a result, the Middlemen collect milk from the smallholder dairy farmers with less prices. Sometimes middlemen travel to the farms to collect the milk, and the farmers bear no direct responsibility for transportation costs. Other times, however, farmers who are very far from the market place of operation bring their milk to the middlemen, and therein must face transportation costs themselves. Both the farmers and the middlemen are typically not satisfied with each other, and they are often involved in conflict situations. The peri-urban or urban dairy farms are usually owned by market oriented, progressive farmers, with larger herd size. Members of the dairy cooperatives in the study area sell their milk to the existing dairy cooperatives at the farm gate. Dairy milk processing companies have their own mid agents who collect milk in the peri urban areas from dairy cooperatives and progressive farmers. The dairy cooperatives and milk processing companies give attention to quality milk supply and encourages quality milk suppliers.(Abebe, 2022)

Most of the year Ethiopia has a hot climate and unless the milk is cooled, during this condition the raw milk is mess up. However, in some part of the rural area, the cooling systems are not practicable. Besides, there are things like poor handling, pollution; technology applied which has low level in the conservation of milk to expand its shelf life and lack of market which create losses in the post-harvest (Getachew, 2003).

The overall milk and milk products handling practices and pressing processes in the study area was undertaken traditionally by using traditionally made utensils. The milk collection centers were located along roadsides, which could likely expose the milk to dust contamination created by

moving vehicles and animals. They do not have good drainage, clean floor, walls and ceilings. This may hinders milk products making stable throughout the year, decreases milk quality and the demands of milk consumers and processors.

2.8. Conceptual frame work of the study

The Conceptual framework is an illustration of the relationships between the variables identified for the study. It shows the relationship between the independent and the dependent variables. For this particular study, the Milk productivity of small-scale dairy farmers in Wachale district was the dependent variable while the independent variables are the factors that in one way or the other affect milk productivity of dairy farmers. These factors are:

- Demographic factors (gender, age, farmer's experience, and land for production),
- Institutional factors(access to extension, dairy cooperative membership, frequency of vaccination),
- Market of the milk (milk sale, distance and access to market),
- farmers awareness (training, information access, farmers experience, collaboration and linkage),
- Breeds of dairy cattle (breeds available, matting used).
- Improved inputs (feeds, veterinary service).

These factors, either in isolation or a combination will cause or influence farmers milk production in the study area. The moderating variable for this study will be the cultural issues affecting the milk production for example the rearing system adopted by the people living in the area. The frame work assumes that dairy production and productivity was a net result of the positive and negative effects exerted by all the explanatory variables on the dependent variable.

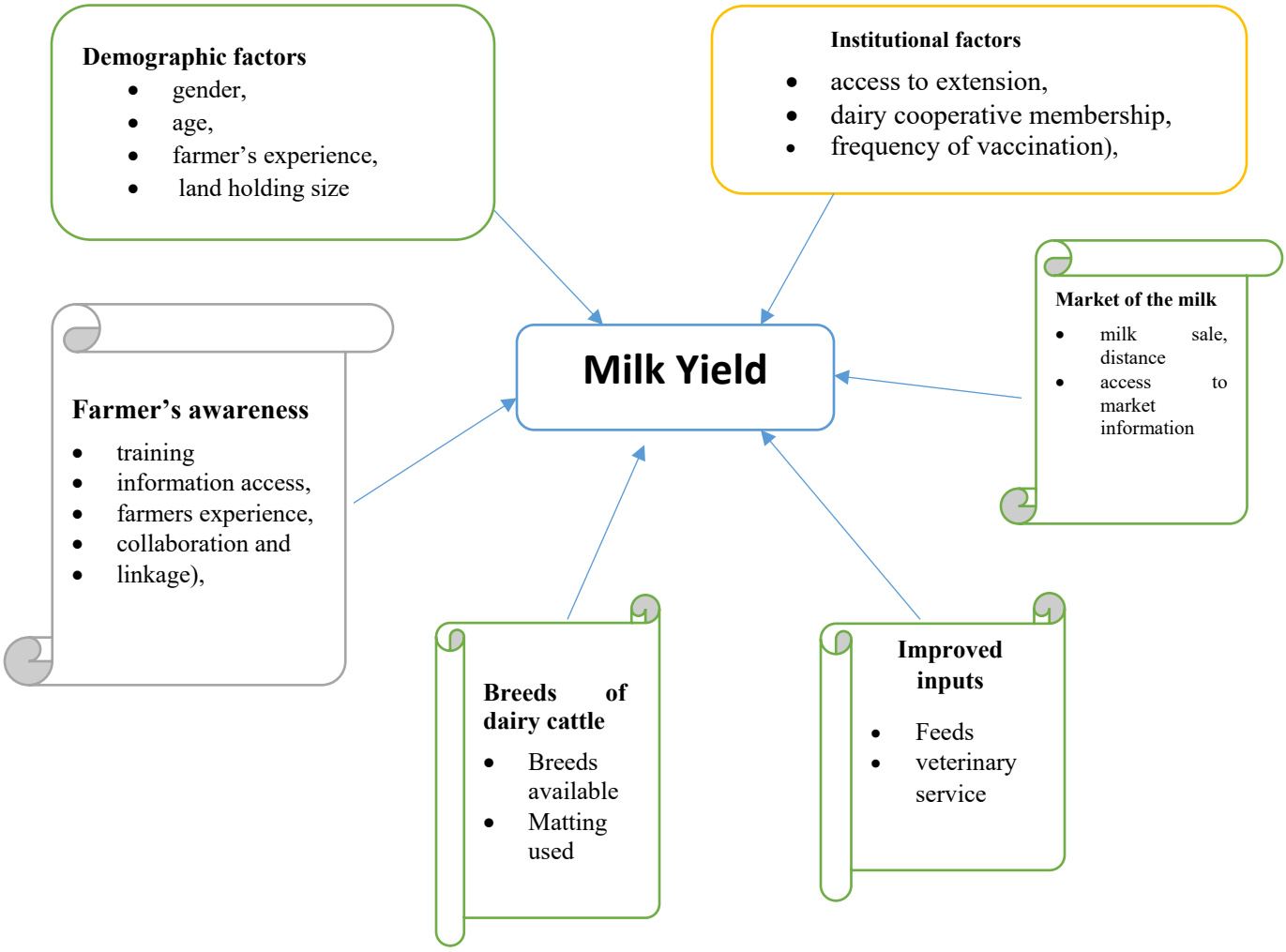

Figure 1Conceptual frame work of the study

CHAPTER 3: RESEARCH METHODOLOGY

3.1. Description of the Study Area

Wachale woreda is found in North Shewa administrative zone of Oromia Regional state. The Woreda is located at a distance of 78 KM from Addis Ababa and 35 KM from the zonal capital towns (Fitche). The district is demarcated by Sululta in the south, Debre libanos & Region 3 in the North, Abichu & Jidda in East and Yaya Gulale in the West. The latitudinal & longitudinal location of the woreda is 90 25"&90 47" N and 380 38'&390 55" E respectively. Total area of the woreda is estimated to be about 48,880 hectares or 697.9 sq.

The agro-Ecological (climatic) zone of the woreda includes Beda (Dega) which ranges from (2300-3300) & accounts for 69.8%, woina-dega /bada-dare/ ranging from (1500-2300) accounts about 30.2%. The average annual rain fall and temperature of the woreda is about 1800mm and 12^{o}c respectively. The woreda had 27 kebeles of which 24 were acting as rural Residence (village) or countryside. The district has three towns of which, Mukaturi act as a capital town whereas, and Gimbichu & wobery serves as small towns of the district.

The district is endowed with ample resources such as underground water, mineral, agriculturally potential areas, grazing or pasture areas and even enriched with historical and cultural Tourist attraction angles1. There are about 63,620 cattle population available in the district and the total annual milk production of the district is 56,942,805literes. The population of the district is estimated to be about 131,677 of which 121,552 were resides in rural areas (M=61,492, F=60,060) while, 10,125 (M=4, 960, F=5,165) were urban2.

[1] Wachale district Finance and economic corporation 2013 E.C.
[2] Population projection of Oromia of 2009/10 *E.C.*

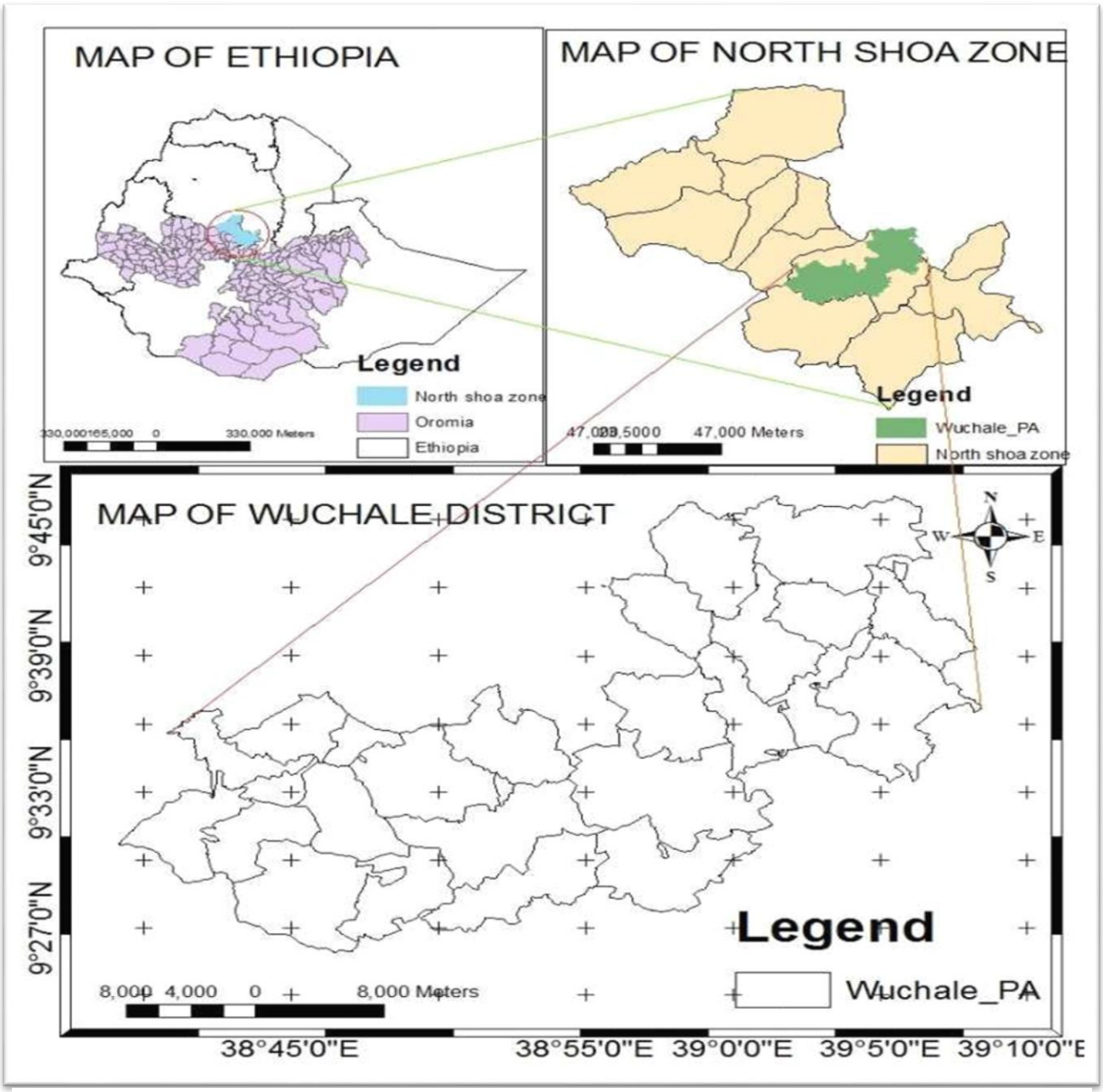

Figure 2: Map of Wachale district

3.2. Study Design

The Wachale district was selected for this study due to its potential for milk production and marketing, as well as its accessibility. We specifically chose smallholder farmers with one or more milking cows and those who had prior expertise in milk production. A two-stage sampling strategy

was employed in this investigation. The district's Peasants' Associations (PAs) were first selected primarily based on their potential for milk production and marketing involvement. Four PAs from the district were chosen at random for the second stage. An in-depth interview, focus groups, and observations will be used. The approach enabled the researcher to deal with simple through complex situations. It assisted the researcher to answer "how" and "what" type questions while taking into consideration how a phenomenon was influenced by the context within which it was situated. A household survey was used to gather the primary data for this investigation.

3.3. Types and sources of Data

Cross-sectional data were used to accomplish the objective of the study. The types of data were both primary and secondary. Primary data was collected from the randomly selected smallholder dairy farmers and district-level institutions (dairy cooperative leaders, district cooperative promotion agency, development agent, district livestock resource expert, and one expert from zone livestock resource). On the other hand, secondary data was collected from reports (published and unpublished (woreda office document)) and journal article theses.

3.4. Study Population

The target population were the smallholder dairy farmers in the Wachale district. To ensure representation among smallholder dairy farmers in the Wachale district, stratification of the study population was conducted where each division was treated as a stratum and random sampling conducted to collect data. The study population were 1908 household farmers.

3.5. Sampling Frame

The samples for the study were taken from smallholder dairy farmers in the Wachale district who produced milk at the time of the survey. To identify the sample households, the first step was selecting the district's Peasants' Associations (PAs) primarily based on their potential for milk production and marketing involvement. Four district PAs were randomly chosen for the second stage. In the district, there are 27 rural kebeles. According to district data, the woredas grouped/stratified the kebeles into two groups based on milk production potential. 18 kekebeles identified as high milk production potential and 9 kebeles are identified as less milk producer’s

kebeles using stratified sampling. Then, **four kebeles were** randomly selected (3 from high milk potential kebeles and 1 from less milk-producing kebeles).

3.6. Sampling size

A systematic random sampling procedure was used to select the sample respondent households. Because the district's population was nearly homogeneous in terms of livelihood and dairy production, each kebele had a list of dairy producer household heads. The total population size where samples were drawn was 1908. The Tara Yamane statistical (1967) calculation method was used to determine the sample size from a given population (milk producers in the district). The mathematical illustration according to the Taro Yamane method was:

$$n = N / (1 + N (e)^2)$$

Where:

- **n** was the total the sample size,
- **N** was the total population of milk producers under study(1908) and
- **e** indicated the margin error (0.05). Based on the above formula, 330 household sample were selected randomly.

A total of 276 sample smallholder milk producers were selected randomly from those 4randomly selected kebeles. The sample size for each Keble is 68.75, which is rounded up to 69.

S.No.	Name of the Kebele administration	Total no. of Milk producers HH	Sample size
1	Bosoke Jate	515	83
2	Bidaru	665	83
3	Galmo Gora	468	83
4	Muka Turi	260	80
	Total	1908	330

Figure 3Sample size determination

3.7. Method of data collection

The information was gathered from 332 smallholder dairy farmers in total using a standardized questionnaire. Both open-ended and closed-ended questions were included in the poll. The survey

was composed in English, translated, and then given out in Afaan Oromoo, the local tongue. After that, a questionnaire was modified and pre-tested with smallholder dairy farmers who weren't involved in the final study. Key informants interview and household survey was conducted and collected data on (assessment of milk production, handling practices and marketing, and identification of challenges and constraints of milk production). Focus group discussions was conducted in 4 kebeles and discussed on the dairy production systems, milk handling practices and marketing systems, and identified major challenges/constraints and opportunities for dairy development in the area. Checklists and critical observation were the tools utilized to collect the data. Semi-structural questionnaires were used to gather primary data, and farmers who had been chosen at random were interviewed. Prior to the creation of the questionnaire, a preliminary visit that was pertinent to the study's goals was made. In order to examine the location, milk handling procedures, and milk marketing location of smallholder milk producers, critical observation was employed. Notes were also gathered. The interview method was chosen because it allows for face-to-face interaction with respondents while using a structured questionnaire. Key informant interviews were performed to gather specific data regarding milk production and marketing. A source of secondary data was the examination of secondary documents.

The primary challenges and prospects for milk production, as well as the current patterns of milk handling practices, opportunities and challenges of milk marketing channels, were the main issues of the study and were covered in the questionnaire.

3.8. Data Analysis

Data gathered from dairy producers in the research areas was analyzed using two different methods: descriptive statistics and econometric analysis.

3.8.1. Descriptive analysis

In order to identify obstacles and opportunities, STATA was utilized to evaluate data on dairy production and marketing. Ratios, percentages, means, and standard deviations were used for data analysis.

3.8.2. Econometrics Model

3.8.2.1. Key Concepts

- Econometrics: may be defined as the quantitative analysis of actual economic phenomena based on the concurrent development of theory and observation, related by appropriate methods of inference(Gujarati, 2008)
- Regression analysis is concerned with the study of the dependence of one variable, the dependent variable, on one or more other variables, the explanatory variables, with a view to estimating and/or predicting the (population) mean or average value of the former in terms of the known or fixed (in repeated sampling) values of the latter(Gujarati, 2008).
- Multiple regression analysis: studying the dependence of one variable on more than one explanatory variable(Gujarati, 2008)
- cross-sectional data: are data on one or more variables collected at the same point in time,(Gujarati, 2008)

The regression equation helps in understanding the interrelationships of variables among them.

3.8.2.2. Empirical literatures

1. Assumptions of multiple linear regression

- ☞ Multiple linear regression makes all of the same assumptions as simple linear regression:
- ☞ **Homogeneity of variance (homoscedasticity)**: the size of the error in our prediction doesn't change significantly across the values of the independent variable.
- ☞ **Independence of observations**: the observations in the dataset were collected using statistically valid sampling methods, and there are no hidden relationships among variables. In multiple linear regression, it is possible that some of the independent variables are actually correlated with one another, so it is important to check these before developing the regression model. If two independent variables are too highly correlated (r2 > ~0.6), then only one of them should be used in the regression model.
- ☞ **Normality**: The data follows a normal distribution.
- ☞ **Linearity**: the line of best fit through the data points is a straight line, rather than a curve or some sort of grouping factor. (Bevans, 2020)

2. Multiple linear regression

The formula for a multiple linear regression is: according to Bevans, R. (2020, February 20) was.

$$y = \beta_0 + \beta_1 X_1 + \ldots + \beta_n X_n + \epsilon$$

- y = the predicted value of the dependent variable
- B_0 = the y-intercept (value of y when all other parameters are set to 0)
- $B_1 X_1$ = the regression coefficient (B_1) of the first independent variable (X_1) (a.k.a. the effect that increasing the value of the independent variable has on the predicted y value)
- … = do the same for however many independent variables you are testing
- $B_n X_n$ = the regression coefficient of the last independent variable
- ϵ = model error (a.k.a. how much variation there is in our estimate of y)

To find the best-fit line for each independent variable, multiple linear regression calculates three things:

- The regression coefficients that lead to the smallest overall model error.
- The *t* statistic of the overall model.
- The associated *p* value (how likely it is that the *t* statistic would have occurred by chance if the null hypothesis of no relationship between the independent and dependent variables was true). (Bevans, 2020)

It was assumed that independent variables were expected to have immediate effect on dairy production resulting in increased milk production. To be specific, improved breed, educational status, sex of the households, age, land holding size, access to extension, dairy cooperative membership, market access affect dairy production.

The dairy production analysis was done following the regression technique in linear form. The following multiple regression model Ordinary least square (OLS) was employed to estimate the determinants of dairy production.

Raw data will be collected from the field, organized, clustered, and interpreted and conclusions made from it. The final version of the model estimated was indicated as below.

$$Yi = B0 + B1\ (Sex)\ i + B2\ (Age)\ i + B3\ (EDL)i + B4\ (LHS)i + B5(Breed)i + Ui$$

Where,

Yi= Milk Yield

Sex=Sex of the respondent household

Age=Age of the respondent household

EDL=Education level of the respondent household

LHS=Land holding size of the respondent

UIB=Use of Improved Breed

3.9. Reliability and Validity

Reliability was the extent to which results are consistent over time and an accurate representation of the total population under study. The variables to be used for the analysis of Reliability and validity were as follows:

Measurements of variables

3.9.1. Dependent Variable:

Milk Productivity: A continuous variables that influences the milk production in liter of the smallholder dairy producers in the study area.

3.9.2. Independent variables:

The independent variables are those variables that contribute to the productivity of milk of the smallholder dairy producers in the study area. These factors were:

- **Sex of the households:** It is a dummy variable describing for male and female household head. In milk production farm, both men and women participated in management. Women contributed more labor input in area of feeding, cleaning of barns, butter and selling of dairy products. These variable was expected to have positive relation with milk production. **Meryem(2013)**
- **Age of the household head:** It was a continuous variable and measured in years. In previous study, the older milk producers were more adaptable to milk production and

marketing than young generation focus to other business. It was expected to have positive relation with milk production. Holloway and Ehui (2002)

- **Use of improved breed**: The main problem of milk production in the country was that of the poor genetic potential of the indigenous cattle, which gives rise to low milk output. If improvement of the local Ethiopian breeds for milk production is targeted, then it was important to have a well-designed selection program in place for a few selected promising breeds (Gebreselassie, 2020)
- **Education Level of the Household Head (EDL**): It was a continuous variable and measured in years of formal schooling of the household head. Education plays an important role in the adoption of innovations/new technologies to maximize dairy production and get updated demand and supply price information which in turn enhances producers' willingness to produce more and increase milk market entry decision and volume of sale. Formal education was expected to affect dairy production positively (Fakoya et al., 2007).
- **Land holding size (LHS)**: it was a continuous variable and measured by meter square. Large land size has positive influence on preparation of improved feed, increment of number of cows and therefore land size affect dairy production positively.
- **Access to market information:** It is a dummy variable to indicate access to dairy market information or not. Dairy producers who have market information were better to decide how to produce and supply dairy products to the market. Therefore, this variable was hypothesized to influence positively the smallholder milk producer households' probability and intensity of participation in milk market supply. Berhanu (2012)
- **Access to extension:** a dummy variable measured with the household who get dairy related extension services from their extension agent. The expected outcome will be positive because if the farmers get extension, they can adopt new technology and improve their livelihood by participating in market and meet others demand.(Abebe, 2022)
- **Farmers' awareness**: is dummy variable proposed to influence the participation decision and level of participation in milk market supply by milk producers positively. It is expected that training service widens the actor's knowledge and has positive impact on milk market supply in the possible areas. Hence, access to training service was hypothesized to affect milk producers positively in milk market supply. Muriuki (2003)

The independent factors were anticipated to have an immediate effect on dairy output, increasing production. Descriptive statistics were employed to analyze the variables in the dataset and were presented as tables, graphs, and regression models. The multicollinearity problem among the continuous variables was statistically handled before generating a model, and the correlation between the discrete variables was examined.

Ethical Considerations

According to McMillan and Schumacher (1993), ethics is thought to deal with views about what is good or evil, suitable or improper, and right or wrong. Due to the face-to-face interactive data collection with participants during the research execution, the researcher must be mindful of ethical concerns.

The St. Marry University of Ethiopia granted initial clearance. The respondents guaranteed that the information provided would be used only for the purpose of this study and would be kept in strict confidence.

CHAPTER FOUR: RESULTS AND DISCUSSION

The socioeconomic factors, milk production system, milk handling and marketing are reported in the first section of the assessment results using descriptive statistics. The limitations of milk production and marketing were discussed in the second section of the conversation. This chapter offered a discussion of the study's results.

4.1. Factors contributing to milk production

4.1.1. Sex

330 dairy cattle producers were interviewed, of which 69% of them were men, with the remaining 31% being household heads who were women. Both men and women manage and market milk in the study region. Even though the majority of the interviewees were male heads, most of the dairy production tasks were carried out by women.

Table 1sex of the respondent

Sex of the respondents	Freq.	Percent	Cum.
Male	228	69.09	69.09
Female	102	30.91	100.00
Total	330	100.00	

Source own survey (2023)

4.1.2. Age

23%of of the responders appears to be between 30-35 age, 30.9%of the respondents were between 36-40 age, 33.6% of the respondents were between 41-45 age and 7% of the respondents were >46 years age.

Table 2; age of the respondents

Age of the respondent	**Freq.**	**Percent**	**Cum.**
30-35 year	76	23.03	23.03
36-40 year	102	30.91	53.94
41-45	111	33.64	87.58
>46 years	23	6.97	94.55
	18	5.45	100.00

The age range of the respondent shows that they were in the productive age groups and can actively involve in activities of dairy production and marketing management as dairy management is a labor intensive needs to be capable both in physical and mentally.

4.1.3. Educational status of the respondent

The data obtained indicated that (38%) of the respondent were illiterate, 49% of the respondent can read and write, (19%) attained secondary school and (5%) of the respondents obtained college diploma and above. One of the crucial factors that improves farmers' capacity to gather, process, and apply knowledge connected to agriculture is education. Due to their propensity for innovation and potential for implementing best practices, educated individuals may be a potential contributor to the disparity in dairy productivity. When the household head more educated they became willing in involving in dairy production and more productive as a result of adoption of technologies in feed preparation, milk handling, animal health care, and marketing system and dairy management in general. Education plays a clear impact in influencing household income, technology adoption, demography, health, and the overall socioeconomic position of the family (Kerealem, 2005). The majority of dairy cattle owners in the research area, according to the data, are literate, which suggests that they can enhance their conventional system-based dairy production and marketing systems

Table 3: Educational status of the respondent

Educational Status of the respondent	**Freq.**	**Percent**	**Cum.**
Illiterate	127	38.48	38.48
read and write	164	49.70	88.18
primary school	15	4.55	92.73
high school	19	5.76	98.48
diploma and above	5	1.52	100.00
Total	**330**	**100.00**	

4.1.4. Experience in milk Production

Experience in milk production was an important variable of intellectual capital measured by the number of years the farmer engaged in activities of participation in milk production. The maximum milk production experience of the respondent in the study area is 12 years and the minimum is 3years.This shows that majority of the respondents were traditionally experienced in dairying for a long period of time. Therefore, in this study, experience in dairying have a positive relationship with participation of milk marketing.

Table 4 Experience in milk production

Experience of the respondent in milk production	Freq.	Percent	Cum.
<5year	142	43.03	43.03
6-10 years	183	55.45	98.48
>10 years of experience	5	1.52	100
	330	100.00	

4.1.6. Land holding per households in the study area

The minimum landholding size per households in the study area was 0.5ha and the maximum landholding size was 2.25ha. (Table 8). Land holding is a crucial aspect in raising milk output. However, respondents protect their land so that it can be used for pasture, especially grassland. The assessment outcome in the research district demonstrated that there is a technical skill gap in how they are managing their property to increase fodder production.

Table 5: Landholding size

land Holding size	Freq.	Percent	Cum.
<1 hectare	143	43,33	43.33
1 to 2 hectare	165	50	93.33
>2 hectare	22	6.67	100.00
Total	330	100	

4.1.7. Feed Sources

This assessment report showed that the major sources of feed for livestock production in the study area are natural pasture (72.73 %), and Grazing communal land (29%) and zero grazing (18.48%).

According to the respondents, livestock production system in Wachale district was heavily dependent on grazing from natural pasture. These feed resources are generally poor in quality and their productivity and supply is seasonal, particularly a critical problem during the dry season. Natural pasture, crop residue, and free grazing are the main sources of feed for cattle in the study area. Overgrazing lands are currently rapidly increasing as concentrates are rarely used for dairy farm production in the area. This finding is consistent with the reports of Asaminew (2007) and Seyoum et al. (2007), which stated that natural pasture, crop residue, and free grazing are the main sources of basal feed for cattle in the Bahir Dar and Mecha regions and the highlands of Ethiopia, respectively.

The major feed sources from November to March were crop residues, and after math grazing, while it was free grazing during the other months (April to October). However, the respondents reported that they face feed shortage mainly during the dry season (November to March) due to poor availability of feed from the grazing land. The farmers strategies used to cope with the feed shortage in the months were supplementing livestock with any available dry crop residues.

Table 6 Feed Sources

Feed source	Freq.	Percent	Cum.
Communal grazing	95	28.79	28.79
Crop Residue	9	2.73	31.52
Zero Grazing	22	6.67	38.18
Own pasture	204	61.82	100.00
Total	330	100.00	

The main problems related to improved forage availability are lack of awareness (36%), lack of improved seed and high prices (54%), and poor adaptability (10%). Lack of awareness (36%), are the main problems related to concentrate feeding in the study area.

Table 7: Feed related constraints

Feed Constraints |	Freq.	Percent	Cum.
Poor Adaptability |	36	10.91	10.91
Lack Awareness |	117	35.45	46.36

Feed Shortage |	177	53.64	100.00
Total |	330	100.00	

4.1.8. Dairy cattle breeding systems in the study area

According to the respondents in the study area, two types of breeding methods (natural mating using bulls and artificial insemination) were used for breeding system. About 72 % of the respondent in the study area use artificial insemination and 28% of the respondent use bull service for dairy cattle breeding respectively. Though the respondents prefer AI, Lack of access, shortage of liquid nitrogen and semen were ranked as first and second constraints to access AI in the study area.

Table 8: Breeding System

Breeding system	Freq.	Percent	Cum.
Bull	**220**	**66.67**	**66.67**
AI	**100**	**30.30**	**96.97**
Both	**10**	**3.03**	**100.00**
Total	**330**	**100.00**	

4.1.9. Milk yield of the dairy cows in the area

According to the response of the respondent, the average daily milk yield of local cows is 1.5litere and the maximum milk yield obtained per day was 3liter which is less than the national yield. The minimum milk yield of the crossbred dairy cows in the study area was 8 Liters and the max is 18 per cow per day, and it was significantly different between production systems, herd size group and parity.

4.1.10. Milk production constraints in the area

According to the response of the respondents, the major factors associated with milk production were high price of feed (35%), lack of improved breed, lack of technical support, lack of adequate marketing, Disease outbreak (16%) and lack of improved milking utensils. This study revealed that in both production systems, farmers stressed lack of feed to be the most important limiting factor for productivity of their cattle, and indicated the importance of improving their feeding regime as an essential step towards any improvement program

Table 9: Milk Production constraints in the study area

Milk production Constraint	Freq.	Percent	Cum.	Rank
Disease	54	16.36	16.36	3rd
High Feed Price	116	35.15	51.52	1st
Lack of stable Market	51	15.45	66.97	4th
Lack of breed	81	24.55	91.52	2nd
Total	330	100.00		

4.1.11. Opportunities of milk production in the study area

The study area was known for its high milk production potential, according to key insiders in the dairy industry. The large territory that farmers once farmed for crop production was now left for grazing because of the decline in fertility and the rise in profitability of dairying. The expansion of institutions assisting the dairy production. The district's suitable environment for dairy farming and the town's proximity to milk processing facilities were the main opportunities in the area.

4.2. Milk Handling Practices

4.2.1. Milking frequency in the study area

The majority of milking in the study area was conducted twice a day, morning and evening.70%of the respondents conduct milking in the morning and evening, 16%in the evening and 14%in the morning only. The finding report supports Haile Mikael et al. (2019)

Table 10: Milking Frequency

Milking frequency	**Freq.**	**Percent**	**Cum.**
Morning milking	153	46.36	46.36
Morning and evening	158	47.88	94.24

Milking in the evening only	19	5.76	100.00
Total	330	100.00	

4.2.2. Milking utensils and cleaning practices

One of the major factors affecting the quality of dairy products is milking utensils. According to the respondents, 16.67%of the milk producers use aluminum type milk handling equipment and 82.73% of the milk producers use plastic containers for milk handling. Hand milking is performed by massaging and pulling down on the teats of the cow. Good hand milking practice increase milk yield in dairy farm (supports the report of {Abebe, 2022).

Table 11: Milk handling equipment's in the area

Milkingequipment	Freq.	Percent	Cum.
Plastic container	273	82.73	82.73
Aluminum container	57	16.67	99.39
Total	330	100.00	

The milk utensil cleaning method used by the milk producers in the area was washing (53%), smoking (28%) and both methods (19%). In the study area, two types of containers are utilized to store milk products. These include plastic buckets and aluminum can. Nearly all milk producers' Plastic buckets are used in the Wachale district as equipment for milking and milk storage. Only a small percentage of local milk producers employ aluminum-type milk equipment. This could be as a result of the majority of farmers being unable to purchase or obtain aluminum-made vessels since they are too expensive. Additionally, the results of this study concur with those of Teshome et al. (2014), Abunna et al. (2018), and Alemnesh et al. (2020).

The majority of rural households in Ethiopia milk their cows twice a day, in the morning and the evening, according to Hailemikael et al. (2019). The only method of milking in the study area, according to this research, is manual milking (100%) exclusively. The process of hand milking involves stroking and drawing down on the cow's teats. Both before and after milking, calves were permitted to nurse their mothers. The findings of the current study are also supported by numerous papers, including Tadesse et al. (2020). For both evening and morning milk, milk is frequently

collected in the research area in the morning. In the study location, milk is often collected in the morning for both evening and morning milk. Dairy farmers kept.

4.2.3. Milk cooling facility

According to the assessment report obtained by the respondent, 91% do not use milk cooling facility and only 9% use milk cooling facility in the assessment area.

4.2.4. Milking method

The milking method used by the respondent in the study area was hand milking (100%), and milking of cows was mostly done by women. In addition, women are responsible for milk processing, barn cleaning and sale of milk and milk products. Men have greater contribution in breeding decision. Milk production activities in the study area were done by both male and female members of the family and children above 10 years of age. Females covers 75% of involvement in dairy milk production. Boys and girls in the age range of 5–10 years were involved in cattle herding and feeding, respectively.

Milking, milk processing, cleaning and selling of milk and butter is performed by female. The majority of the respondents clean their milk utensils once per day. To increase the shelf life of milk and milk products, smoking of container and washing after collection was used. 19%of the respondents use both washing and smoking method, 28% of the respondent use smoking and 53%of the respondent uses washing method to clean milk equipment's.

4.3. Marketing of milk and milk products in the study area

4.3.1. Channels of Milk Marketing in the study area

Milk products in Ethiopia are channeled to consumers through both formal and informal milk marketing systems (Mohamed et al.2004). Formal marketing systems are usually controlled by the government which include organized collection, processing and distribution of fresh milk and other dairy products at official government controlled prices as (Abdissa Tadesse, 2020). Milk producers of Wachale district not only consume milk products, but also sell the milk and butter to consumers, retailers and traders. According to the respondents, the major milk marketing channels in the Wachale district flows from producers to cooperatives (74%) producers to traders (20%) and producers to consumers (6%), while the reported butter buyer type were consumers and

retailers. The reported milk outlets were farm gate/homestead, cooperative and door to door delivery. These supports the findings of Woldemichael (2008).

A market can be visualized as a procedure where ownership of items is passed from sellers to buyers, who may be intermediaries or end consumers (Debrah and Berhanu, 1991). Although it is a less-than-developed system, selling raw milk was not a significant issue for the district under study. This is because the area is close to the nation's capital city and has a large number of milk processing facilities nearby. This is owing to the location of the area being close to the nation's capital city and the presence of numerous milk processing facilities in the area's surroundings. In Ethiopia, milk and milk products are marketed through both informal and formal marketing systems. In the dominant informal marketing system, producers sell to consumers directly or to unlicensed traders or retailers. As a result of the survey, various milk and milk product marketing channels were identified.

The cost of milk was high in the research area throughout the months of November and December. Since most people do not observe fasting at this time, the high milk demand could be explained by the fact that the dry season results in comparatively low milk production. The major fasting season for Ethiopian Orthodox Christians occurred between January and March, when milk prices hit their lowest point. After the lengthy fasting period and the wet months of June, July, and August, there was a sudden increase.

Households that produce milk in the Wachale district noted that one of their major challenges in producing and marketing milk was the seasonality of supply and demand, distance to marketing locations, lack of training in milk product marketing, lack of milk cooling facilities, lack of milk product processing skill and price volatility were all identified as issues with the marketing of milk products in the investigated district. On the other hand the assessment finding identified adulteration as very serious challenge in the study district due to the ansence of milk quality regulation rules. This supports the findings of (Benti et al., 2021).

The goal of this study was to identify milk marketing channels in the study area and to suggest recommendations for smallholder farmers' empowerment. The major Milk producers in the study area provide milk to their cooperatives, vendors, or collectors.

- Producers 32 milk collector's 34 consumers/processors

- Producers → 32 → Vendors → 34 → consumers/processors
- Producer's → 33 → Cooperative → 34 → processors

During the survey period, the following were the main outlets for marketing butter:

- Producer's → 500 → trader's → 600 → consumers

Cooperatives → 580 → consumers

4.3.2. Prices of Milk and Milk products in the study area

During the survey period (February to June 2015), the average price of raw milk in the area was 32 ETB per liter with minimum and maximum price of 32 ETB and 34 ETB per liter, respectively. The average price of butter was 500 ETB per kg and maximum price of 600 ETB per kg, respectively. From this study it was noted that various factors affect the price, demand and supply of milk products in the study area.

Table 12: price of milk during the study

Milk Price in Birr/lit	Freq.	Percent	Cum.
32	230	69.70	69.70
33	4	1.21	70.91
34	96	29.09	100.00
Total	330	100.00	

4.3.3. Constraints of Milk and milk product production in Wachale district

The prevailing constraints to milk marketing are low milk production, seasonal demand, low price of milk, lack of formal milk marketing, transport cost, spoilage and distance to market were considered to be the most important constraints to milk marketing (Belay and Janssens ,2014). Among all the constraints of milk and butter marketing in the Wachale area, Disease outbreak (15%), feed problem in quality and quantity (33%), lack of technical support to milk and milk product marketing (25%), lack of potential marketing points and fluctuation of prices (16%) and lack of appropriate milk handling utensils (11%) were considered as the major problems ranked

first, second and third by households in respectively. The finding report supports (Workneh and Ulfina (2011).

There are a number of problems and obstacles that milk producers in the study region face that stand in the way of their attempts to achieve the success they hope for in the milk sector. Numerous variables relating to production, processing, and marketing were discovered to be limiting milk production and marketing in the milk shed. The major challenges in producing and marketing milk was the seasonality of supply and demand, distance to marketing locations, lack of training in milk product marketing, lack of milk cooling and handling facilities, lack of milk product processing skill and price volatility

Econometric analysis for factors contributing for milk production

1. Pairwise correlation test (pwcorr.)

The table provided shows the correlation coefficients between the six variables: age, education, experience, landholding, milk yield, and milk price. A correlation coefficient is a measure of how strongly two variables are related. A correlation coefficient of 1 means that there is a perfect positive correlation between the two variables, meaning that as one variable increases, and the other variable also increases. A correlation coefficient of -1 means that there is a perfect negative correlation between the two variables, meaning that as one variable increases, the other variable decreases. A correlation coefficient of 0 means that there is no correlation between the two variables.

- ☞ The correlation coefficients in the table show that there are some significant correlations between the variables. The strongest correlation is between milk yield and experience (0.2055). This means that as experience increases, milk yield also tends to increase. There is also a significant correlation between landholding and milk yield (0.3688). This means that as landholding increases, milk yield also tends to increase.

- ☞ There are also some significant correlations between the variables and milk price. The strongest correlation is between milk yield and milk price (0.767). This means that as milk yield increases, milk price also tends to increase. There is also a significant correlation between

experience and milk price (0.0796). This means that as experience increases, milk price also tends to increase.

☞ The correlations between the variables suggest that there are some factors that can affect milk yield and milk price. These factors include experience, landholding, and education. However, it is important to note that correlation does not equal causation. Just because two variables are correlated does not mean that one causes the other. For example, the correlation between milk yield and experience could be due to the fact that both experience and milk yield are affected by other factors

2. OLS Regression Model

Source	SS	df	MS	Number of obs	=	330
				F(10, 319)	=	10.76
Model	714.435136	10	71.4435136	Prob > F	=	0.0000
Residual	2118.41638	319	6.6408037	R-squared	=	0.2522
				Adj R-squared	=	0.2288
Total	2832.85152	329	8.61049093	Root MSE	=	2.577

milkyieldlitdaycow	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
sexofrespondents	-.5184442	.3150642	-1.65	0.101	-1.138311	.101422
ageofrespondent	-.2976437	.1382751	-2.15	0.032	-.5696901	-.0255973
educationalstatus	-.3491913	.1805123	-1.93	0.054	-.7043364	.0059538
experienceinmilkproduction	-1.076774	.2958924	-3.64	0.000	-1.658922	-.4946273
landholdingsize	1.713147	.2504897	6.84	0.000	1.220327	2.205968
milkingfrequency	1.41564	.3236877	4.37	0.000	.7788078	2.052473
breedsystem	-.2117	.299368	-0.71	0.480	-.800685	.3772851
feedtype	-.2619773	.219022	-1.20	0.233	-.6928874	.1689328
coopmembership	-.045602	.0383854	-1.19	0.236	-.1211227	.0299186
milkingequipment	.3215792	.366142	0.88	0.380	-.398779	1.041937
_cons	9.939901	1.333702	7.45	0.000	7.315937	12.56386

The table shows the results of a multiple regression analysis that was conducted to assess the factors that affect milk yield in dairy cows. The dependent variable in the analysis is milk yield (in liters per day per cow), and the independent variables are sex of the respondent, age of the respondent, educational status, experience in milk production, landholding size, milking

frequency, breed system, feed type, coop membership, and milking equipment. The results of the analysis show that the following independent variables are statistically significant predictors of milk yield:

- Age of the respondent (older respondents have lower milk yields than younger respondents)
- Educational status (respondents with lower educational levels have lower milk yields than respondents with higher educational levels)
- Experience in milk production (respondents with more experience in milk production have higher milk yields than respondents with less experience)
- Landholding size (respondents with larger landholdings have higher milk yields than respondents with smaller landholdings)
- Milking frequency (respondents who milk their cows more frequently have higher milk yields than respondents who milk their cows less frequently). The other independent variables in the analysis were not statistically significant predictors of milk yield. Overall, the results of the analysis suggest that the independent variables in the model have a moderate effect on milk yield in dairy cows.
- **Use of improved breed**: smallholder dairy farmers who used improved dairy breeds obtained high milk yield. The main problem of milk production in the country was that of the poor genetic potential of the indigenous cattle, which gives rise to low milk output.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusion

As described in the introduction part of this chapter, the study was carried aiming at addressing the objective such as: to identify factors that contribute to milk production in the study area, to assess milk handling practices in the study district, and to assess milk marketing channels in the district. The study was carried in North Shewa Zone, Wachale district of the Oromia National Regional state.

A systematic random sampling procedure was used to select the sample respondent households. Because the district's population was nearly homogeneous in terms of livelihood and dairy production, each kebele had a list of dairy producer household heads**.** Cross-sectional data were used to accomplish the objective of the study. Both primary and secondary data were collected for the purpose of this study**.** The information was gathered from 330 smallholder dairy farmers in total using a standardized questionnaire in four purposively selected kebeles of the district.

Checklists and critical observation were the tools utilized to collect the data. Semi-structural questionnaires were used to gather primary data, and farmers who had been chosen at random were interviewed. Prior to the creation of the questionnaire, a preliminary visit that was pertinent to the study's goals was made. The primary challenges and prospects for milk production, as well as the current patterns of milk handling practices, opportunities and challenges of milk marketing channels, were the main issues of the study and were covered in the questionnaire.

Data gathered from dairy producers in the research areas was analyzed using two different methods: descriptive statistics and econometric analysis. It was assumed that independent variables were expected to have immediate effect on dairy production resulting in increased milk production. To be specific, improved breed, educational status, sex of the households, age, land holding size, access to extension, dairy cooperative membership, market access affect dairy production.

The dairy production analysis was done following the regression technique in linear form. Multiple regression model Ordinary least square (OLS) was employed to estimate the determinants of dairy production. The dependent variable in the analysis was milk yield (in liters per day per cow), and

the independent variables are sex of the respondent, age of the respondent, educational status, experience in milk production, landholding size, milking frequency, breed system, feed type, coop membership, and milking equipment The results of the analysis show that the following independent variables are statistically significant predictors of milk yield:

- Educational status (respondents with lower educational levels have lower milk yields than respondents with higher educational levels)
- Experience in milk production (respondents with more experience in milk production have higher milk yields than respondents with less experience)
- Landholding size (respondents with larger landholdings have higher milk yields than respondents with smaller landholdings)
- Milking frequency (respondents who milk their cows more frequently have higher milk yields than respondents who milk their cows less frequently). The other independent variables in the analysis were not statistically significant predictors of milk yield.

In general, the study demonstrated that there was a severe feed deficit and poor quality of the available concentrate feeds particularly from November to February. Although crop leftovers are readily available, their use is limited because of their poor quality, and the results of improving feed quality through treatment were dismal. Both natural mating and artificial insemination are used. The use of unselected bulls may have a negative impact on the herd's productivity and contribute to the spread of diseases like brucellosis. Pasteurellosis, skin disease, tuberculosis, blackleg, and foot and mouth disease are the most commonly reported cattle diseases in the research area. Milk producers in Wachale district practice smoking for milk, spicing for cheese, and washing for butter to increase the shelf life of milk and milk products. For smoking milk and milk product containers, we utilize Woira (Olea africana), Girar (Acacia spp.).

Nearly all milk producers' in the study area use plastic buckets for milking and milk storage. Only a small percentage of local milk producers employ aluminum-type milk equipment. This could be as a result of the majority of farmers being unable to purchase or obtain aluminum-made vessels since they are too expensive.

The major milk chain in the area were: Producers to consumers, producers to local collectors, producers to cooperatives and then to processors. Households that produce milk in the Wachale

district noted that one of their major challenges in producing and marketing milk was the seasonality of supply and demand, distance to marketing locations, lack of training in milk product marketing, lack of milk cooling facilities, lack of milk product processing skill and price volatility were all identified as issues with the marketing of milk products in the investigated district.

The major challenges in producing and marketing milk was the lack of feed as the primary constraint on the productivity of their cattle and emphasized the significance of enhancing their feeding practices as a necessary first step in any reform effort. The area's milk production system suffered from inadequate and unsafe veterinarian and artificial insemination services. In terms of dairy management and development, the farmers felt that they received limited extension assistance, distance to marketing locations, lack of training in milk product marketing, lack of milk cooling and handling facilities, lack of milk product processing skill and price volatility were the major challenges observed in the area.

5.2. Recommendation

As a result of this study, it was discovered that numerous constraints related to feed, nutrition, health, breed, breeding practices, handling, processing, and marketing of products predominate in the study district, and these constraints are intertwined with the existing milk production systems, which are primarily extensive, and milk handling & marketing systems, which are primarily informal.

In general, this study demonstrated that despite an untapped population of cattle and an agro-climate that is favorable for the development of the dairy industry, the productivity of milk production in the study district was low and the milk marketing system was underdeveloped as a result of numerous constraints, including those related to capacity, technology, organizational structure, and institutional requirements. As a result, a concerted effort is needed to overcome the restrictions at each level of the value chain for dairy commodities.

For the problems which have been hindering the small holder’s milk production, milk handling and marketing, the following suggestions were forwarded by the researcher:

- ☞ The government should strive to help the farmers improve their breeds by registering them and offering semen through the government veterinary doctors and extension officers at a considerable cost.

- ☞ Strengthening the service delivery of the artificial insemination technology to consider the possibility of selection and cross breeding of local breeds for better is recommended.
- ☞ Introduction of fodder seeds disbursement in the area is recommended. The minimum land holding size of small holder's farmers in the area is 1.5ha which is left for local pasture.
- ☞ Enhancing the skill of the small holder dairy farmers on forage production is recommended
- ☞ Provision of technical skills training in dairy production, processing and marketing is recommended. This will enable to improve the current milk handling system and quality of their product.
- ☞ Introduction improved milk handling equipment technologies in the area is recommended
- ☞ Milk pasteurizing units are to be established in the district so to enhance the shelf life of milk
- ☞ The formation and strengthening of milk marketing cooperatives is strongly recommended to enable them a better link to the market since the existing cooperatives in the area was weak in service delivery.

5.3. Implication for future studies

Out of this research, the following areas were found to have deficiencies of information and further research on these areas might be of value.

- ☞ Determine the policy interventions required in controlling the informal input output marketing in Ethiopia
- ☞ Determine the guiding rules and regulations to control milk adulteration in Selale area

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Annex. Research Questionnaire

RESEARCH QUESTIONNAIRE USED

This questionnaire is to be completed by dairy farmers. The respondents are kindly requested to complete this questionnaire. The information gathered on the Assessment of Milk production, Milk handling, and Marketing practices among smallholder Dairy Farmers for the case of the Wachale district will be used for partial fulfillment of a Master's degree in Development Economics from St. Marry University.

Name of enumerator_____
Date_____ PA _____

Associated factors for milk production

I. **Demographic Characteristics**

1. Name of the household head_____
2. Age of household head_____
3. Sex of household head 1-Male 2.Female
4. Educational status of the household

1. Illiterate 2. Read and Write 3. Elementary school 4.High school 5. Diploma and above

5. Total farm size of the household (ha)
    1. Grazing land_____ (ha)
    2. Cropland (both annual and perennial)_____(ha)
    3. Improved forage land_____(ha)
    4. Total land holding _____(ha)
6. Which crops do you produce?
7. Farming system

1. What is your major farming activity?

    1. Livestock production 2). Crop production 3). Both livestock and crop production

2. If both livestock and crop production, which one is more important to you (please rank)

    _____

3. Among livestock species which one is more important for you (please list and rank)

s/n	List of livestock species	Rank the importance
1		
2		
3		
4		
5		

4. Do you produce milk? 1. Yes 2. No
5. If yes, for what purpose do you produce milk? 1. Home consumption 2. Market 3. For both 4. Others (specify):_____
6. What is your **major** livestock farming? 1. Cattle production 2. Small ruminant production 3. Poultry production 4. Other: _____
7. Which part of your farming contributes most to your families' income?
   1) Livestock production only 2).Crop production only 3). Livestock and crop production 4) .Livestock and off-farm activity 5). Crop and off-farm activity 6). Livestock, crop and off-farm activity.
8. How long have you been engaged in milk production? _____
   1).1-5 years 2). 6-10 years 3). 11-15 years 4). >15 years

Feeds and Feeding related

1. What do you feed animals at different months

Feeding management	Months											
	J	F	M	A	M	J	J	A	S	O	N	D
Grazing own pasture												
Grazing communal land												
Grazing on crop residue												
Crop aftermath grazing												
Zero grazing												
Weeds from crop farms												

2. Is there a problem of feed shortage for milk cows? 1. Yes 2. No

3. If yes, when? _____

4. How do you cope up with feed shortage in your locality? _____

6. What are the major feed related constraints of livestock production (List and rank them)

s/n	List of constraints for milk production	Rank
1		
2		
3		
4		
5		
6		

7. What are the main problems in the area of improved forage use for milk cows?

1. Lack of awareness 2. Lack of seed 3. Lack of growing land
4. Poor adaptability 5. Shortage of improved forage in the area

8. What are the main problems in the area are of concentrate feed use for milk cows?

1. Unawareness 2. Lack of access 3.Costly
4. Combination of them (specify)

5. Shortage of supply 6. Others (specify) _____

9. What are the main problems in the area of crop residue use for milk cows?

1. Shortage of production 2. Utilization by other livestock type
3. Shortage due to Utilization for other purpose other than feed
4. Combination of them (specify) _____5. Others (specify)

_____

10. Which cop residue is your dominant feed?

1. Teff straw 2. Barley straw 3. Rice straw

4. Maize stalk 5. Inset residue 6. Other (specify):__

11. What is the major source of feed to your livestock?

1, natural grazing 2. Improved forage

3. Crop residue 4. Crop aftermath

4. Other (specify):_____

13. In what form are you using the natural grazing lands you have?

1. Continuous grazing 2. Rotational grazing 3.Cut-and-carry system 4. Other (specify):____

14. How do you get feed (all kind of feeds) for your livestock?
    1. Produce on farm 2. Purchase from outside 3. Produce and purchase 4. Other (specify): _____
15. Do you conserve feeds to feed milk cows in times of feed shortage? 1. Yes 2. No
16. If yes, how do you conserve? 1. Hay making 2.Silage 3.other:_____
17. If no, Why not_____
18. Do you supplement your lactating animals? 1. Yes 2. No
19. If yes, mention the types of feeds that you supplement_____
20. How do you provide supplementary feeds?
    1. Separately 2. Group feeding 3. Others (specify) _____
21. How frequently do you provide supplementary feeds for your lactating animals?
    1. Once a day 2.twice a day 3.As available
22. What is the source of water for your animals?
    1. River 2. Tap water 3.Spring 4.Pipe water 5. Bore well 6. Other (specify) _____
23. How frequently do you provide water for your cattle?
    1. Free access 2. Once per day 3.Twice per day 4. Every other day
24. What is your water related problem?
    1. Scarcity/unavailability 2. Parasites 3.Impurities 4. Distance

II. Calf Rearing Practices

1. System of weaning exercised by the owner?
    a) Isolation and herding separately
    b) Protection from sucking without isolation
    c) Other (specify) _____
2. What method do you use for pre-weaning milk feeding?
    a) Bucket feeding (for local, cross or both)
    b) Partial suckling (for local, cross or both)
    c) Other (for local, cross or both) _____
3. Do you provide colostrum for your newborn calf? 1. Yes 2. No
4. If no, why_____
5. For how long is the newborn calf supplied with milk (In months)?
    a. Local _____ b. Crossbred _____
6. For how long newborn calves stay indoors until they start grazing?
    Local _____ Cross _____.
7. Do you provide supplementary feed to newborn calf till they start grazing? 1. Yes 2. No

8. If yes, mention the type of feed and form of feeding?

Type of feed	Form of feeding (group or individual)
a. Local	_____ _____
b. Crossbred	_____ _____

III. Housing, Facilities and Management

1. How do you house your animals? 1. in the same house with family 2. Separate from family house 3. Other (specify): _____
2. If separate, what type of house?
   1. Corral. 2. Well-built house with shelter and wall. 3. Only shelter 4. Specify (other): _____ 3. Specify the area of the barn you have (m^2) _____.
3. Frequency of cleaning the barn
   1. Three times a day 2.Two times a day 3.Once a day 4. Others (specify) ____
5. How do you dispose the cattle dung from the barn? 1. Draining system 2. Labor
6. Frequency of disposing manure from the barn
   1. Once per day 2. Twice a day 3. Three times a day. 3. three times and above
7. If they graze for how long they stay in grazing (hours per day)?

	Dry season	Rainy season
Crossbred cows	_____	_____
Local cow's	_____	_____
Crossbred calves	_____	_____
Local calves'	_____	_____

IV. Breed, Breeding and Reproduction

1. Do you keep crossbred milk cow/s? 1. Yes 2.No
2. Source of crossbred heifer(s): 1. Government ranches 2.Market 3. Private ranches
3. Merit and demerit of crossbred cattle compared with local cattle.

	Merit	Demerit
a)	_____	_____
b)	_____	_____
c)	_____	_____

4. Which breed of milk cows do you like to keep in the future? 1. Local 2. Crossbred
5. Why do you select it? _____

6. What is the average age at first calving (year)? a. Local _____b. Crossbred _____
7. In which month/season of the year cows come into heat?

Season	Month(s)
Dry	_____
Rainy	_____

7. What is the average age at first mating for female (in years)?

a) Local_____ b). Crossbreeds_____

10. What is the average age at first effective service for male (in years)?

a). Local_____ b). Crossbreeds_____

11. Calving interval of a milking cow? (in months)

a). Local_____ b). Crossbred_____

12. What is the average lactation length for milking cows (in months)?

1. Local _____ 2. Crossbred _____

13. Which breed sire mostly you use for natural mating?

1. Crossbred 2. Local 3.Both equally 4. Unknown

14. If you use AI, what is the source of it?

1. Government recruited technicians' 2. NGO's. 3. Private 4. Others (specify) ____

15. Which method do you prefer and why? 1. Natural (bull service) 2. Artificial insemination
16. Is there a problem of AI? 1. Yes 2. No
17. If yes, why?

1. No access 2. Unwillingness of AI technicians' 3. Shortage of liquid nitrogen and semen 4. Others (specify) _____

18. If no, where is your source for the bull?

1. Neighbor 2. Rent from neighbor 3. Bull services (Rent) 4. Others (specify) _____

19. When do you mate the cow after calving (in days)?

1 Local _____ 2. Crossbreeds _____

20. If you cull milk cattle due to financial constraint, which is your priority for culling?

1. Milking cow 2. Bull 4. Heifer 5. Male calves 6. Female calves 7. Pregnant cow 8. Infertile/cows with low milk yield 9. Others (specify) _____

21. Of the above you mentioned which breed you mostly cull?

1. Locals. Why? _____
2. Crossbreeds. Why? _____

V. **Milk cattle Diseases and Treatments**

1. Describe the major disease you have experienced in your milk cattle during the last year in order of importance.

Local name of diseases	Symptom	Month of occurrence
1._____	_____	_____
2._____	_____	_____
3._____	_____	_____
4._____	_____	_____
5._____	_____	_____

2. What do you do when your animal is sick?
   1. Keep of waiting 2. Culling 3. Consult veterinarian 4. Others (specify)
3. Do you have access to veterinary services? 1. Yes 2. No
4. Is there a problem with animal health services? 1. Yes 2. No
5. If yes, please mention_____
6. Do you use any control measures for ecto-parasites of milk cows? 1. Yes 2. No
7. If yes, specify:

Method	Frequency	Cost per treatment/ head
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____

8. How do you control internal parasites?

Method	Frequency	Cost per treatment/ head
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____

VI. External input services for milk producers

1. Have you ever participated on milk production training? 1. Yes 2. No
2. If yes, specify the training type and the institution which organized the training
   _____
3. Is there any extension service given for livestock especially milk development? 1. Yes 2.No
4. Do you think that there is a need for external input (assistance) which helps the milk Production?_____
5. Are you a member of milk collection group/ cooperative? 1. Yes 2. No

6. If yes, benefits and obligations (e.g. obtain credit, inputs, and guaranteed sales outlet).

_____

7. Are you a member of saving association or group? 1. Yes 2. No
8. If yes, what kind of savings do you have? _____

VII. **Milk production and marketing**

1. Milk yield and frequency of milking for milk cows (select the possible frequency of milking and indicate the average milk yield).

Period of lactation		Time and amount of milk produced			Remark
		1. Morning	2. Mid-day	3. Evening	
Local	Early lactation				
	Mid of lactation				
	Late lactation				
Crossbred	Early lactation				
	Mid of lactation				
	Late lactation				

2. Type of milking practices
   1. Milking without suckling 2. Few suckle before and after milking

3. Suckling before milking only 4. Others (specify) _____
3. Do you practice complete milking practice? 1. Yes 2. No
4. Do you wash udder of milking cows? 1. Yes 2. No
5. Do you milk your animals in the absence (death) of their calves? 1. Yes 2. No
6. If yes, how? _____
7. Do you use disinfectants for milk equipment? 1. Yes 2. No
8. If yes, mention the type of disinfectant you use to disinfect_____ 11. What methods do you use to increase the shelf life of milk and milk products?
   1. Smoking of containers 2. Boiling before collection 3.Salting 4. Others (specify)
12. How many kg of butter you get from one churning? _____

Type of cow	Amount of milk churned at a time (lit)	Amount of butter produced (kg)	Amount of cheese produced (kg)
1. Local			
2. Crossbred			

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

Produced used for home consumption Sold

Milk _____ _____ _____

Butter _____ _____ _____

Cheese _____ _____ _____

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

Products	Minimum		Maximum	
	price (birr)	Season and/months	price (birr)	Season and/months
Milk				
Butter				
Cheese				

VIII. Marketing practices of Milk

3. Who is the milk buyer from milk producers?
4. Availability of milk Marketing Agents? 1. Available 2. Not avilable
5. Distance of the milk collection centers from the farmers' house 1).minimum distance 2)long distance
6. What factors affect the price of milk and milk products? _____
7. For what purpose do you mostly use the money that you get from the sale of milk and milk products 1. Farm inputs 2.Food and non-food items 3.House construction 4. Teach children
8. Please specify the frequency of selling milk products in a month. _____
9. Is there any period that you have problem of marketing your milk products? 1. Yes 2. No
10. If yes, which months? 1. Fasting month's 2. In any month of the year 3.Specify 21. Have you ever experienced spoilage of milk and milk products due to lack of market?
    1. Yes 2. NO
11. Do you process milk? 1. Yes 2. No
12. Do you produce butter? 1. Yes 2. No
13. For how long can you store butter with minimum spoilage? _____
14. Which milk products do you use for family consumption?
    1. Fresh milk 2.Fermented milk 3.Buttermilk 4.Cottage cheese

14. Did you encounter sickness due to consumption of contaminated milk? 1. Yes 2. No.

IX. Milk handling practices

1. What hygienic practices do you use during milking?

1. Smoking the utensil before milking 2. Washing of the udder before milking.3. Washing teats, 4.others

2. What type of utensils you use for milking? 1. Plastic 2. Aluminium type 3. Others

3. How frequently you clean your milking equipment? _____
   1. Once per day 2. Twice per day 3.3 times per day 4. Others (specify) ___
4. What are the plants used for smoking milking equipment? _____
5. What is the purpose of smoking? _____
6. Milking hygienic practice
   1. Wash hands and milk vessels 2. Wash udder before milking
   3. Wash udder before and after milking 4. No hygiene

X. Constraints of milk production (List and rank them).

15. What are the constraints of milk production in your area

s/n	Constraints of milk production	Rank
1		
2		
3		
4		
5		
6		

16. What are the constraints of milk marketing? (List and rank them)

s/n	Constraints of milk and butter marketing	Rank
1		
2		
3		
4		
5		