ECONOMICEFFICIENCY OF URBAN DAIRY FARMING IN WOLISO TOWN; OROMIA, ETHIOPIA

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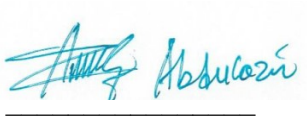
Abdulaziz Mosa (PhD)		21.11.2023
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DECLARATION

I, senait teka, hereby declare that this MSc thesis entitled **"**Economic efficiency of urban dairy farming in woliso town; Oromia, Ethiopia**"** is my original work and has not been presented for a degree in any other university, and all sources of material used for this thesis have been duly acknowledged.

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DEDICATION

I dedicate this thesis manuscript to my father Teka wolede (R.I.P).

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LIST OF ACRONYMS/ABBREVIATION

AE Allocative Efficiency

AI Artificial Insemination

CSA Central Statistics of Agency

DEA Data Envelopment Analysis

EE Economic Efficiency

Freq. Frequencies

Kg Kilogram

LR: Log likelihood Ratios

Max. Maximum

Min. Minimum

MLE Maximum Likelihood Estimates

NGO's Non-Governmental Organizations

Obs. Observation

OLS Ordinary Least Square

SD Standard Deviation

SPF Stochastic Production Frontier

TE Technical Efficiency

UNRRA United Nation Relief and Rehabilitation Administration.

VIF Variance Inflation Factor

Table of Contents

ADVISORS' APPROVAL SHEET ii

EXAMINERS' APPROVAL SHEET iii

DECLARATION iv

DEDICATION v

ACKNOWLEDGMENT vi

LIST OF ACRONYMS/ABBREVIATION vii

LIST OF TABELS xi

TABLE OF FIGURES xii

ABSTRACT xiii

CHAPTER ONE 1

1. INTRODUCTION 1

1.1. Background of the Study 1

1.2. Problem Statement 4

1.3. Objectives of the study 5

1.3.1 General objective 5

1.3.2 Specific objectives 5

1.4 Research questions 5

1.5. Scope of the Study and limitation 5

1.6. Significance of the Study 6

1.7. Organizationof the study 6

CHAPTER TWO 7

2.LITERATURE REVIEW 7

2.1. Dairy Production System in Developing Countries 7

2.2. Dairy Production System in Ethiopia 8

2.3. Urban Dairy Production System in Ethiopia 10
2.4 Economic efficiency 11
2.4.1 Technical efficiency 11
2.4.2.Allocative efficiency 12
2.5. Methods of efficiency measurements 12
2.6 Determinants of efficiency 13
2.6.1 Farm and farmer characteristics 13
2.6.2 Cost of inputs 14
2.6.3 Economic factors 15
2.6.4 Institutional factors 15
2.7 Theoretical framework 15
2.8. Empirical Studies on efficiency 17
2.8.1. Empirical Studies outside Ethiopia 17
2.8.2. Empirical Studies of Efficiency Analysis in Ethiopia. 19
2.9 Conceptual framework 20
CHAPTER THREE 23
3. RESEARCH METHODOLOGY 23
3.1. Description of the Study Area 23
3.2. Sampling Technique 24
3.3. Data sources and data collection method 25
3.4 Data analysis 25
3.5Model specification 26
3.5.1 Technical efficiency 27
3.5.2 Allocative efficiency 28
3.5.3 Assessing determinants of economic efficiency 30

3.6 Expected signs of variables estimating farmers' economic efficiency..... 31
3.7.Model diagnostic tests..... 33
CHAPTER FOUR..... 34
4. RESULT AND DISCUSSION..... 34
4.1. Socioeconomic Characteristics of Dairy Farmers..... 34
4.1.1 Summary statistics of variables used in the production and cost function..... 35
4.2. Estimation of production and cost function..... 37
4.3 Distribution of efficiencies among urban dairyfarmers..... 39
4.4. Factors influencing the economic efficiency of milk production in urban dairy farming. 42
CHAPTER FIVE..... 46
5. CONCLUSIONS AND RECOMMENDATIONS..... 46
5.1. Conclusions..... 46
5.2. Recommendations for policy intervention..... 48
5.3 Areas for Further Research..... 49
References..... 50
APPENDIXS..... 52
Appendix 1 Questionnaire English..... 52
Appendix 2 Questioner Amharic (መጠይቅበአማርኛ)..... 57
Appendix 3 Stochastic Frontier Production Estimates of Model one..... 65
Appendix 4 Tobit model of Factor affecting EE..... 66
Appendix 5 Mean of EE ,TE and AE..... 66
Appendix 6 VIF Test Result for SFA Model Continues Variables..... 66
Appendix 7 Pair Wise Correlation Test Result for Dummy and Categorical variables..... 67

LIST OF TABELS

Table 1: expected signs of variabels estimating farmers economic efficiency variable..... 33
Table 2 Socioeconomic characteristics of dairy farmers 35
Table 3: summary statistics of variables used in the production and cost function..... 36
Table 4: Maximum likelihood estimates of stochastic frontier production function..... 38
Table 5: Maximum likelihood estimates of stochastic frontier cost function..... 39
Table 6: Technical, Allocative and Economic efficiency scores distribution 40
Table 7: Parameter estimates of determinants of technical, allocative and economic..... 43

TABLE OF FIGURES

Figure 1 farrell's measure of technical and alocative efficiency..... 16
Figure 2: conceptual framework showing links between factors influencing dairy production decisions and economic efficiency 22
Figure 3: map of study area 24
Figure 4: mean of efficiency score distribution 41

ABSTRACT

The aim of the study was to measure the level of technical, allocative and economic efficiency of urban dairy farming and to identify factors affecting them in the study area. The study was conducted using Cross-sectional data on socio-economic factors and milk production collected from the 184urban dairy farmers sampled in 2015, using semi-structured questionnaires. The study used the Stochastic Frontier model to analyze the technical, Allocative and economic efficiency of milk production, while Tobit model was used to assess the factors associated with economic efficiency. The results indicated that the farmers had a mean of 84.8% in technical efficiency, 78.1% in Allocative efficiency and 66.3% in economic efficiency. The results showed that the economic inefficiency among the farmers is mostly caused by low Allocative efficiency since the farmers indicated high levels of technical efficiency. From the findings, there were considerable production inefficiencies and thus there was room for increasing productivity through the use of available inputs and reducing costs. Farmers having utilization of the available resources would yield a proportionate increase in the milk output. Increasing herd sizes, feeding animals with enough concentrates and ensuring the animals' health care costs are met were found to be some of the solutions to the low milk productivity in urban dairy farming. The cost of concentrates and other feeds was found to be the major component of the total cost of dairy production. However, the Allocative efficiency level among the farmers was quite high, an indication that the farmers in the study area, though resource-poor, were efficient at minimizing costs. The study indicated that household size, having dairy farming as the main source of income, access to credit, hired labour, cost of fodder and concentrates were the significant factors associated with economic efficiency in urban dairy farmers in woliso. Price subsidies on dairy inputs, especially fodder and concentrate, as well as better milk prices, are some of the interventions that will see an increase in efficiency resulting in an increase in milk productivity.Policy makers should focus on increasing supply of fodder and control price of fodder and concentrates to increase milk yield further. Providing training to dairy farmers is important to increase efficiency by increasing management skills of the dairy farmers. The management skill development of dairy farmers needs to focus on feeding and cattle husbandry.

Key words: Efficiency, Economic, technical efficiency, Stochastic frontier function.

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the Study

Ethiopia is among the countries with the largest livestock population in Sub-Saharan Africa, and is ranked to be the ninth in the world (CSA, 2011a). Ethiopia has the largest livestock population and the highest draft animal population in the continent. The growth rate of population in Ethiopia is 2.5 percent per year while the urban population increases at the rate of 4.9 percent. The growing population and increasing income are expected to increase milk demand significantly in the future. To meet the higher milk demand, increasing productivity and efficiency of dairy farming is critical to Ethiopia. Moreover, although livestock production is source of income and food in Ethiopia, the potential of dairy production has not yet fully exploited and promoted(Solomon, Workalemahu, 2003). Given suitable agro-ecology for livestock production in Ethiopia, development of the dairy sector and increasing value for dairy products could potentially contribute to poverty alleviation(Ahmed et al.2007).

High incidence of livestock disease and increasing cost of feeding cattle, fluctuations of fresh milk prices, animal health problems and weak and inefficient marketing system in developing countries like Ethiopia are challenges of livestock production. Therefore, low productivity of Ethiopian dairy farming system has been recognized as a major problem. The problem of low productivity could be solved through increasing dairy farming efficiency. Provision of extension services comprising animal breeding, feeding and animal health is key to support efficient milk production(Mekonnen, 2006).

Urban dairy farming is a more specialized farming practiced in state sector and very few individuals on commercial basis. These farming systems with combination to perurban and urban Small scale dairy farmers produce 2% of the total milk production of the country. Farmers use part or all of their land to grow fodder crops for their dairy cattle. The dairy animals do not

provide draft, but their manure is used as fertilizer on crops, milk is the main source of farm income. It is mainly under taken by small farmers using family labor, but commercial farmers using herd labor also practices this system on a large scale. The herd is dominated with improved/cross breed dairy cattle and the production system is market oriented and milk production is for sales. As compared to other systems they have relatively better access to inputs (e.g. feeds) and services (e.g. artificial insemination) provided by the public and private sectors and use intensive management system. Marketing of fluid milk is arranged through direct contact between producers and consumers, and/or involves wholesalers/ processors, cooperatives, and retailers(Getabalew et al., 2019).This system comprise small and medium size dairy farm located mainly in the highlands of Ethiopia.

The need for milk and its products majorly come from the urban and peri urban dairy production systems. The systems involve production, processing and marketing of milk and milk products that are channeled to urban centersTegegne, Tadesse, (2013). This system is contributing immensely towards filling in the large demand-supply gap for milk and milk products in urban centers, where consumption of milk and milk products are remarkably high. Dairy farmers and cooperatives involved in milk production in the peri-urban and urban areas are selling milk to consumer in the nearby town and city Gebremichael, (2014).

Urban dairy production system is becoming an important source of fresh milk and milk products to urban centers, where the demand for milk and milk products is remarkably high. As a result of this, urban dairying could be intensified through the use of crossbreed dairy cows, purchased and conserved feed and stall-feeding. Proximity of dairy farming to market where high fresh milkdemand and easy access to agro-industrial by-products, veterinary services and supplies promotes dairy production(Mekonnen, 2006).

Ethiopia lacks policy frameworks for UPA despite the fact that the sector is source of livelihoods and fresh food items for hundreds of thousands of urbanitesin the country. It was not even addressed in the National Urban Development Policy of the Country (2005).

Furthermore, no issues of UPAhave beenmentioned in the subsequent urban-oriented development-spurring documents such as Urban Development and Construction Component of PASDEP (2006), Urban Industrial Development Package (2006) and Urban Lands Lease Holding Proclamation (2011). Many urban farmers in the country, therefore, operate without

formal recognition of their main livelihood activity and they lack the structural support of proper municipal policies and legislation. This indicates that the sector is absolutely neglected calling for urgent policy framework for UPA in Ethiopia(Mulugeta,2013).

The existing dairy farming practices in urban areas of the country in general and woliso city in particular is largely traditional and characterized by low input and dairy farming technology usage and focuses on management of indigenous breed types that have low milk yield output (Azage et al*.,* 2006). Moreover, the traditional milk production accounts for the greater proportion of dairy farming and milk production in urban areas of the country. On the other hand, modern dairy farming practices cover a range of intensive management practices and zero grazing(zelalem,Emmannuelle,2011).In addition, dairy farming competes with for scarce arable land. It implies that the utilization of scarce land resource and dairy production need to be optimized and efficient in order to get maximum profit from dairy enterprises (Azage et al*.,* 2006).

1.2. Problem Statement

In Ethiopian Urban population is to grow at the rate of 5 to 6 (Percent) between1990 to 2025 accounts for much of the increased milk demand (T/Giorgs, 2010). Marketed dairy production is already increasing in the urban centers as a direct response to consumer demands either by smallholders or commercial dairy enterprise.

Further development of dairy farming significantly contributes to livelihood of smallholder farmers through the production of higher-value products as compared to most crops. Smallholder dairy farming is a source of income and employment, which involves both self-employment and the use of hired labor(USAID, 2010). Livestock production in Ethiopia source of income and has also insurance functions. Moreover, argued that, dairy development improves nutrition status of smallholders, particularly children and maternal nutritional status (Staal et al., 2003).

Given the livelihood benefits of dairy farming and dynamic change across the globe, market oriented sustainable dairy production is facing several constraints. Constraints to sustainable dairy production related to animal feed resource upgrade, breed type and management of reproduction, disease, marketing mechanisms, environmental impact, and policy environment. Given the challenges and the good prospects of market oriented dairy production in many African countries, dairy farming systems have become a priority area for research and development (Fita et al., 2013).

Scientific studies that focus on dairy production in developing countries can be useful for informed policy making to increase economic efficiency of dairy farming. Moreover, explaining the concept of production efficiency provides a theoretical knowledge for concerned bodies that helps in decision making(Russell & Young, 1983). Moreover, contends that in developing countries' where farm efficiency is low enhancing agriculture farm efficiency is important to increase yield without additional input usage.

Moreover, earlier studies on agricultural production technical efficiency in many developing countries, for instance, studies by Al-Sharafat, (2013); Sharma and Singh, (1995); Deepak et al., (1995); and Alam et al., 1995). Similar studies are also in Ethiopia by Jema, (2007); Beshir et al., (2012); Fita et al., (2013); and Dayanandan, 2011) suggested for further studies that focus on dairy production in developing countries for informed policy making to increase efficiency and

hence profitability of dairy farming. Therefore, it is important to estimate economicefficiency of urban dairy farming in Ethiopia so as to suggest policy interventions to increase milk supply to meet increasing milk demand in urban areas because of population growth and income.identifying the extent of efficiency and the factors that contribute to it is of a paramount importance on the level of resource use efficiency in dairy milk production Even if there are studies regarding this issue, the scope and several determinants which economics efficiency of urban dairy farming did not studied in depth. This study, therefore, tried to contribute to the existing gap in knowledge on economic efficiency in dairy production in Ethiopia and the case in point is wolisotown as a case study.

1.3. Objectives of the study

1.3.1 General objective

- The general objective of this study is to assess the economic efficiency of urban dairy farming in WolisoTown,Ethiopia.

1.3.2 Specific objectives

- To determine the technical efficiency of urban dairy farming in WolisoTown, Ethiopia.
- To determineAllocative efficiency of urban dairy farming in WolisoTown, Ethiopia.
- To determine the factors influencing the economic efficiency of urban dairy farming in WolisoTown,Ethiopia.

1.4 Research questions

- The specific research questions to sharpen the study problem are:
  1. What is the mean technical andAllocative efficiency of urban dairy farming?
  2. What are the factors that affecting economic efficiency of urban dairy farming?

1.5. Scope of the Study and limitation

This study was focuses on productivity and efficiency of urban dairy farming in wolisotown Oromia, region of Ethiopia. Moreover, the studyis examines economic efficiency of urban dairy farmers ranging from small, medium to large size dairy farmers, involving in both traditional and modern dairy farming. Although, thescope of the study waslimited to single townAnd used a cross-sectional data, the household reluctance to provide information

1.6. Significance of the Study

The study resultsis help to advice and guide producers as to which part of the business deserve special attention to make improvements and the results also used by policy makers, government and NGO's to streamline intervention and also used as a springboard to conduct similar other studies

Studying, the economicefficiency and its determinants of dairy farms help to identify opportunities and constraints that can be used as input information to advice improvement strategies that intensify dairy farms in woliso.

1.7. Organizationof the study

This thesis is organized into fivechapters. The first chapter is an Introduction that comprises background of the study, statement of the problem, objectives of the study, significance of the study, scope & limitation of the study. Chapter two is literature review, where the analytical foundations of theoretical and empirical literature of efficiency measurements are well discussed in the chapter two, and the third chapter is researching methodology. Method of data collection and system of analysis are presented and analyzed in the fourth chapter, and the last chapter is conclusions and policy implications

CHAPTER TWO

2.LITERATURE REVIEW

2.1. Dairy Production System in Developing Countries

Dairy production systems vary enormously throughout the world in terms of farm size, agro-climatic zones and socioeconomic and political settings(Bonnier et al., 2004). Economics of dairying in the tropics is difficult to analyze at a single stage of the production-collection-processing-distribution-consumption continuum, International Livestock Research Institute. Three systems commonly used for keeping cattle are the grazing-system, the grazing-with supplementary-feeding-system and the zero-grazing-system; each defined according to the way the animals are fed. The type of feeding determines the most possibilities and constraints in a system, for example labor use and production potential(Bonnier et al., 2004).

Duguma & Kechero(2012), stated that, smallholder dairying is invariably part of a larger and more complex farming system that typically includes farm-produced inputs such as feeds, various non-farm inputs, family inputs of labor and management and outputs of various types. Also their study dairy production systems in developing countries may be identified by a combination of characteristics. Using such breakdowns, analysts can then look at the strengths and weaknesses of each system and devise improvement or adjustment strategies. Also International Livestock Research Institute(ILRI, 2012), showed an alternative approach, which is more oriented towards farm-level management, resources and constraints places primary emphasis on feed resources available to smallholders.

Staal et al(2003) reported that, in areas of greater land availability, less intensive feeding practices of combined grazing and stall-feeding, or only paddock grazing, are employed. Thus, farmers choose feeding systems which best utilize their relatively most scarce resource: land in the case of zero-grazing, and labor in the case of paddock grazing. Costs of milk production in turn reflect this substitution of primary inputs.

Bonnier et al (2004) argued that dairy cattle are kept all over the world. There are several reasons to keep dairy cattle at the household level. Short term reasons are for direct economic returns on

products such as milk, meat, hides, manure and traction. Long term reasons may be for investment, bank and life insurance.

2.2. Dairy Production System in Ethiopia

Dairy production is practiced almost all over Ethiopia involving a vast number of small subsistence and market-oriented farms and is being practiced as an integral part of agricultural activities in Ethiopia since a time of immemorial. There are different types of milk production systems identified based on various criteria Based on climate, land holdings and integration with crop production as criterion, the dairy production system classified as rural (pastoralism, agro-pastoralism and highland mixed smallholder), peri-urban and urban The dairy sector in Ethiopia can also be categorized based on market-orientation, scale, and production intensity into three major production systems: traditional smallholder, private/ state-owned commercial, and urban/ peri-urban Tadesse & Yilma(2018).

The state dairy farms now privatized or in the process of privatization, use grade animals (those with more than 87.5 percent exotic bred) and are concentrated within 100 kilometers radius around Addis Ababa. The urban and pre-urban milk production system, the third production system, includes small and larger private farms in urban and peri-urban areas, concentrated in the central highland plateaus Getachew and Gashaw (2001). This sector is commercial and mainly based on the use of grade and crossbreed animals that have the potential to produce 1120 to 2500 liters over a 279 days lactation periodStaal et al (2000).

In Ethiopia, according to Central Statistics Authority CSA(2011), cattle are the main source of milk production, although small quantities of milk are also obtained from goat and camel in pastoral areas. The total cattle population is estimated at about 53.4 million out of which 99.26 percent of the total cattle are local breeds 0.64 percent and 0.1 percent are cross and pure breeds, respectively. The total urban cattle population is estimated at about 888 thousand of which 2,354 (0.26 percent) and 9,792 (1.1 percent) are crossbreedand pure exotic breeds, respectively. Also CSA database showed that the population of milking cows is estimated at about 10.7 million and 259 thousand exist in urban areas. The total milk production of the nation is estimated to be over 4.1 billion liters and this corresponds to an average milk production of 1.857 liters per cow per day. The total milk production in urban areais estimated to be 112 million liters and this gives an average daily production per cow of 2.1 liters.

During the first half of the 20th century, dairy in Ethiopia was mostly traditional comprising small rural and peri urban farmers uses local breeds,. Modern dairying started in the early 1950s when Ethiopia received the first batch of exotic dairy cattle from United Nation Relief and Rehabilitation Administration (UNRRA). With the introduction of these cattle in the country, commercial liquid milk production started on large-scale farms in Addis Ababa and Asmara (Ketema and Tsehay, 2005). Government intervened through the introduction of high-yielding dairy cattle on the highlands in and around major urban areas. The government also established modern milk processing and marketing facilities to complement these input oriented production efforts. Most interventions during this period focused on urban-based production and marketing including the introduction of exotic dairy, concentrate feed, modern dairy infrastructure and high management level.

Milk production in Ethiopia increased significantly during 1960s. Between 1961 and 1974, milk production from all species increased by 16.6 percent from 637 thousand metric tons to 743 thousand metric tons, with an average annual growth rate of 1.63 percent. This growth was largely due to the expansion of large scale production as well as marketing, subsidies in transport to formal market, secured land tenure and active free market for feed and other input (Staal et al., 1996).

Following the 1974 revolution, the government shifted attention from urban producer to rural producers. Despite the shift in policy, substantial resources were devoted to establishing large-scale state farms to provide milk for urban consumers. This phase was characterized by intensive effort by the government and donors towards developing the dairy sector through producers' cooperatives. The entire program was intended to bring about improvement in milk production and income through introduction of improved feeding, breeding and health development programs while less attention was given to marketing and processing(M.M. Ahmed, 2003)

As a result of these promotional efforts, total milk production increased significantly with the exception of mid 1980s when the country experienced a debilitating three-year drought. Despite the significant increase in aggregate milk production, per capita milk production had declined. To bridge the gap between supply and demand, dairy imports increased significantly since 1978. Also import dependency rose steadily following the 1974 revolution. For instance, dairy imports

as a percent of total consumption increased from 4.15percent to 12.85percent between 1977 and 1989. Commercial import grew rapidly by 24.18 percent per year (Getachew and Gashaw, 2001).

The prevailing demand for dairy product in the country is expected to induce rapid growth in the dairy sector. Factors that contribute to this excess demand include rapid population growth, increased urbanization and expected growth in income. With shift towards market economy and liberalization policies, private entrepreneurs are expected to respond to the increased demand through investment in dairy and milk processingAhmed(2003).

2.3. Urban Dairy Production System in Ethiopia

There is a large difference in population growth rates between rural and urban areas and among though developed and developing regions. More than 55 percent of the world's population lives in cities of more than one million people by 2025. These demographic changes have significant implication in developing countries where growth is most rapid. The urban per capita demand for dairy product is higher than in rural areas. Predictions of future demand for livestock are staggering. It was estimated that between1990 to 2010 the demand for dairy products would increase by 70percent, respectively. These increases demand and present a challenge for the dairy industry in developing countries because the demand is anticipated to be greater than the production Kitalyi and Minde(2003).

According to Alemu et al(2000), urban and peri-urban are among the three intensive production systems based on market orientation, scale and production intensity. Market oriented urban and peri-urban dairy production systems are emerging as important components of milk production system in Ethiopia. These systems are contributing greatly towards filling in the large demand-supply gap of milk and milk products in urban centers, where consumption of milk and milk products is remarkably high. The total milk production from these dairy farms amount to 34.5 million liters per annum of which 73 percent is sold 10 percent left for house consumption, 9.4 percent goes to calves and 7.6 percent is processed mainly into butter and ayib(Tegegne & Gebre-Wold, 1998).

Tsehay (2001), categorized urban and peri-urban as one milk production system based on location. As she indicated both urban and peri-urban dairy farming were located in or near Addis Ababa and regional towns in Ethiopia take the advantages of the urban markets. Those identified

urban milk system near and Addis Ababa and regional towns consists of 5,167 small, medium and large dairy farms producing about 35 million liters of milk annually. In terms of marketing, 71 percent of the producers' milk is directly sold to consumers. Similarly, peri-urban milk system includes smallholder and commercial dairy farmers in the proximity of Addis Ababa and other regional towns. The sector consists most of the country's improved dairy stock. Those Dairy farms found in Addis Ababa are specialized and intensive production units based on zero-grazing of cross and high grade cows. There was little or no grazing within the city and stall-feeding is based on purchased hay and concentrates Tegegne, Tadesse(2013).

2.4 Economic efficiency

In microeconomic theory of the firm, Economic efficiency is divided into Technical efficiency and Allocative efficiency. A producer is said to be technically efficient if production occurs on the boundary of the producer's production possibilities set. That means TE is the extent to which the maximum possible output is achieved from a given combination of inputs. On another note, a producer is said to be allocatively efficient if production occurs in a region of the production possibilities set that satisfies the producer's behavioral objective Ellis(1988); Snyder & Nicholson, (2008). Farrell(1957)distinguished between technical and Allocative efficiency in production through the use of a frontier production function.TE is the ability of a firm to produce a given output using the smallest set of inputs. It is attained when the best available technology is used to produce maximum output possible. AEis the ability of the firm to allocate an input bundle or produce a given level of output in the cost minimizing way. EE is the product of TEand AE. There is not much difference between economic efficiency and production efficiency as they both use the same measure; however, production efficiency is treated as economic efficiency in some studies, such as the one by (Mugambi, 2014)

2.4.1 Technical efficiency

Technical efficiencyis the farms achieved when a high level of output is realized given a minimum level of inputs. It is therefore concerned with the efficiency of the input to output transformation. In Accordance with (Battese, 1992), a production function isdescribed in terms of maximum output that can be produced from a specified set of inputs, given the existing technology available to the farm(Farrell, 1957), technical efficiency can be measured by considering two way: the input-oriented strategy , in which we attempt to determine the extent to which a number of inputs can

be proportionally reduced without changing the volume of output generated. The output-oriented strategy aims to determine how much output may be raised proportionally without changing the number of inputs used.

2.4.2.Allocative efficiency

Allocative efficiency (AE) is the ability of the firm to allocate an input bundle orproduce a given level of output in the cost minimizing way(Chukwuji et al., 2006). It can also be defined as the ratio between total costs of producing a unit of output using actual factor proportions in a technically efficient way, and total costs of producing a unit of output using optimal factor proportions in a technically efficient way. Thus for the farm to maximize profit, under perfectly competitive markets, it is required that the extra revenue (Marginal Value Product) generated from the employment of an extra unit of a resource must be equal to its unit cost (Marginal Cost = unit price of input) (Chukwuji et al., 2006). Technical and Allocative efficiency were distinguished by(Farrell, 1957) as measures of production efficiency.

2.5. Methods of efficiency measurements

Efficiency measurement has been the concern of researchers with an aim to investigate the efficiency levels of farmers engaged in agricultural activities. Based on Farrell's (1957) pioneering article, several approaches to efficiency measurement have been developed. Among these, Stochastic Frontier analysis (SFA) models and Data Envelopment Analysis (DEA) models have proved an extremely useful tool in measurement of the economic efficiency of production units. The stochastic frontier approach was initiated by Aigner et al., (1977) and Van Der Broek (1980), while DEA approach was proposed by Charnes et al., (1978). Many authors in economic literature have dealt with the two approaches

Parametric method is the Stochastic Frontier Analysis (SFA) that gives efficiency estimates/scores of individual producers. it treats deviations from best-practice as comprising both random errors (it separates random noise from efficiency) (Coelli, 1995)and grants room for single step estimation of inefficiency effects(KUMBHAKAR, 2003).This method uses data to econometrically estimate the parameters of a hypothesized function using a set of Decision Making Units (DMUs). Generally, it is assumed that producers aim to maximize profits or outputs and minimize costs or inefficiency; however, this is not normally achieved due to random statistical noise, such as rain failure. Due to differences in resource endowment, skills or

knowledge, some farmers tend to be more efficient than others in production; therefore, SFA can be used to model these deviations.

Data Envelopment Analysis (DEA) is an example of the non-parametric approach that compares every producer with the seemingly most efficient producer, that is, it is based on comparative analysis of the examined producers to their counterparts(Greene, 2007).DEA involves the use of a linear programming method to construct a non-parametric 'piecewise' surface (or frontier) over the data.

2.6 Determinants of efficiency

The factors that influence the efficiency of the farms these determinants can be categorized broadly into; farm and farmer characteristics, cost of inputs, economic factors and institutional factors.

2.6.1 Farm and farmer characteristics

Farm features include: Farm size, farm distance to market, herd size, and farm characteristics include age, education, household size, farming experience, and off-farm income.

Because milk is highly perishable, distance to markets influences a farmer's decision to engage in dairy farming. Farmers are more likely to keep dairy cows when the pickup location of the buying company is closer to the farm. This distance also affects the farmer's transportation costs. The more farmers engage in dairy farming, the lower the transportation costs.

Herd size also determines a farmer's efficiency. For example, with the introduction of most technologies such as electric milking machines, large herds are easier to manage and more efficient in terms of workload. Education level and age of the head of household, combined with agricultural experience, are of paramount importance in farmers' decisions on issues such as the use of new technologies and the use of available inputs. Older farmers tend to be reluctant to use new technologies in milk production and are therefore considered inefficient (Omiti et al., 2006). The same finding were reported by Tiongco(2003).Farmers with more years of formal education know how to operate their farms and tend to be more efficient because they reduce risk and uncertainty Omiti et al (2006).

In dairy farming activities, human physical energy is a necessity. The individuals living in the household are a source of this physical energy. The number of individuals determines the available family labour for dairy farming and their involvement determines the level of output.

However, depending on the number of individuals, the pressure to cater for their daily needs such as food and clothing adds strain to the capital or income that could have otherwise been ploughedinto dairy farming. Engaging in off-farm activities to earn income causes detraction from specialization in dairy farming (Mishra and Morehart, 2001).

Off-farm income by the farmer influenced the decision of the small-scale farmers on whether to increase and improve the dairy milk production. Therefore, off-farm income has an influence on efficiency.

2.6.2 Cost of inputs

The efficiency of milk production is affected by input costs. A study by(Omiti et al., 2006)showed that the amount of concentrate required to produce one liter of milk, combined with high feed prices, adversely affected the profitability and efficiency of milk production. I'm here. The price of concentrate is high compared to the price of other inputs in milk production. Given the high cost of concentrates due to the high price of raw materials and fuel, small farmers aim to minimize costs in order to maintain efficiency.

Over time, dairy farmers became overly reliant on rain-fed forage to ensure adequate fodder in adverse weather conditions. These farmers end up buying commercial feed such as hay, the price of which usually escalates. There are recommendations for some forage crops such as alfalfa and calliandra. These are required by animals in small amounts and have the effect of increasing milk production. However, according to Kiama and Nderitu (2009), farmers' knowledge of these alternative crops is limited.

Another high cost for farmers is veterinary services. Animal health is very important for milk production. Diseases such as mastitis and foot-and-mouth disease lead to a reduction in the milk production of cows. As much as farmers want to control disease, the costs of veterinary medicines, services and vaccines are high and most farmers are unfamiliar with the application process (Wachira, 2015)at the effects of animal health costs on dairy production and found that they have a negative influence on efficiency. In the previous studies, labourhas also been seen

to influence how efficiently the farms operate. A high labour cost causes the smallscale farmers to shy away from hiring enough labour for their farms, thus the farmers end up operating inefficiently.

2.6.3 Economic factors

Economic factors include factors such as interest rates and taxes.Dairy farming requires significant investment, and as the majority of urban farmers lack the necessary resources, they must borrow money to finance their business. Also, due to concentrate prices, farmers borrow money from their dairy cooperatives in the form of concentrates. The farmers typically have to pay interest on these creditsA study by (Mugambi, 2014) identified bank interest rates in Ethiopia as major contributors to the high cost of dairy milk production. When the banks impose high-interest rates, it would inhibit credit access and influence the developments that the urban farmers would undertake to improve their efficiency.

2.6.4 Institutional factors

Access to credit and extension services enhance urban farmers' efficiency (Kavoi et al., 2010)Extension services are meant to offer urban farmers with information on new technologies and the recommended techniques of farming. Some extension services are normally linked with veterinary services such that one offering extension service can also offer the veterinary services to the farmers. The lack of extension services close to the farmers can be linked to low productivity. A study by (Al-hassan, 2012)indicated that access to extension services increased efficiency. Credit is important in matters concerning the adoption of new technologies in the dairy sector. Access to credit by a farmer increases their capacity to expand their dairy venture and purchase of the necessary concentrates as well as treatment of their cows. Therefore, it has a positive effect on efficiency.

2.7 Theoretical framework

Economic efficiencyas a measureof technical and Allocative efficiency through the use of frontier production and cost function, respectively. Farrell illustrated that Koopman (1951) and (Debreu, 1951)had not considered that production efficiency had a second component reflecting on the ability of the producers to choose the "right" technically efficient input-output vector considering the existing input and output prices. Economic efficiency is the overall performance measure. Most of the empirical studies on productivity and efficiency, such as this one, have

their analytical framework provided by the economic theory of production (Mutoko et al., 2008). Farm-level production efficiency can be measured by estimating a production frontier that includes all the input or output data available for analysis(T. Binici, 2006).Farms operating on the production frontier are said to be efficient while those operating within the frontier are said to be inefficient since the farm is producing less output given its level of inputs. (Farrell, 1957) also illustrated how the overall efficiency can be divided into technical and allocative efficiency as shown in Figure 2. 1.

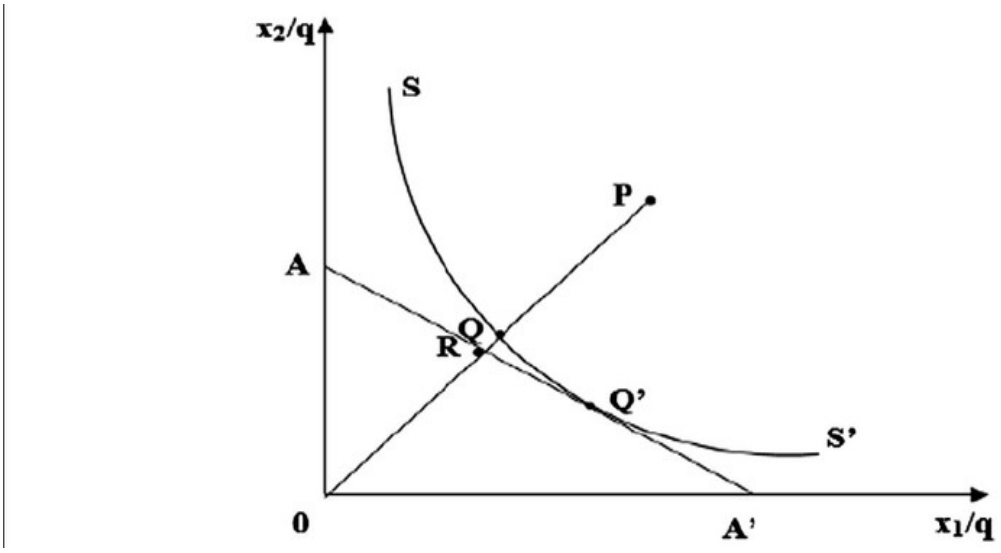

Figure 1farrell's measure of technical and alocative efficiency

Point P is technically inefficient as it is located on the interior of the production isoquant for output level S'; fewer amounts of inputs X1/q and X2/q could be used to produce the same level of output given the best practice frontier. Point Q is technically efficient as it lies on the isoquant for output Sbut it is not allocatively efficient since it is not on the isocost line A. Point Q' lies at the tangency of isocost A and isoquant S', thus it is both technically andallocatively efficient, it is the point of economic efficiency(Schmidt, 1979).

Farrell's study had concerns about the human ability to measure prices accurately enough to make good use of allocative measurement. Thus, (Charnes, 1978) noted this concern as the

reason for the advancement of the study on efficiency. They also cite (Farrell, 1957) concern as one of the motivations for operational research and management science (OR/MS) emphasis on the measurement of technical efficiency.

2.8. Empirical Studies on efficiency

2.8.1. Empirical Studies outside Ethiopia

Empirical studies carried out on milk production indicated variations in the efficiency of inputs used between the traditional (local) and modern (cross) farms as well as among different farm sizes. These studies used to identify important inputs and differentials in efficiency and productivity between farms in utilization of these inputs.

Monika et al. (2013) analyzed the technical efficiency (TE) of the milk production on 83 cattle herds in the period 2006-2010 and to synthesize the impact of main inputs (costs) on the TE value. A nonparametric approach Data Envelopment Analysis with the input-oriented variable return to scale model was used to evaluate the TE value. Average value of TE in the analyzed period was 0.96, i.e. evaluated herds reached 96% of technical efficiency in milk production on average. For these, reduction of inputs by 4% is recommended to reach the efficiency at the given level of milk yield. Value of individual inputs: total feed cost, material cost, labour cost, repair and service, depreciation, other direct costs and overhead costs, should be reduced by 3.7, 10.0, 3.3, 15.8, 2.1, 2.9 and 8.5% respectively, while maintaining the same level of output. It is possible to state that the analyzed farms are inefficient in utilization of inputs for the given level of output. The TE value was statistically significantly and influenced by the feed costs only. The negative influence of this factor indicates inefficient utilization of feeds (balance of feeding ration, losses of storage, reciprocal substitution of feeds) or inefficient utilization of its production potential in relation to the given output level.

In India Sharma and Singh (1993) used the Cobb-Douglas and semi log production functions to study the resource productivity and allocation efficiency in milk production and to assess the relationship between milk production and various factors influencing it. They assessed the effects of value of green fodder, value of dry fodder, value of concentrate, human labor cost, order of lactation, stage of lactation and miscellaneous expenditure variables in different seasons of the year and between farms with and without crossbreed. The study revealed that, concentrates were the most important factor in milk production.

Moreover, Deepak et al., (1995) employed Cobb-Douglas production function to study input-output relationship in the resource use efficiency for milk production of different breeds of cows. They studied the relationship between value of milk and explanatory variable such as stage of lactation, value of cow and expenditure on green fodder, on dry fodder, on concentrate and on labor. The study revealed that, expenditure on concentrate was the single most significant factor affecting return from milk.

Anthony et al., (2004) carried out a comparison of urban and peri-urban dairying in Hawassa. They compared Hawassa city with its peri urban areas. In the study 124 farms were covered, out of which 60 farms were from urban and 64 from peri-urban areas. The farms were stratified into small (1-3 cows), medium (4-9 cows) and large (greater than 9 cows). The result revealed that, urban producer spent on average a total of Birr 689.59 and Birr 100.67 per cow per month on feed for crossbreed and local cows, respectively. While their peri-urban counterparts spent Birr 97.06 and 15.57 for cow per month for crossbreed and local breed, respectively. The yield per lactation in the urban area was 1489.6 liters per local cow and 3949.6 liters for crossbreed cow. In the peri-urban area, per lactation yield were 444.4 liters and 2596.32 liters, respectively for local and crossbreed cows. The urban producer sold 80 percent of the total milk produced, while the peri-urban sold only 35 percent.

The study conducted by Alfawwaz & Al-sharafat(2013) to determine the level of technical efficiency of dairy producing farms in Jordan by applying the stochastic production frontier (SPF) on 100 dairy farms in Jordan and the results of the study indicated that the mean technical efficiency was estimated to be only 39.5 percent for the sampled dairy farms. The study results also implies that the dairy farms in Jordan are producing milk to only about 40 percent of the potential frontier production levels of this industry, implying that the production is about 60 percent below the frontier due to technical inefficiency.

(Florence et al., 2018)employed assessing the economic efficiencyin his M.Sc. thesis submitted to Nairobi University in Kenya to come up with profit efficiency rankings among the dairy farmers, and study used the Stochastic Frontier model to analyze the technical, allocative and economic efficiency of milk production,. The data was processed using STATA and frontier packages. The mean efficiency according to the results was 68.7%in technica efficiency. 91.3% in allocative efficiency and 62.6% in economic efficiency . The results showed that the economic

inefficiency among the farmers is mostly caused by low technical efficiency since the farmers indicated high levels of allocative efficiency.

2.8.2. Empirical Studies of Efficiency Analysis in Ethiopia.

The study conducted by Fita et al (2013) on two hundred forty dairy farms in Ada'a district of Oromia regional state in Ethiopia using cross sectional data and applying stochastic frontier production function of the Cobb-Douglas model to estimate the technical efficiency of milk production. The maximum likelihood estimates (MLE) of the Cobb- Douglas stochastic frontier production for peri-urban and urban production sub-systems are depicted that , green fodder, dry fodder, concentrate feed had positive and highly significant in determining the productivity of dairy production. The study result also depicted that the mean technical efficiencies of milk production of the peri-urban and urban dairy farmers were found to be about 67.47 and 63.06 percent, respectively. The overall mean technical efficiency of milk production of the dairy farmers in the study area was about 65 percent, and this shows low technical efficiency of the study area.

Beshir et al(2012)analyzed the efficiency of crop-livestock production and assessing their potential for improvement in North-East Ethiopian highlands and used cross-sectional data to analyze the economic efficiency of mixed crop and livestock production system and identify its determinants factors from 252 farmers. Apply parametric method stochastic frontier approach to measure economic efficiency and the efficiency measurement indicated that most farmers in the study area were not efficient and the mean Technical Efficiency (TE was 62 percent, Allocative Efficiency (AE) 51 percent and Economic Efficiency (EE) 29 percent. The study also identified determinants of the technical efficiency of mixed crop-livestock farming where farm size, livestock ownership, labor availability, non-farm income participation, total household asset, total household consumption expenditure and improved technology adoption.

Jema, (2007) studied the determinants of efficiency of vegetable dominated mixed farming system in two districts of eastern Ethiopia. He employed the non- parametric DEA to calculate technical, Allocative, and economic efficiencies of vegetable dominated mixed crop farmers and he used Tobit regressions to identify factors that explained efficiency differentials among farmers. He found out that asset, off/non-farm income, farm size, extension visits, and family size were the significant determinants of technical efficiency, whereas asset, crop diversification,

consumption expenditure and farm size had significant impact on Allocative and economic efficiency.

A study made byDayanandan(2011) in town of Mekele: northern Ethiopia, among 168 dairy farms (85 crossbreed and 83 local breed) to evaluate the efficiency of inputs use, assess profitability and analyze the efficiency differentials of modern (crossbreed) and traditional (local breed) dairy farms and applies Cobb-Douglas production, cost-benefit and break-even ratios are employed to assess resource use efficiency, profitability and financial efficiency of both cross and local breed dairy farms and the result depicted that concentrate for medium and small size crossbreed farms are positive and significant. Also dry fodder for medium size crossbreed and local breed are significant.

2.9 Conceptual framework

Figure 2.shows the interaction between various factors that were considered to have a various degree and direction of effect on the level of EE of dairy milk production. Efficiency of production was determined by the multitude of socio-economic,infrastructural and institutional factors (Jema, 2008). These factors directly/indirectly affect the quality of management of the farm's operator and, therefore, are believed to have effect on the level of TE, AE and EE of farms. According to Bakhsh (2007), a range of factors like farm and farmers' characteristics, cost of inputs, and institutional factors.

Some of these parameters can be controlled personally by the farmer, such as education level, size of the household, years of farming experience and the income earned off-farm, while other parameters are beyond farmers' control, such as the cost of inputs and institutional factors, for example, access to credit and extension.

The institutional factors such as access to credit influences the ability of the farmers to purchase inputs for dairy farming while access to market motivates the farmers' decision to venture into dairy farming, as there is a reliable market for their milk. Before making a decision to undertake dairy farming, a farmer will have to consider the cost of inputs to assess the profitability of the enterprise. A farmer's decision to invest in dairy farming is also influenced by various farm and farmer characteristics. For instance, the farm size will determine the herd size one can keep while farming experience and level of education will enable the farmer to make a more informed decision concerning dairy farming.

The decisions made will then determine whether the farmer is getting the maximum expected amounts of milk per cow while incurring the minimum cost of production. It is, therefore, the relationships between all these factors that are responsible for which point the farmer produces on the production possibility frontier, be it within the frontier, in which case the farmers' milk production is efficient, or below the frontier, in which case the farmers' milk production is inefficient. Achieving both the allocative and technical efficiency is dependent on the decisions made and they, in turn, influence the economic efficiency of the farm. According toTiongco, (2003), farmers' attainment of economic efficiency, that is, technical and allocative efficiency, is highly dependent on the decisions they make. .

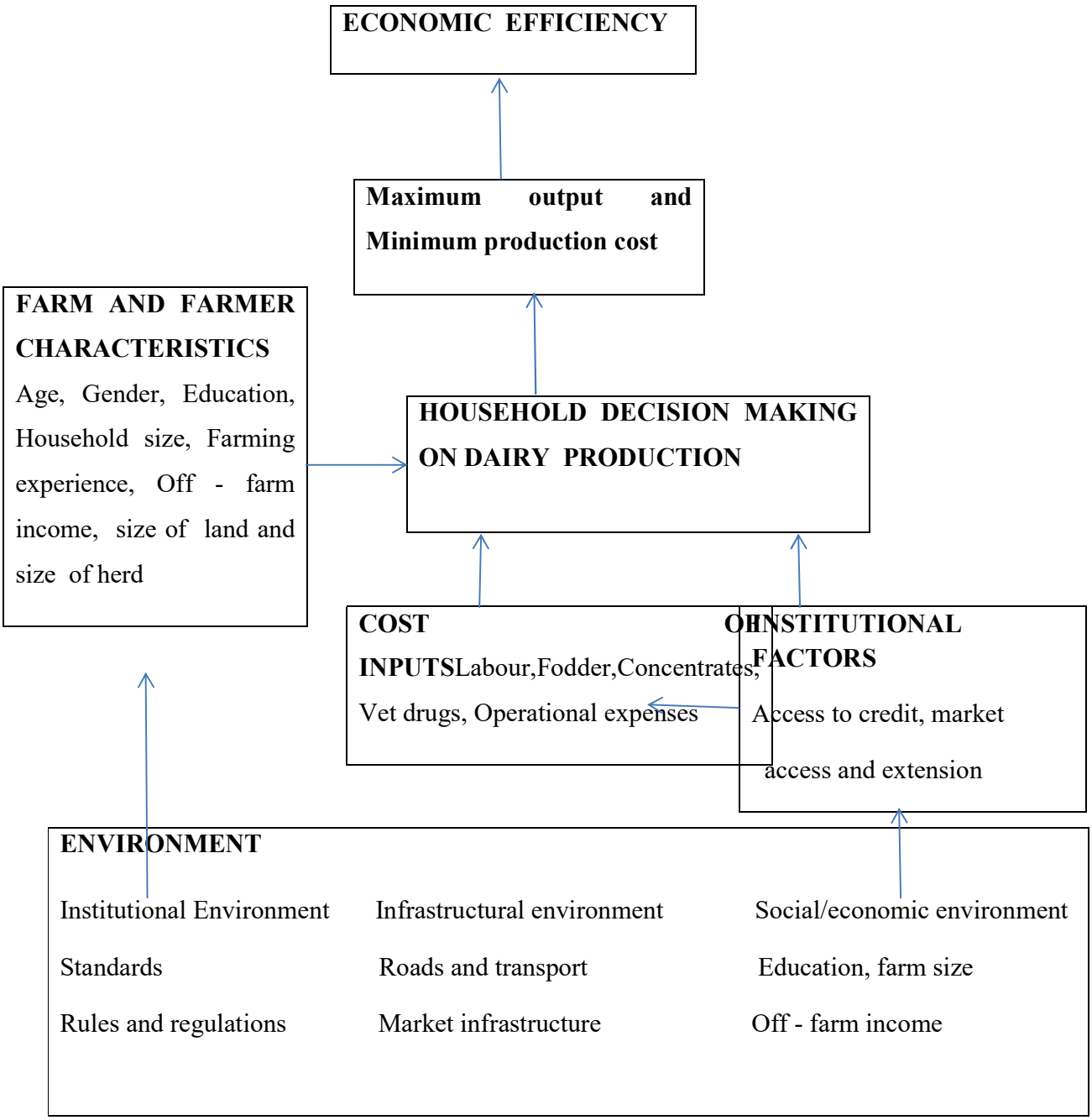

Figure 2: conceptual framework showing links between factors influencing dairy production decisions and economic efficiency

CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1. Description of the Study Area

The study area was wolisotown; woliso is the administrative center of southwest shewa zone of the Oromia region in Ethiopia.The geographic location of the city is latitude and longitude of 8 32′37 58′E with an elevation of 2063 meter above sea level. Woliso town has seven administrative kebeles. Ambo university-faculty of social science(waliso campus)and other private institutions and colleges are located in woliso; there is a natural hot-spring, which makes the town one of the leading tourism heritages in Ethiopia.

According toCSA(2007)the national census reported a totalpopulationforwoliso is 59,685 whom 27,873 were men and 31,812 were women

The rainfall of the towns recorded as a mean monthly rainfall of 44.9mm and mean annual rainfall of 267.9 mm. The mean annual daily temperature of the town is 20 degree centigrade. The coldest months are November, December and January.

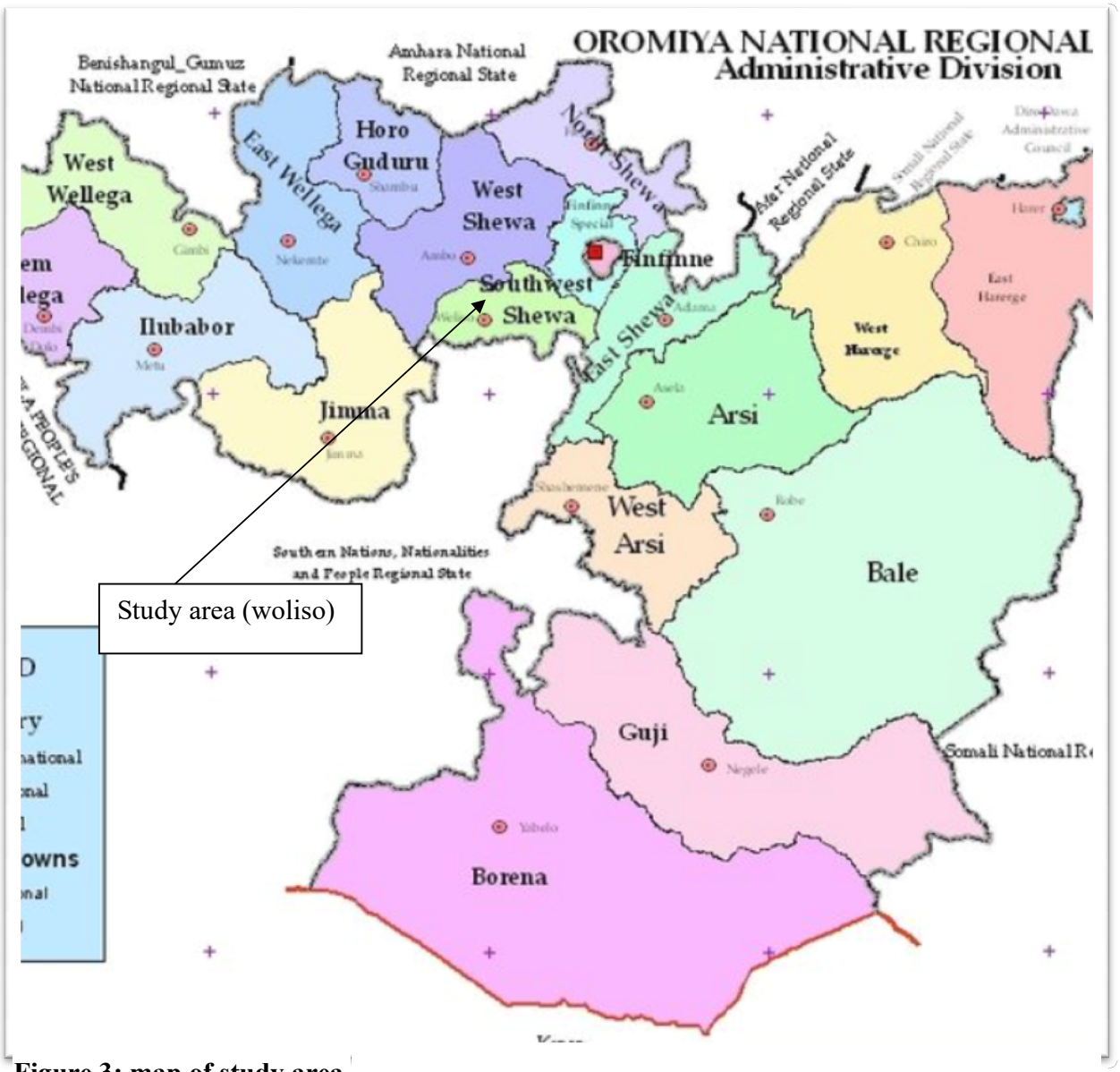

Figure 3: map of study area

Urban Agriculture, especially dairy farming is practiced to a considerable extent in the wolisotown. The livestock data get from the town Bureau of Agriculture revealed that 542 registered households own dairy farms in the city agriculture bureau. The dairy farms are engaged primarily in milk production as a source of income

3.2. Sampling Technique

Two stage stratified random sampling procedure was used to select the dairy farms. Prior to sampling, all the dairy farms in the city was taken including breed types (local and cross) and herd

sizes from the town agriculture bureau. For the purpose of study the dairy farms will categorized into small, medium and large based on the herd size. The dairy farms categories and herd size of the farm used by Tsegay, (2010), farms owning 1-3, 4-10 and greater than 10 dairy cows were classified as small, medium and large farms, respectively. Therefore, small, medium and large size farms areconsidered for further data collection. According to the town agriculture bureau report of 2014, there are about 542 dairy farms in the urban areas of woliso. From the total 542 dairy farms in the selected area, based on (yamane, 1967) 184 dairy farms were considered for the study.

This study were apply a simplified formula provided by Yamane (1967) to determine the required sample size at 95% confidence level, degree of variability=0.5 and level of precision= 6% (0.06)

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

$$n=\frac{542}{1+542(0.06)2}=184$$

Where n is the sample size, N stands for total population, e designate maximum variability or margin of error=0.06 was taken as margin error.

3.3. Data sources and data collection method

Both primary and secondary data was used for the study. The survey tool waspre-test and appropriate adjustment wasmade. The structured questionnaire designed to obtain information from respondents regarding socio-economic characteristics(age, education status, mass media exposure, extension contacts, organizational participation of the farmers, and training on dairy farming and experience on dairy farming)in the study area. From 542 farmers who dairy milk producers, about 184 sample households were selected randomly using stratified random sampling a simplified formula provided by (Yamane, 1967).

The secondary data that pertain to published and unpublished information about the study area were also collected from different sources.

3.4 Data analysis

In the study to summarize the primary data simple analytical tools like tables and percentages were used to describe households and farms characteristics. In addition, data on quantities of inputs, used in milk production, amount of milk produced. Stochastic frontier analysis was used to estimate the technical and allocative efficiency scores, as well as come up with estimates for

the factors influencing the technical and Allocative efficiency. Two-limit Tobit model so as to identify the factors that significantly influenced technical, allocative and economic efficiency using STATA.

3.5Model specification

The stochastic production frontier (SPF) model was composed by (Aigner & Schmidt, 1977)and (Broeck, 1977). It has been made popular by studies of (Bravo-Ureta, 1991) Sharma et al. (1999), Binam et al. (2004) and Taylor et al. (1986) who used it to analyze production efficiency. The stochastic frontier production function can be expressed as

$Y = (x)$ (1)

Where Y represents the farms' output and X represents the vector inputs used in the production. Stochastic productionfrontier for observation is written as:
Where:

$Yi = (Xi; \beta) + \varepsilon i$ (2)

Where Yi is output obtained by farmer i, Xi is vector of input for farmer i, β is vector of parameter to be estimated, ϵi is error term for farmer i. The essential idea behind the stochastic frontier model is that the error term is composed of two components.

$\varepsilon i = vi + ui$ (3)

$vi$is the ordinary two-sided error term assumed to have a mean of zero, constant variance, and to be normally identical and independently distributed. It takes into consideration the mysterious and uncontrollable factors outside the farmers' control. ui is a one-sided error term and is an efficiency term that accounts for the shortfall from the stochastic frontier. $ui \geq 0$, and if $ui > 0$, thefarm is below the frontier but if $ui = 0$, the farm is on the frontier. Normally, $ui$is said to have a half-normal error term and to be non-negative.

In order to analyze the economic efficiency, that is, technical and Allocative efficiencies, a Cobb-Douglas production function that has been used widely in similar studies such as economic efficiency of the smallholder farmer in Swaziland by (Masuku et al., 2014) and in Peshawar district by (Sajjad & Khan, 2010) was used instead of a transcendental logarithmic (translog)

function. The reason for selecting either Cobb-Douglas function or translog function should be guided by the research objective, should be theoretically consistent and suitable for a given field.

The stochastic frontier production function model of Cobb-Douglas functional form wasemploy to estimate technical and Allocative efficiencies of the farmers in the study areas the functional form is widely used in farm efficiency for the developing and developed countries. It meets the requirement of being self-dual, allowing an examination of economic efficiency and lastly Kopp and Smith (1980) suggested that functional form has limited effects on empirical efficiency measurement. Also Cobb-Douglas function has disadvantages as its place restrictionson the relationships between inputs which may not be realistic. For example its assumes an elasticity of substitution between any two inputs in one.

The Cobb-Douglas production functional form which specifies the production technology of the farmers is expressed asfollows:

$Yi = (Xi; \beta) \exp Vi - Ui$ (4)

Where:

Yi = Daily milk production in litres;

Xi = Quantity of inputs required in milk production; and

β = Vector of the unknown parameter to be estimated.

vi is the random variable that is assumed to be independent and identically distributed (iid), normally distributed N (0, $\sigma v2$), and independent of ui. ui is the non-negative random variable assumed to account for technical inefficiency effects in production, taken to be independent and identically distributed (iid) and normally distributed N (0, $\sigma u2$).

3.5.1 Technical efficiency

To measure the technical efficiency, the Cobb-Douglas production function was used. Since the Cobb-Douglas production Equation 4 is non-linear, natural logs was taken to make the equation linear (linearization).

The Cobb-Douglas Equation 4 is linearized as follows:

$lnYi = ln\beta 0 + \beta 1 lnX1i + \beta 2 lnX2i + \beta 3 lnX3i + \beta 4 lnX4i + Vi - ui$ (5)

Where:

Y= Total milk production in litres;

β =Vector of the unknown parameter to be estimated

$X1$= Herd size (number);

$X2$= Fodder in Kgs;

$X3$= Concentrates in Kgs;

$X4$= Animal health expenditure and

viandui= Error terms.

The technical efficiency of individual farmers is defined in terms of the ratio of observed output to thecorresponding frontiers output, conditional on the level of input used by the farmers. Hence the technical efficiency of thefarmer is expressed as

$TEi = Yi/Yi* = (Xi; \beta) \exp Vi - Ui/(Xi; \beta) \exp Vi = \exp(-Ui)$ (6)

Where, Yi is the observed output, and $Yi*$is the frontier/expected output. TEi should lie between 0 and 1. If Ui=0 then the farm is 100% efficient but if Ui> 0 the farm is operating inefficiently

3.5.2 Allocative efficiency

The corresponding cost frontier of Cobb- Douglas functional form which is the basis of estimating theAllocative efficiencies of the farmers is specified as follows

$Ci = g(Pi; \alpha) \exp(Vi + Ui)$ (7)

where: Ci werethe cost of all inputs, $g$is a suitable function a Cobb-Douglas function, Pi is prices of inputs used in production, α is the parameter to be estimated, and Vi and $Ui$was random errors taken to be independent and identically distributed (iid) and normally distributed N (0, $\sigma v2$). Ui showed the level of Allocative efficiency of a farm.

The Cobb-Douglas Equation 7 waslineralized as follows:

$\ln C = \alpha 0 + \alpha 1 lnP1 + \alpha 2 lnP2 + \alpha 3 lnP3 + \alpha 4 lnP4 + Vi + Ui$ (8)

Where: C=Total cost of milk production;

α =Vector of the unknown parameter to be estimated

$P1$ = Cost of fodder;

$P2$ = Cost of concentrates;

$P3$ = Cost of animal health;

$P4$ =other operating expenses; and

viandui= Error terms.

The Allocative efficiency (AE) wastaken to be the ratio of expected minimum cost of production to the observed/actual cost of production, as is shown in Equation 8. The AEi should lie between 0 and 1.

$AEi = Ci*/Ci = \exp(Ui)$ (9)

Maximum likelihood was used to simultaneously estimate the unknown parameters of the stochastic production limit and the Cobb-Douglas cost. The probability function is expressed by the parameters variance and sigma square (total variance); $\delta 2 = \delta v2 + \delta u2$ where $\delta v2$ is the variance of ν error and $\delta u2$ is the variance of the error u, giving the combined effect of all other factors not included in the assessment of milk production efficiency. The gamma variance (γ) of the ratio gave the fraction of the total milk production variability from the border that was explained by allocation or technical inefficiencies$\gamma = \delta u2/\delta 2$ (Greene, 2007). γ must be between zero and one, where zero means that the deviation from production efficiency is due to noise alone and one indicates that the deviation is due to the farmer's production inefficiency(Battese, 1992).

Technical and Allocative inefficiency effects defined by;

$\mu i = \delta 0 + \delta 1X1i + \delta 2X2i + \delta 3X3i$ (10)

Where: μi = inefficiency score for farmer i;

δ = Vector of the unknown parameter to be estimated

$X1$= Age (Years);

$X2$= Education level of farmer (Years of formal education); and

$X3$= Household family size (Number of members).

These variables wereincluding in the model twoshows their potential impact on farmer efficiency. The maximum likelihood method (MLE) was used to estimate Equations 5 and 8.Each of these two equations was individually correlated with Equation 10 during the STATA estimation. Economic efficiency is assumed to be the product of technical efficiency and Allocative efficiency ($EE = TE \times AE$).

3.5.3 Assessing determinants of economic efficiency

The Tobit regression model was used to estimate factors affecting EE. The Tobit model was used because the efficiency values fall in a double-bounded range from 0 to 1. The coefficients in the Tobit regression model do not directly represent the marginal effect of their independent variable on the dependent variable. But their signs show the direction of change of the dependent variable when the corresponding explanatory variables change;Morgan ,Mutoko, (2008)
The estimating equation is as follows:

$\mu i = \delta 0 + \delta 1 X1i + \delta 2 X2i + \delta 3 X3i + \delta 4 X4i + \delta 5 X5i + \delta 6 X6i + \delta 7 X7i + \delta 8 X8i + v9 X9i + \delta 10 X10i$ (11)

Where: μi = level of EE for farmer i;

X_i is a vector of explanatory variables that include

$X1$= Age (Years);

$X2$= Education level of farmer (Years of formal education);

$X3$= Household family size (Number);

$X4$=distance travelled to the market (in kilometres),

$X5$= Dummy variable for dairy farming as main source of income (1=Yes; 0= No);

$X6$= Dummy variable for cost of labour (1=Hired labour; 0= Did not hire);

$X7$= Cost of fodder (Monthly in birr)

$X8$= Cost of concentrates (Monthly in birr);

$X9$= Dummy variable for credit (1=Acquired credit; 0= Did not acquire); and

$X10$=Dummy variable for membership to a group (1=Yes; 0= No).

The technical, Allocative and economic efficiency scores were each regressed against the set of explanatory variables to identify which variables influenced them at three different levels of significance, that is, 1%, 5% and 10%.

3.6 Expected signs of variables estimating farmers' economic efficiency

The expected signs of the variables used to estimate the farmers' economic efficiency are shown in table 1. The age of the household head was taken into account in the study because it was assumed that he or she is in charge of making household farming decisions. A positive relationship between the age of the household head and economic efficiency was hypothesized, with older farmers being more efficient because they are more likely to make reasonable and sound decisions regarding the dairy enterprise.

Education is important in agricultural production because it can instill knowledge and skills in people that they can use while farming. Farmers who are more educated are less skeptical of new technology adoption. As a result, education was expected to have a positive impact

.

Dairy farming can be labor intensive, thus the higher the number of people in the household, the more the labour is available for dairy farming activities, which will determine the output. However, large numbers of people in the household also mean that more capital is required to run the household activities, such as feeding and schooling of children, hence less capital will beallocated to dairy farming. Household size was therefore hypothesized to have both positive and negative influence on economic efficiency.

Farmers' expenses and time management are influenced by their distance from the milk selling market. The farmer who lives further away from the market may incur transportation costs and become exhausted. The additional cost of transportation reduces a farmer's Allocative efficiency, which in turn reduces yield. A farmer living close to the market saves time as they deliver their

milk on time and go back to cater for their other dairy farming activities. Therefore, distance of the marketwas hypothesized to have a negative influence on the economic efficiency

Dairy farmers devote all of their time and effort to dairy production because it is their primary source of income. Their productivity has increased as a result of their undivided attention to their dairy production activities. While those with off-farm income as their primary source of income choose to focus on the activity that provides them with off-farm income, they will overlook dairy farming. It was thus hypothesized that having dairy farming as the primary source of income would improve economic efficiency.

If the cost of feeds, whether green/dry fodder or concentrates, is high, the farmers were purchase fewer feeds, and the cows will end up under-fed, lowering productivity. The high costs of fodder and concentrates also constitute the highest portion of the total variable costs in dairy farming, thus lowering farmers' Allocative efficiency. Therefore, it was expected that both costs of fodder and concentrates would have a negative effect on the economic efficiency of milk production.

The access to credit can increase their ability and chance of adopting new technology practices in dairy farming, as well as provide capital for the acquisition of fodder and concentrates. The credit can be in the form of money, fodder, concentrates or even heifers. By adopting better new technologies, farmers improve their efficiency and by purchasing enough fodder and concentrates, they increase their productivity. Access to credit was thus expected to positively affect the economic efficiency.

Farmers normally belong to a dairy association that deals with milk production and marketing. By so doing, the farmers in such association tends to have more information concerning dairy farming since the associations normally organize learning seminars and workshops for their members. These associations, as well as other self-help groups, provide support to their members through lending finances, table banking or providing inputs on credit. Being a member of a group or a farmers' association was hypothesized to positively influence the economic efficiency of farmers**.**

Table 1: expected signs of variabels estimating farmers economic efficiency variable

Variable	Description of variable	Unit of measurement	Expected sign
Age	Age of household head	Years	+
Education level	Number of years of formal education	Years	+
Household size	Number of household members	Number	+/-
Distance of market	Distance to milk Sells market	Kilometers	-
Main source of income	Dairy farming is the main source of income	1=Yes 0=No	+
Labor	Utilization of labor	1=Hired 0= Did not hire	+/-
Fodder	Cost of fodder per month	Birr	-
Concentrates	Cost of concentrates per month	Birr	-
Credit	Acquired credit for dairy farming in last one year	1=Acquired 0=Did not acquire	+
Group membership	Has membership to any group	1=Yes 0=No	+

3.7. Model diagnostic tests

Heteroskedasticity

This is a situation whereby the variance of the error term is not constant. That is, there is a violation of the OLS assumption BLUE (Best Linear Unbiased Estimator). The explanatory variables used in the model will tested for any heteroskedastic disturbances using the BreuschPagan test.

Multicollinearity

Tests for the existence of Multicollinearity between explanatory variables made using Variance inflation factor (VIF) for continuous variables and pair wise correlation test method for dummy and categorical variables. According to Greene (2000), this problem leads to large standard errors and low significant levels for coefficients of one or both of the collinear variables, resulting in a misleading conclusion. This study will be used to analysis of correlation matrix to check for multicollinearity.

CHAPTER FOUR

4. RESULT AND DISCUSSION

This chapter of the thesis presents the results comprising descriptive statistics and stochastic frontier analysis.

4.1. Socioeconomic Characteristics of Dairy Farmers

Age of dairy farmers ranged from 26 to 65 years while the mean age of farmers was 39.81 years. The mean age of dairy farmers implies that most of farmers are at the latter stage of their labor force. For example 12.84 percent farmers were involved in dairy farming during their retirement age. Dairy farmers divided into two categories, women owned dairy farms were 33.7 percent and male owned dairy farms were 66.3 percent.

Most of dairy farmers (98 percent) can read and write. The mean years of education for dairy farmers were 3 years that means a mean of secondary education (Table 2). Also based on categorical observation of educational level of the farmers about 10 percent below primary, 21 percent attend primary education, 32 percent aresecondary education and 36 percent are attend higher education. In general 90 percent of farmers were attending regular schooling. Therefore as the study was in urban area most of the farmers attend formal education these would be best opportunity for intervention.

Regarding family size on average each farm had 4.43 family members and family size ranging from smallest family size of 1 to maximum of 11. The mean family size distribution among farm categories was small farm 4.10, medium 4.58 and large farm 5.5 this shows mean size was similar and these will be an indication for family size will not be major factor for productivity among farm categories maybe t its quality will mater.

Table 2 Socioeconomic characteristics of dairy farmers

Variable	Obs	Mean	Std. Dev.	Min	Max
Age	184	39.84783	8.41276	26	65
Education	184	2.88587	1.009797	0	4
Family size	184	4.434783	1.713363	1	11
Experience	184	6.972826	4.079044	1	26
Numberofda~	184	4.288043	2.395047	1	14
Employedla~r	184	1.673913	.4700586	1	2
Memberof gr~p	184	1.875	.3316213	1	2
Accesstocr~t	184	1.798913	.4019065	1	2
Yourmainso~e	184	1.288043	.4540871	1	2

Table 2 shows that the majority (67.39%) of the urban farmers relied on family labour for their dairy farming activities rather than hired labour (32.61%). These finding tallies the households depended on family labour for their dairy production activities.

The majority (79.89%) of the sampled farmers had no access to credit, and this can be attributed to the fact that most of the dairy farmers in woliso are not members of the Dairy Cooperative that offers credit services to the farmers. In this case, the credit was in the form of cash, commercial feeds, heifers or artificial insemination services. The results indicated that 71.20% of the farmers relied on dairy farming as their main source of income, while 28.80% relied on other main sources, such as formal employment, casual employment or businesses.

4.1.1 Summary statistics of variables used in the production and cost function

Summary statistics of variables used in the production and cost function of the frontier analysis are presented in Table 3. The mean daily milk production per cow was found to be 13.89litres with a standard deviation of 3.96 liters. A study by Sajjad and Khan (2010) also found a high standard deviation in mean monthly milk production. The mean herd size in terms of the dairy animals of the farmers was found to be 4.29 cows, with a standard deviation of 2.40 cows. A study by Mgomezulu (2002) corroborates these results, as he found that the smallscale farmers own between two and three cows.

The daily average amount of fodder fed to the individual animal was 8.93kgs with a standard deviation of 3.43kg. A study by Tolossa (2018) found that the weekly average fodder fed to each cow was 40.63kg. This finding by Tolossa (2018) is similar to the results of this study as the daily average fodder fed. The average dailycost of fodder was Birr.216.64with a standard deviation of birr.73.56. The farmers in the area of study relied primarily bought hay from both individual farmer and trader fodder for their cows. The mean concentrate per animal was 5.48kg with a standard deviation of 2.00kg. The maximum amount of concentrates per cow in a dairy was 9kg while the minimum was 2 kg. The large variability may be because some of the farmers had inadequate capital to purchase concentrates whose prices tended to be high thus they provided small quantities. Some farmers tended to feed their lactating cows with a flat rate of 2kg per day throughout the lactating period instead of varying the concentrate amounts with the milk production level and lactating period. Mean of the concentrate cost was found to be birr.108.62 with a standard deviation of birr .55.91.

Table 3: summary statistics of variables used in the production and cost function

Variable	Obs	Mean	Std. Dev.	Min	Max
milkoutput	184	13.88587	3.959221	4	22
Numberofda~e	184	4.288043	2.395047	1	14
Fooder	184	8.926141	3.430432	3	16
concentrates	184	5.475543	1.967829	2	9
animalhealthco	184	8.327898	3.900162	3.333333	20
costoffodder	184	216.6416	73.56948	80	448
costofconc~s	184	108.6196	55.91347	12	270
operatinge~s	184	34.17572	13.68169	10	66.66666

The cost of the concentrates was the second highest cost that the farmers incurred, after the cost of fodder.

The daily animal health cost per cow had a mean of 8.9. The health cost constituted expenses such as deworming, artificial insemination, vaccination and treatment of any disease. Most of the farmers' cow health cost was on vaccination, deworming and artificial insemination. The mean for other dairy operating expenses was found to be birr 34.18. These expenses included repair and maintenance of the sheds, the building of sheds, purchase of a chaff cutter, silage construction, and purchase of milking equipment.

4.2. Estimation of production and cost function

The maximum likelihood estimates of the Cobb-Douglas Stochastic Frontier Analysis (SFA) for milk production in the study area are presented in Table 4. All input variables are measured in logarithmic form; output elasticities are represented by the estimated coefficients. As can be seen in table 4, all of the estimated parameters associated with inputs like heard size, fodder, concentrate feed indicate positive signs and animal health cost have negative sign. Coefficients of heard size, fodder and concentrate are highly significant at the 1 percent of significance level. The coefficient of animal health cost was the only statistically insignificant variable. The estimated coefficients of all significant parameters of production function are positive meaning that total milk production increases by the value each of coefficient as the quantity of each variable increase by 1 unit. The estimates of the parameters of stochastic frontier cost model of milk in the sample area were presented in Table 5. The estimated coefficients of the parameters of cost function were positive .This implies that the variables (cost of feed, cost of concentrates, cost of animal health and other operating expenses) used in regression analysis have direct relationship with total cost of production used as output. In other words, cost of milk production increases by the value of each coefficient as the quantity of each variable is increased by one. All the cost variables were significant to the total cost of production.

Table 4: Maximum likelihood estimates of Cobb–Douglas stochastic production function

Variables	Parameters	Coefficient	Standard error	z	p>|z|
Constant	B0	1.311097	.1021845	12.83	0.000
Lnherdsize	B1	.0732437	.0210625	3.48	0.001
Lnfooder	B2	.4089256	.0340479	12.01	0.000
Lnconcentrates .	B3	.3225096	.0364102	8.86	0.000
Lnanimalhealthcost	B4	-.0206896	.0236677	-0.87	0.382
Inefficiency Model					
Constant	δ0	3.364583	.8860453	-3.80	0.000
Age	δ1	.0089735	.0167154	0.54	0.591
Education	δ2	-.1066101	.1417459	-0.75	0.452
Family size	δ3	.0569397	.0778172	0.73	0.464
Variance					
Sigma squar	$\delta 2$	.0582432	.0102779		
Gamma	γ	0.83			
Log-likelihood	LH	73.62			

The study revealed that there was presence of technical and allocative inefficiency effects in milk production as confirmed by the test of hypothesis for the presence of inefficiency effects. The variance parameter gamma is a ratio of inefficiency error term ($\delta u2$) to the total sum of errors ($\delta u2 + \delta v2$), that is, $\gamma = \delta u2/\delta u2 + \delta v2$. The variance related to inefficiency effect in production function was 0.83, indicating that about 83% of the variation in the output of milk among the farmers was due to differences in their technical efficiencies while the other 17% represented the stochastic random errors. This result is an implication that the one-sided error (inefficiency) is a major component of the total variance, and that 83% of the observed variance among dairy milk producers was as a result of differences in their technical efficiencies such as poor utilization of available inputs such as concentrates. The Cobb-Douglas cost function results from the stochastic frontier model are as indicated in Table 5. The gamma was found to be an indication that there was the presence of allocative inefficiencies among the urban dairy farmers in the study area. The gamma value of 0.79 shows that 79% of the total variance was as a result of

inefficiencies. Hence, the variables in the inefficiency model, as well as other socio-economic variables not included in the model, could be used to explain 79% of the estimated allocative inefficiency.

Table 5: Maximum likelihood estimates of Cobb–Douglasstochastic frontier cost function

Variables	Parameters	Coefficient	Standard Error	z	p>|z|
Constant	B0	2.522498	.2389651	10.56	0.000
lnfoodercost	B1	.2494686	.0343162	7.27	0.000
Lnconcentrates cost	B2	.3014602	.0309462	9.74	0.000
Lnanimalhealthcost	B3	.0675245	.032197	2.10	0.036
Lnoperatingexpenses	B4	.208985	.0381213	5.48	0.000
Inefficiency Model					
Constant	δ0	-3.659331	1.001721	-3.65	0.000
Age	δ1	.0272169	.0208751	1.30	0.192
Education	δ2	-.2552467	.1533497	-1.66	0.096
Family size	δ3	.1142899	.0979365	1.17	0.243
Variance					
Sigma squarδ2.1079243	.0167158				
Gammaγ		0.79			
Log-likelihood	LH	18.27			

4.3 Distribution of efficiencies among urban dairy farmers

The overall technical efficiency ranged from a minimum of 48.79% to maximum of 97.10% with a mean of 84.82% as shown in Table.6 Considering the mean, there is an indication that farmers had a loss of 15.18% in milk production due to technical inefficiencies. In another study of urban dairy farmers, Harar Tolossa (2018), it was found that the mean technical efficiency was 77.1%. The results indicate that farmers in woliso were high efficient and had the potential tomore increase their efficiency. The distribution of the technical efficiency indicates that majority of the farmers operate between 51-90% efficiency scores, while 11% of the farmers operate in a technical efficiency score of below 50%. This means that the farmers from the study area have the potential to decrease the amounts of inputs used without reducing their milk production by improving their technical efficiency. Urban dairy farmers,Allocative efficiency scores range

between 44.03% and 97.25% with a mean of 78.11%. Average farmers would save a cost of 21.8% if they were to operate at the same level with the most allocatively efficient farmer (1-(78.11/97.25)*100), while the most allocatively inefficient farmer would save a cost of 55.97% by operating at the level of the most efficient farmer (1- (44.03/97.25)*100). The mediummeanAllocative efficiency score, indicates that the farmers at the study area are efficient at saving costs.

The economic efficiency of the urban dairy farmers had a mean of 66.34%, which ranged between 33.9% and 87.24%. If the least efficient farmer were to get to the level of the most economically efficient farmer, the farmer would lower costs by 61.2% (1- (33.9/87.24)*100), while an average farmer would lower cost by 24% (1- (66.34/87.24)*100). These results indicate that most farmers in the study area could reduce cost by about 24% if they would decrease input use to an efficient input level and achieve an optimal input combination considering input prices and technology

Table 6: Technical, Allocative and Economic efficiency scores distribution

Efficiency	TE			AE			EE		
	Freq.	Percent	Cum.	Freq.	Percent	Cum	Freq.	Percent	Cum.
<.49	10	5.43	5.43	1	0.54	0.54	9	4.89	4.89
0.50-0.59	12	6.52	11.96	2	1.09	1.63	19	10.33	15.22
0.60- 0.69	9	4.89	16.85	9	4.89	6.52	15	8.15	23.37
0.70- 0.79	44	23.9	40.76	31	16.85	23.37	53	28.80	52.17
0.80-0.89	107	58.15	98.91	83	45.11	68.48	78	42.39	94.57
>0.90	2	1.09	100.00	58	31.52	100.0	10	5.43	100.0
Total	184	100.00		184	100.00		184	100.00	

Variable	Obs	Mean	Std. Dev.	Min	Max
TE	184	.8482983	.0856284	.4879873	.9710053

AE	184	.7811957	.1172468	.4403523	.9725525
EE	184	.6634838	.1225905	.3390153	.8724903

Key; TE- Technical efficiency, AE- Allocative efficiency, EE- Economic efficiency

The mean economic efficiency of 66.34% was higher than the 37% found by Bizuayehu (2012) in a study of wheat seed production farmers in Amhara region, Ethiopia. However, the findings of our study were similar to a mean of 62.62% achieved by wanjiru. (2018) in their study of assessing the economic efficiency of milk production among small-scale dairy farmers in mukurweini,county, kenya.A majority of the farmers operated below 70% level of economic efficiency in our study, an indication that there is potential for improvement among the dairy farmer

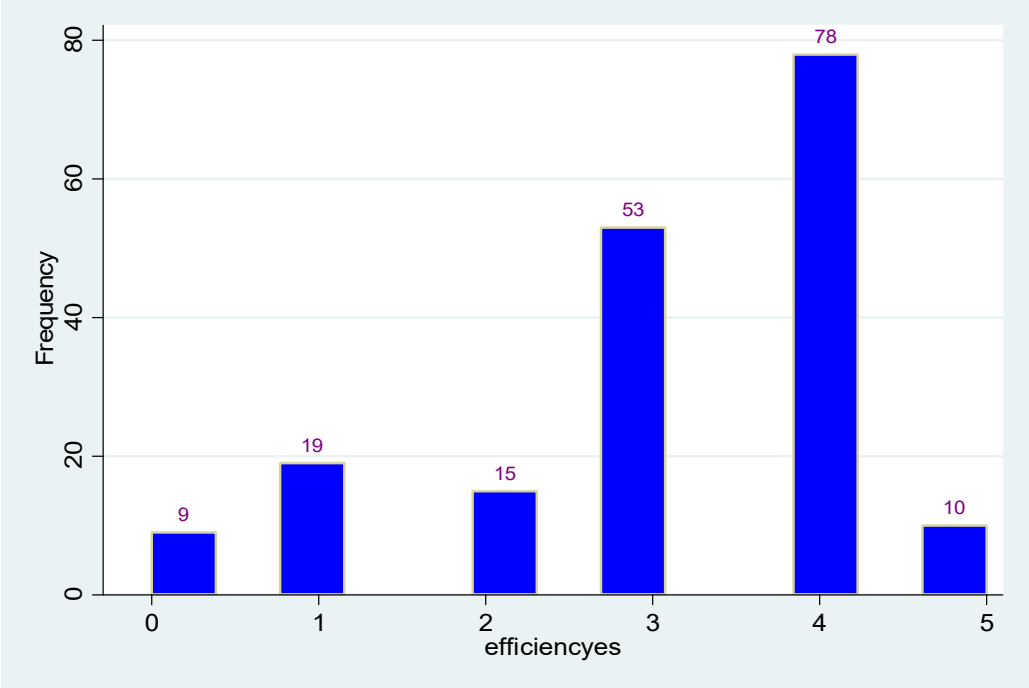

Figure 4: mean efficiency score distribution

Hypothesis tests

Test for model specification of the stochastic production frontier model help us to check about these models are correctly specified. For this Ramsey RESET-test result showed in appendix 3 confirms that the models have no specification error.

Heteroskedasticity This assumption tells us that the variance of the error term remains constant for all observation. The test result of Breusch-Pagan–Godfrey result showed that the existence of Heteroskedasticity and this is associated with existence efficiency Ui and the stochastic frontier model allows us to model the error term as a linear function of a set of covariates.

Tests for the existence of Multicollinearity between explanatory variables was made using Variance inflation factor (VIF) for continuous variables and pair wise correlation test method for frontier model variables. The Test result that are showed in Appendix 6 for production frontier variables, the result of VIF was less than 10 which was the indication of absence of sever Multicollinearity among explanatory variables.

On the other hand for dummy and categorical variables the appropriate pair wise correlation test was made and the result is shown in the Appendix 7 The result showed that the pair wise correlation result was below 0.5 and these shows there was no sever Multicollinearity problem among dummy and categorical variables and we can get the individual independent variables effects on the dependent variables

4.4. Factors influencing the economic efficiency of milk production in urban dairy farming

Table.7 presents results from a Tobit model for the determinants of technical efficiency, allocative efficiency and economic efficiency. The Tobit model used by Bravo-Ureta and Pinheiro (1997) was considered for this analysis since efficiency is bounded between zero and one. Ten variables were regressed against the technical efficiency score, allocative efficiency scores and economic efficiency scores

From the results,family size access to credit and dairy farming as the main source of income coefficients were the statistically significant variables that influenced technical efficiency.

The household size coefficient was found to negatively influence the technical efficiency, an indication that as the number of household members increased, the technical efficiency declined. Larger households can cause a diversion of funds to the family maintenance, potentially leaving the dairy enterprise struggling financially. Tijjani and Bakari (2014) reported similar results. The access to credit coefficient was found to be significant at 5% and it positive influenced technical efficiency. The access to credit can increase their ability and chance of adopting new technology practices in dairy farming, as well as provide capital for the acquisition of fodder and

concentrates. The credit can be in the form of money, fodder, concentrates or even heifers. By adopting better new technologies, farmers improve their efficiency and by purchasing enough fodder and concentrates, they increase their productivity. Access to credit was thus expected to positively affect the economic efficiency on TE.

The coefficient on having dairy farming as the main source of income had a positive sign and was significant at 5% level of significance. This shows that farmers who concentrated primarily on dairy farming were more technically efficient, as they might have been keen on dairy production so as to sustain their income. This finding is similar to that of wanjiru. (2018) who found that farmers who engaged in farm income earning activities in dairy farming in economic efficiency of small-scale farmers.

Table 7: Parameter estimates of determinants of technical, allocative and economic

Variable	Technical efficiency		Allocative efficiency		Economic efficiency	
	Coef.	p>|t|	Coef.	p>|t|	Coef.	p>|t|
Age	.0001748	0.825-	.0006076	0.409	-.0004706	0.584
Education	.0022754	0.704	.0051467	0.357	.0050004	0.443
Family size	-.0087192	0.017	-.0038769	0.253	-.0099905	0.012
Distance	.0067546	0.190	-.0015786	0.742	.0038271	0.495
Employed labor	-.0051493	0.687	-.043558	0.000	-.0422242	0.003
Member of group	-.0242151	0.216	.0070274	0.700	-.02474451	0.246
Access to credit	.0338719	0.040	.0119618	0.435	.0358578	0.046
Source of income	.0312251	0.017	.0113257	0.351	.0318637	0.026
Cost of fodder	.0001006	0.240	.00007637	0.000	.000717	0.000
Cost of concentrates	.0001744	0.123	.0001778	0.091	.0002542	0.039
Constant						
Significance at levels: *5%;**1%.						

The hired labor and fodder costs were the only variables whose coefficients were found to significantly affect the allocative efficiency, the hired labor coefficient was found to be significant at 1% and it negatively influenced allocative efficiency. This finding may be attributed to the intensity of dairy farming activities. Dairy farming is labour intensive and requires continuous labour input, thus prompting hiring labour in the farm. However, the hired labour tends to spend a limited amount of time on dairy farming as they multitask with other farming activities in the farm, thus contributing to the inefficiency of dairy milk production. This finding is similar to that of Onumah *et al*. (2009) where they reported that women who hired labour for fish farming in Ghana were allocative inefficient in fish production. The cost of fodder also had a positive influence on allocative efficiency due to the positive sign on its coefficient. This result meant that an increase in the cost of fodder could result in aincrease of the farmers' allocative efficiency. It implies that farmers can aim at minimizing the amount spent on fodder in order to increase their allocative efficiency. feed can be in the form of hay, straw of barley, wheat, sorghum and teff as well as maize stalk. Significant; it had positive effect on the allocative efficiency of milk production of the urban dairy farmers.

The coefficients of household size and hired labor were found to be statistically significant and they had a negative influence on economic efficiency. The coefficient Access to credit, having dairy farming as the main source of income,fodder cost and concentrates cost were significant and had a positive influence on economic efficiency.

The household size coefficient was negative and statistically significant at 5% level of significance. These findings indicated that an increase in the number of members living in a given household would result in a decline in the farmer’s economic efficiency. These results are similar to those of a study by Nyekanyeka (2011) who found that an increase in household size resulted in an increase in inefficiency in urban dairy farmers in Lilongwe. Some studies, however, found a positive association between increased household size and economic efficiency. They attributed this finding to the fact that more household members increase family labour, thus saving hired labour costs. For example, bizuayehu. (2012) found that family labour enhanced measures of AE, TE AND EE among wheat seed production in amhara region ethiopia.

The hired labour coefficient was found to be significant at 5% level of significance and negatively influenced the economic efficiency. The negative influence could be attributed to the fact that hired labour increases the total dairy production costs that might, in turn, decrease the allocative efficiency of a farmer and finally bring about economic inefficiency

The access to credit coefficient was positive and statistically significant at 5% level of significance. These findings indicated that as I mentioned above the access of loan from in the form of cash of money, fodder, concentrates or even heifers, By adopting better new technologies, farmers improve their efficiency and by purchasing enough fodder and concentrates, they increase their productivity. Access to credit resulted in an increase in efficiency among urban dairy farmers positive association between access of loan and economic efficiency.

The coefficient of having dairy farming as the main source of income was found to be positive and significant at 5% level of significance. This implies that farmers who concentrated and invested majorly on dairy farming as their major source of income were more economically efficient. This result shows that dedication to dairy farming activities increases efficiency.

. The cost of fodder and concentrates coefficient was found to be significant at 1% and5% level of significance respectively and its positive impacted on the economic efficiency of the farmers. This result implies that an increase in the cost of fodder and concentrates would result in a increase in economic efficiency, which could be attributed to the fact that an increase in the cost of concentrates lowers allocative efficiency that results in a decrease in economic efficiency of urban dairy farmers.

CHAPTER FIVE

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

The study found that an average household head involved in dairy farming in woliso is 40 years, has acquired primary education and has engaged in dairy farming for a period of over two decades. The results also showed that an average household has four members. The majority of the households depended on family labour for their daily dairy farming duties. Majority of the sampled farmers have no access to credit and most on dairy farming as their main source of income.most of the farmers receive the veterinary services from the woliso city urban agricultural bureau. The average herd size among the farmers was found to be four cows, while the mean daily milk production per cow was about 13.88 liters. The fodder and concentrate costs are the highest composition of the dairy production variable costs.

The study revealed that most farmers have a technical efficiency of above 80%, with a majority operating over the 80% level of efficiency. Majority of the farmers are good at minimizing costs as they have Allocative efficiency level above 90%. However, when the technical and Allocative efficiency are combined to come up with economic efficiency, most of the farmers are operating below the 70% level of economic efficiency. The results also indicated that if the average farmers were to operate at the same level as the most economically efficient farmer, they would cut down on cost by about 30% by just using the inputs efficiently and combining the inputs appropriately while considering their prices. The economic inefficiency among the dairy farmers in the study area is more a result of technical inefficiencies than Allocative inefficiencies.

The study found that an increase in the herd size, amount of concentrate per animal amount of fodder per animal or the amount spent on animal healthcost(technical efficiency variables) would result in an increase in milk production. The increasing returns-to scale shows that farmers are resource-poor but are fairly efficient in the utilization of resources, thus an increase in the use of any resources can produce a corresponding increase in the output. All variables included in the cost function (fodder cost, concentrate cost, animal health cost and other operating costs) for Allocative efficiency variables were found to significantly increase the total cost of production.

This implies that any cost incurred in the dairy production would significantly affect the total cost of production.

Technical efficiency was found to increase with the credit access and the farmers having farming is the main source of income was found to influence it positively influence. These results may reflectfarmers who have access to credit can increase their ability and chance of adopting new technology practices in dairy farming. The factors identified to negatively influence Allocative efficiency were hiring labor and positively influence of the fodder costs.

Factors found to be negatively correlated with economic efficiency were the household size and hired labour hired labour could affect efficiency in terms of the time and energy required by dairy farming, while household size and concentrate cost are responsible for increased expenditure. Having dairy farming as the main source of income,access to credit ,fodder and concentrates cost were found to have a positive influence on the economic efficiency of the farmers. Farmers that rely on their dairy farming for maintenance and source of income may put more effort in the dairy farming.

5.2. Recommendations for policy intervention

The findings indicate substantial production inefficiencies among the urban dairy farmers. Therefore, there is room for increasing productivity through the proper use of the available inputs, as well as improving efficiency through production cost reduction.

The cost of concentrates and fodder constitute most of the dairy production variable costs. Efforts to subsidize the dairy inputs would reduce the cost of dairy milk production by a huge margin. Most farmers in the study area complained of a continued increase in the price of concentrates and fodder. The dairy cooperative, should find means of subsidizing the concentrates and other dairy fodder. Subsiding the fodder and concentrate prices, especially during the dry season, would enable the farmers to continue producing milk in the same capacity as when there is plenty of fodder. The cooperative could also produce own fodder and supply to the farmers at affordable prices.

training farmers on production practices and store high-protein fodder on their farms Animal feeds abundant in local, for example, fodder produced in local area growing has to be promoted as it improve milk output. These could be achieved through encouraging farmers to grow green feeds in their farms through irrigation. For this, research institution, woliso Agriculture and Rural Development Bureau should work together jointly in promoting and extending fodder development and marketing in the area.

Regarding feed development the other best strategy will be taking initiatives by government or concerned bodies or investors should establish animal feed processing factory that could improve access to various feeds.

The farmers should further be trained on how to make silage so as to cater for the fodder needs during the dry seasons. The farmers should also take advantage of the new technologies such as hydroponics fodder whereby fodder is planted without water and is ready in six days. Disease prevention strategies would also be helpful, such as the promotion of vaccine and teat dip use. The government and other concerned stakeholders should focus on training the farmers on various disease prevention methods as well as readily avail the necessary vaccines.Policy makers should also increase dairy farmers' access to credit to buy feeds during cheap seasons and to finance medical and insemination expenditures.

5.3 Areas for Further Research

The study focused on urban dairy farmers in woliso city alone. There is need for a further study to be conducted in similar cities of Ethiopia to capture variation in economical efficiency in different agro ecological zones and other research gaps not addressed by this study would be more important.

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APPENDIXS

Appendix A:

Appendix 1 Questionnaire English

WOLKITE UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS DEPARTMENT OF ECONOMICS

ECONOMICS EFFICIENCY OF URBAN DAIRY FARMS IN ETHIOPIA: CROSS SECTIONAL DATA EVIDENCE FROM WOLISO TOWN

Dear participant,

My name is Senait teka, MSC student at wolkite University. I am conducting research on economics Efficiency of Urban Dairy Farms in woliso. You were randomly selected to participate in this exercise and participation is voluntarily. The information that you provide is used only for academic purposes and will be treated with utmost confidentiality. You will be briefed on the results of the study.

Part I General Information:

Wereda/kebele	
Farm type /Modern or Traditional	
Farm Category/Small ,Medium or Large	
Enumerator Name	
Date of interview	
Date checked	

SECTION 1: SOCIO DEMOGRAPHIC INFORMATION

1. Name of household head/Optional/ _____

2. Age of household head _____

3. Sex of household head 1=Male 2= Female

4. Highest grade completed: _____

5. Can you read and write: 1= yes 2=no

6. Total household size:_____

6.1. Age below 10_____: age 10-14_____: age 15-64 _____and age above 64_____

7. Dairy farming experience in years ----------years

8. Distance of the farm from all-weather road ----------to market centre (km)

9. Which means of transportation do you use to deliver milk to the nearest milk collection centre (circle all that apply)? 1= Private car, 2= Public service vehicle, 3= Motorcycle, 4= Bicycle, 5= Walking, 6= Others(specify)

SECTION 2 :COW INFORMATION ON PRODUCTIVE PERFORMANCE

2.1. Number of dairy cattle----------

Type ofCattle	Type of Breed 1=Local/indigenous 2=Modern Exotic/ Cross breeds3= both	Lactating Stage 1= Early 2= Middle	How many times per day do you milk your Cows? 1= Once 2= Twice 3= Three times	How many liters of milk do you get from each Cow per day?
1				
2				
3				
4				
5				

2.2. In the last 12 months, where did you acquire information on production practices (circle all that apply)? 1= Neighbors, 2= Own knowledge, 3= Television, 4= Radio, 5= media, 6= Workshops and seminars, 7= NGOs, 8= Government staff, 9= Others(specify) ----------

2.3. Where do you make your farm feed purchases (circle all that apply)?

1= Agro-vet store, 2= Local shops, 3= Farmer groups, 4= Government supply, 5= Others(specify)----------

SECTION 3: INFORMATION ON FEEDING

3.1. For bought forages in the last 3 month

Which forages do you purchase	What is their unit of measure	What quantity did you purchase per day	What is the price per unit	Where do you purchased forage feed
Napier grass				
Grass silage				
Maize silage				
Hay				
local feed				
Sweet potato vine				
Protein forages [e.g.Lucerne,alfafa, clover (specify)]				
Others(specify				
Where Purchased **1**=Individual farmer **3**=Trader **2**=Shop/agro vet **4**=Others (specify)……				

3.2. Are these amounts similar to other months in the last 3 month?

1= Yes 0= No If no, please describe differences in other months----------

3.3. Do you face problems with shortages of forages for feeding your cows?

1= Yes 0= No If yes

3.4. What are the major problems with forage feeding (circle all that apply)?

1= Inadequate land, 2= Labour availability, 3= Unreliable rainfall, 4= High prices per unit of forage, 5= Others (specify) ----------

3.5. What concentrates did you supplement the animals within the last 3 month?

Types of concentrates	Number of times fed/ day;1. Once2. Twice 3. Thrice4. > Thrice	Quantityfed to lactating cow at one moment	Cost of feed	
			Unit of measure	Price
Dairy meal				
Wheat bran				
Maize jam				
Vitamin/mineral Powder				

Vitamin/mineral block				
Others(Specify)				

3.6. Are these amounts similar to other months in the last year?

1= Yes 0= No If no, please describe differences in other months ----------

3.7. Do you face any problems with concentrates feeding? 1= Yes 0= NoIf yes,

3.8. What are the problems with supplement feeding (circle all that apply)?

1= High cost of concentrates, 2= Inadequate availability, 3= Inconsistent supply, 4= Others (specify) ----------

SECTION 4: WATER SOURCES AND CONSUMPTION

4.1 What sources of water are you using for your dairy animals?

1. The city pipeline 2. The nearby river 3.Pond 4. Wells / bore hole 5. Other specify.

4.2. How many times a day do you provide water to your animals in a day? (Specify number of times)----------

4.3. What quantities of water do you provide to your cows? (specify amount in litres/ cow) ----------

4.4. What do you use for supply watering the animals (circle all that apply)?

1= Bucket/Container 2= Cemented water trough 3= Others(specify) ----------

4.5. What equipment do you use for milking the cow? 1=Jug(s) 2=Bucket(s)

3= other(specify)

SECTION 5: COST OF LABOUR

5.1. Have you employed labor for cattle activities in the last three months? 1= YES 2 = NO

If Yes, provide details on labor (family or rented)

How many workers do you hire	How much do you pay each worker per month	What Activities engaged in the farm
1		
2		
3		
4		
5		
Farm activity codes: 1= Crop production 2= Cattle management (other than grazing or watering)		

3= Fodder/feed related activities

SECTION 6: VETERINARY COSTS

6.1. Do you use the veterinary service? 1=Yes 2= No,

6.2. Provide details on animal health and breeding services that you have used in the last 3 months?

Services	Have you used for the last 3 months? 1=Yes, 0=No	If yes	
		Who provide	total cost
Vaccination			
Mastitis treatment			
AI services			
Deworming			
Spraying			
Others(specify)			
Service provider 1= Government 4=Farmer 2= Private practitioner, independent 5 = NGO, specify name---------- 3= Private practitioner ---------- 6 = Others (specify			

SECTION 7: INFORMATION ON MILK MARKETING

7.1. Where do you sell your milk?

1= Neighbors/consumers 2= Local shops/hotels 3= Milk processors, 4= Restaurants, 5 = others--7.2. Which form of milk do you sell at your farm (circle all that apply)? 1= Raw, 2= Fermented, 3=Chilled7.3. What is the price per liter at your selling point(s)? (Birr)…… 7.4. What is your average sale of milk per day in liters during the last month?----------7.5. How much is the transportation cost to the market (birr)? ----------**SECTION 8: INSTITUTIONAL AND INCOME INFORMATION** 8.1.Are you a member of any development group? 1= Yes 0= NoIf yes, 8.2. What type of group is it?1= Young farmers group, 2= Women's group, 3= Others (specify) 8.3. How long have you been a member of the group? ----------8.4. What major service is offered by the group (circle all that apply)? 1= Credit service, 2= Marketing information, 3= Marketing of products, 4= Transportation, 5= Provide supplies, 6= Others(specify)----------

----------8.5. In your opinion how importance are these service ----------
---------- 8.6. Who has provided dairy extension services in your area in the last year (circle all that apply)?1= Government 2= NGO (Specify) _____ 3= Private company (eg. bank) 4. Other_____8.7.Do you have access to credit for your dairy enterprise 1= Yes 0= No If yes, .

type of credit	Source	amount	purpose of the loan	If not get credit, what is the reason
Type of creditCredit purpose 1= Cow/Heifer loan, 2= Cash loan, 3=Feed loan, 4= Other loans (specify)		1=Buy medicines, 2=Buy feed, 3 Purchase cow/heifer, 4= AI services, 5= Others(specify		

8.8. What are the most important benefits from your dairy farming (in order of importance)? -----
---

8.9. What are the key challenges in your dairy production enterprise (in order of importance)?.---
---

8.10. Is dairy farming your main source of income? 1= Yes 0= No If yes,

8.11. How much is earned from the dairy enterprise per month? ----------

8.12. What are the other sources of income? ----------

8.13a. how much estimated amount is earned in the last month

8.13b. who control the income from this source? 1=household 2=spouse 3 =other

Thank you

Appendix 2 Questioner Amharic (መጠይቅበአማርኛ)

ወልቂጤ ዩኒቨርስቲ
የድሕረ ምረቃ ትምህርት ቤት
የቢዝነስና ኢኮኖሚኮሌጅ
የከተማ ውስጥ ምርታማነት በወሊሶ ከተማ

ውዴ ተሳታፊዎች
ስሜ ሰናይት ተካ እባላለሁ የመጣሁት ከወልቂጤ ዩኒቨርሲቲ ሲሆን የሁለተኛ ዲግሪ ተማሪ ስሆን የከተማ ወተት ምርታማነት በወሊሶ ከተማ እውነታዎች በማጥናት ላይ ስሆን የእርሶ የወተት ማምረቻ በዚሁ ጥናት በእድል የተመረጠ በመሆኑ ተሳትፎው በፍቃደኝነት ላይ የተመሰረተ ነው፡፡ ለዚህ ጥናት የሚሰጡት ማናቸውም መረጃዎች ለትምህርት አገልግሎት ብቻ የሚውል ሲሆን ሚስጥራዊነቱ የተጠበቀ ነው፡፡በቅድሚያ ስለሚያደርጉልኝ ትብብር ምስጋናዬ ከፍ ያለ ነዉ፡፡

አጠቃላይመረጃ

ወረዳ /ቀበሌ	
የአምራችአይነት /ባህላዊወይምዘመናዊ/	
የአምራችደረጃ /አነስተኛመካከለኛከፍተኛ/	
የመረጃሰብሳቢውስም	
መጠይቁየተሞላበትቀን	
የተረጋገጠበት ቀን	

ክፍል አንድ:የወተት አምራች ዝርዝር መረጃ
1. የአባወራ/ አማወራ ስም፡ _____
2. የአባወራ/እማወራ እድሜ _____
3. ፆታ 1= ወንዴ 2= ሴት
4. የትምህርት ደረጃ = _____
5. ማንበብና መፃፍ ይችላሉ 1= አዎ 2= አልችልም
6. የቤተሰብ ብዛት ፡_____

እድሜአቸው ከ10 በታች የሆኑ፡_____ ከ10-14 የሆኑ፡ _____15-64 የሆኑ፡_____ ከ 64 እድሜ በላይ የሆኑ

7.የወተት እርባታ ምን ያህል አመት ሰርተዋል----------አመት

8.የእርባታ ቦታዎ ከሁሉም የገበያ ማእከላት ምን ያህል ይርቃል(በኪ/ሜ)----------ኪ/ሜ

9.ወተት በአቅራቢያዎ ወደሚገኝ የወተት መሰብሰቢያ ማእከል ለማድረስ በየትኛዉ የመጓጓዣ ዘዴ ይጠቀማሉ(የሚጠቀሙት ሁሉ ያክብቡ) 1 የግል መኪና 2የህዝብ አገልግሎት መኪና 3 ሞተር ሳይክል 4ብስክሌት የእግር ጉዞ 6 ሌሎች(ይጥቀሱ)

ክፍል ሁለት፡- ስለ ወተት ላም መረጃ ምርታማ አፈጻጸም

2.1 ያሎት የወተት ከብቶች ብዛት----------

Type ofCattle **የከብቶችአይነት** 1Caw **ላም** 2. Heifer/**ጊደር** 3. Bull/**ኮርማ** 4.Bull Calf/**ወንድጥጃ** 5.Heifer calf/**ሴትጥጃ**	Type of Breed /**ዝርያአይነት/** 1=Local/**የሀገርውስጥባህላዊ** 2=Modern Exotic/ Cross breeds/**ዘመናዊከብቶች/ድቅልከብቶች/**	Lactating Stage/**የማጋትደረጃ** 1=Early/**የመጀመሪያ** 2=Middle/**መካከለኛ** 3. Late/**የመጨረሻደረጃ**	How many times per day do you milk your Cows? **በቀን ስንት ጊዜ ወተት ያልባሉ** 1= Once/**አንድ ጊዜ** 2= Twice**ሁለት ጊዜ** 3= Three times/**ሶስት ጊዜ**	How many liters of milk do you get from each Cow per day?/ **ከእያንዳንዱ ላም በቀን ስንት ሊትር ወተት ያገኛሉ?**
1				
2				
3				
4				
5				

2.2. **ባለፉት 12 ወራት ውስጥ፣ ስለምርት ልምዶች መረጃ ከየት አገኙ (የሚመለከቶት ሁሉንም ያክቡ)? 1= ከጎረቤቶች፣ 2= የራሴ እውቀት፣ 3= ከቴሌቪዥን፣ 4= ከራዲዮ፣ 5= ሚዲያ፣ 6= ወርክሾፖች እና ሴሚናሮች፣ 7= መንግሥታዊ ያልሆኑ ድርጅቶች፣ 8= ከመንግስት ሰራተኞች፣ 9=ሌሎች----------**

2.3. **የእርሻ ግብዎን የት ነው የሚሰሩት (የሚመለከተውን ሁሉ ያከብሩ)? 1= አግሮ-ቬት መደብር፣ 2= የሀገር ውስጥ ሱቆች፣ 3= የገበሬ ቡድኖች፣ 4= የመንግስት አቅርቦት፣ 5= ሌሎች (ይግለጹ)**

ክፍል ሶስት፡-ስለ ከብቶችመኖአጠቃቀምየተመለከተመረጃ

3.1. **ባለፉት 3 ወራት ውስጥ ለተገዙ መኖዎች**

Which forages do you purchase/**የትኛዉ የመኖ**	What is their unit of measure /**መለኪያ**	What quantity did you purchase per day/**በቀን ምን**	What is the price per	Where do you

አይነት ነዉ የሚገዙት		ያህል ይገዛሉ	unit/ያንዱ ዋጋ	purchased forage feed /የት ነዉ የሚገዙት
Napier grass/				
Grass silages/የሳር አበባዎች				
Maize silage/የበቆሎ ሳር				
Hay/ደረቅ ሳር				
local feed/የአካባቢ መኖ				
Sweet potato vine				
Protein forages **የፕሮቲን መኖዎች** [e.g.Lucerne,alfafa, clover (specify)][**ለምሳሌ ሉሴርኔ፣ አልፋፋ፣ ክሎቨር**				
Others(specify**ሌሎች**				
Where Purchased /የት ነዉ የሚገዙት **1**=Individual farmer **=ከግለሰብ ገበሬ 3**=Trader /**ከነጋዴ** **2**=Shop/agro vet**ከሱቅ/አግሮ** **4**=Others (specify)**ሌሎች (ይጥቀሱ)**				

3.2. **እነዚህ መጠኖች ካለፉት 3 ወራት ጋር ተመሳሳይ ናቸው? 1= አዎ 0= አይደለም አይደለም ከሆነ፣ እባክዎን በሌሎች ወሮች ውስጥ ያሉ ልዩነቶችን ይግለጹ** ---------- ---------- ---------- ---------- ----------

3.3. **ላሞችዎን ለመመገብ የከብት መኖ እጥረት ችግር ያጋጥሞዎታል? 1= አዎ 0= አይደለም እሺ ከሆነ**

3.4. **በኖ መመገብ ላይ ያሉ ዋና ዋና ችግሮች ምንድን ናቸው (የሚመለከተውን ሁሉ ያክቡ)? 1=የመኖ አቅርቦት ፣ 2=የጉልበት አቅርቦት፣ 3=አስተማማኝ ያልሆነ ዝናብ፣ 4=የከብት መኖ ዋጋ መጨመር፣ 5=ሌሎች (ይገልፁ)**

3.5. **ባለፉት 3 ወር ውስጥ እንስሳቱን የትኞቹን የተመጣጠነፉርሽካናሚኒራሌአመጋገብአግኝተዋል**

Types of concentrates	Number of times fed/ day/በቀን ምን	Quantity fed to lactating cow	Cost of feed

የተመጣጠናየፉርሽካ አይነት	ያህል ጊዜ ይመገባሉ 1. Once/.አንዴ 2. Twice/ሁለት ጊዜ 3. Thrice/ሶስት ጊዜ 4. >Thrice/ከሶስት ጊዜ በላይ	at one moment/ለምትታለብ ላም ለአንዴ የሚሰጣት መጠን	Unit of measure/መለኪያ	Price/ዋጋ
Dairy meal/የወተት ምግብ				
Wheat bran የስንዴአንቅጥቃጭ				
Maize jam/የበቆሎ ቅጥቃጭ				
Vitamin/mineral Powder/የማዕድን ዱቄት/ቫይታሚን				
Vitamin/mineral block/አገዳ				
Others(Specify) /ሌላ				

3.6 እነዚህ መጠኖች ካለፈው ዓመት ጋር ተመሳሳይ ናቸው? 1= አዎ 0= አይ አይደለም ከሆነ፣ እባክዎን በሌሎች ወሮች ውስጥ ያለውን ልዩነት ይግለጹ ---------- ------ ---------- ---------- ----------

3.7. በፉርሽካ አመጋገብ ላይ ምንም አይነት ችግር አጋጥሞዎታል? 1= አዎ 0= አይ አዎ ከሆነ መልሶ

3.8. ከተጨማሪ ምግብ ጋር ምን ችግሮች አሉ (የሚመለከተውን ሁሉ ያክብቡ)?

1= የፉሩሽካ ዋጋ መጨመር፣ 2= በቂ ያልሆነ አቅርቦት፣ 3= ወጥ ያልሆነ አቅርቦት፣ 4= ሌሎች (ይግለጹ) ---------- ----------

ክፍል አራት: ስለ ውሃ ምንጮች እና ፍጆታ

4.1. ለወተት እንስሳዎ ዉሃ ከየት ያገኛሉ?

1. የከተማው ቧንቧ መስመር 2. በአቅራቢያው ያለው ወንዝ 3. ኩሬ 4. ከጥልቅጉድጓድውሃ 5.ሌላከሆነይግለፀ----------

4.2. በቀን ውስጥ ስንት ጊዜ ለእንስሳትህ ውሃ ያጠጣሉ? ----------

4.3. በቀን ለከብቶችዎ ምን ያህል ሊትር ውሃ ያጠጣሉ? ----------

4.4. እንስሳትን ለማጠጣት ምን ዓይነት ቁሳቁስ ይጠቀማሉ (የሚመለከተውን ሁሉ ያክብቡ)?
1= ባልዲ 2= በሲሚንቶ የተሰራ የውሃ ገንዳ 3= ሌሎች(ይጥቀሱ) ----------

4.5. ላሙን ለማለብ ምን ዓይነት ቁሳቁስ ይጠቀማሉ? 1=ጁግ 2=ባልዲ 3=ሌላ(ይጥቀሱ)

ክፍል አምስት፡ ስለ ሰራተኛ ቅጥር

5.1. ባለፉት ሶስት ወራት ውስጥ ለከብቶችሥራ ሰራተኛ ቀጥረዋል? 1= አዎ 2 = አይ

አዎ ከሆነ፣ ስለ ሰራተኛ (ቤተሰብ ወይም ተቀጣሪ) ዝርዝሮችን ይሙሉ

How many workers do you hire/ስንት ሰራተኛ ቀጥረዋል	How much do you pay each worker per month/ለእያንዳንዱ ሰራተኛ በወር ምን ያህል ይከፍላሉ	What Activities engaged in the farm/በእርሻ ውስጥ ምን ዓይነት ተግባራት ተከናውነዋል
1		
2		
3		
4		
5		
Farm activity codes:የስራዉ አይነት ኮዶች፡- 1= Crop production/**የሰብል ምርት** 2= Cattle management (other than grazing or watering) **የከብት አያያዝ (ከመመገብ ወይም ከማጠጣት ውጪ)** 3= Fodder/feed related activities /**ከመኖ ጋር የተያያዙ ተግባራት**		

ክፍል ስድስት፡ ስለ የእንስሳት ህክምና ወጪ በተመለከተ

6.1. የእንስሳት ህክምና አገልግሎትን ይጠቀማሉ? 1=አዎ 2=አይ

6.2. ባለፉት 3 ወራት ውስጥ ስለተጠቀሙባቸው የእንስሳት ጤና እና እርባታ አገልግሎቶች በተመለከተበሚከተለውሰንጠረዝይሙሉ

Services/ የህክምናአገልግሎትአይነቶች	Have you used for the last 3 months?/**ላለፉት3 ወራት ተጠቅመዋል?**1=አዎ 2 =አይ	If yes/**አዎ ከሆነ መልሶ**	
		Who provide/**ማን ያቀርባል**	total cost/ጠቅላላ ክፍያ
Vaccination**ክትባት**			
Mastitis treatmentየጡት			

እብጠት ሕክምና			
AI services/ሰዉ ሰራሽ ማራቢ ዘዴ			
Deworming ጥገኛትልማስወገደ			
Spraying/			
Others(specify)			
Service provider አገልግሎት አቅራቢ 1= Government/መንግስት 4=Farmer/ገበሬ 2= Private practitioner, independent/የግል ባለሙያ 5 = NGO፣የኤንጂኦስምይጥቀሱ 3= Cooperative /ማህበራት6 = Others (specify/ለሌላ ካለ ይጥቀሱ			

ክፍል ሰባት፡ ስለ ወተት ግብይት መረጃ

7.1. የወተት ምርቶችን የት ነው የሚሸጡት? 1= ለጎረቤቶች ወይም ለተጠቃሚዮች

2= ለሱቆች/ሆቴሎች 3=የወተት ማቀነባበሪያ 4= ምግብ ቤቶች 5 = ሌሎች

7.2. የሚሸጡት የትኛውን ዓይነት ወተት ነው (የሚመለከታቸውን ሁሉ ያክብቡ)? 1=ጥሬ፣2=የረጋ፣3= የቀዘቀዘ

7.3. በእርስዎ የመሸጫ ቦታ(ዎች) የአንድ ሊትር መሸጫ ዋጋ ስንት ነው፤ ----------ብር

7.4. ባለፉት ወራት የአንተ አማካይ የወተት ሽያጭ በቀን በሊትር ስንት ነው? ----------ሊትር

7.5. ወደ ገበያ ለመጓጓዝ ስንት ብር ያወጣሉ? ----------ብር

ክፍል ስምንት፡ ስለ ተቋማዊ እና የገቢ መረጃ

8.1. የልማት ቡድን አባል ነዎት/ተደራጅተዋል? 1= አዎ 2= አይ አዎ ከሆነ መልሶ,

8.2. ምን አይነት ቡድን ? 1= የወጣት ገበሬዎች ቡድን፣ 2= የሴቶች ቡድን፣ 3= ሌሎች (ይግለጹ) 8.3. የቡድኑ አባል ምን ያህል ጊዜ ኖረዋል? ----------

8.4. በቡድኑ የሚሰጠው ዋና አገልግሎት ምንድ ነው (የሚመለከተውን ሁሉ ያክብቡ)? 1= የብድር አገልግሎት፣ 2= የግብይት መረጃ፣ 3= የምርት ግብይት፣ 4= መጓጓዣ፣ 5= የግብአት አቅርቦቶች ፣ 6= ሌሎች (ይግለጹ) ----------

8.5. በእርስዎ አስተያየት እነዚህ አገልግሎቶች ምን ያህል አስፈላጊ ናቸው----------

8.6. ባለፈውአመት በአካባቢያችሁ የወተት ኤክስቴንሽን አገልግሎት እየሰጠ ያለዉ ማነው (የሚመለከተውን ሁሉ ያክብቡ)? 1= መንግስት 2= መንግሥታዊ ያልሆነ ድርጅት ይጥቀሱ _____ 3= የግል ድርጅት (ለምሳሌ ባንክ) 4. ሌላ_____

8.7. ለወተት ድርጅትዎ ብድር የማግኘት እድል አግኝተዋል?1= አዎ 2= አይ አዎ ከሆነ መልሶ

type of credit/የብድሩዓይነት	Source/ብድሩ የሰጠዉ አካል	Amount/ የብድሩመጠንበብር	purpose of the loan/የብድርአስፈላጊነት	If not get credit, what is the reason ብድር ካላገኙ ያላገኙበት ምክንያት ምንድ ነዉ

Type of credit/የብድር ዓይነት Credit purpose/የብድር አስፈላጊነት

1= የከብት ብድር፣ 1=መድሀኒት ለመግዛት

2=የጥሬ ገንዘብ ብድር ,2=መኖ ለመግዛት

3=የመኖ ብድር 3 ከብቶችለመግዛት

4= ሌሎች የብድር አይነት (ይግለጹ) 4= ለማራባት አገልግሎት 5=ለሌላ (ይጠቀስ)

8.8. ከወተት እርባታዎ ያገኙት ጥቅሞች ምንድ ናቸው? ---------- 8.9. በወተት ምርት ኢንተርፕራይዝዎ ዋና ዋና ተግዳሮቶች ምንድን ናቸው? (በቅደም ተከተል)---------- 8.10. ዋናው የገቢ ምንጭዎ የወተት እርባታ ነው? 1= አዎ 2= አይ አዎ ከሆነ መልሶ, 8.11. ከወተት ኢንተርፕራይዝ በወር ምን ያህል ገቢ ያገኛሉ? ---------- 8.12. ሌሎች የገቢ ምንጮች ምንድ ናቸው?----------8፡13. ሀ. ባለፈው ወር ምን ያህል የተገመተ መጠን አግኝተዋል ?

8፡13. ለ. ከዚህ ምንጭ የሚገኘውን ገቢ የሚቆጣጠረው ማን ነው? 1=ቤተሰብ 2=የትዳር ጓደኛ 3=ሌላ

Appendix 3 Stochastic Frontier Production Estimates of Model one

Stoc. frontier normal/half-normal model — Number of obs = 184
Wald chi2(4) = 394.80
Log likelihood = 73.744712 — Prob > chi2 = 0.0000

lnmilkoutput	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lnherdsize	.073734	.0205619	3.59	0.000	.0334334	.1140347
lnfooder	.4142984	.0339302	12.21	0.000	.3477963	.4808004
lnconcentrates	.3220665	.035672	9.03	0.000	.2521506	.3919824
lnanimalhealthcost	-.027204	.0236671	-1.15	0.250	-.0735907	.0191827
_cons	1.31356	.0987024	13.31	0.000	1.120107	1.507013
/lnsig2v	-4.603703	.329124	-13.99	0.000	-5.248774	-3.958632
/lnsig2u	-3.031844	.2569908	-11.80	0.000	-3.535537	-2.528151
sigma_v	.1000734	.0164683			.0724842	.1381637
sigma_u	.2196056	.0282183			.1707135	.2825003
sigma2	.0582413	.0102531			.0381456	.078337
lambda	2.194446	.0417439			2.112629	2.276262

Likelihood-ratio test of sigma_u=0: chibar2(01) = 7.94 Prob>=chibar2 = 0.002

Appendix 4 Tobit model of Factor affecting EE

```
Tobit regression                                Number of obs   =        184
                                                LR chi2(10)     =      93.01
                                                Prob > chi2     =     0.0000
Log likelihood =   184.3763                     Pseudo R2       =    -0.3373
```

EE	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
age	-.0004706	.0008587	-0.55	0.584	-.0021654	.0012242
education	.0050004	.006505	0.77	0.443	-.0078384	.0178392
familysize	-.0099905	.0039493	-2.53	0.012	-.0177853	-.0021957
Distance	.0038271	.0055975	0.68	0.495	-.0072207	.0148748
employedlabor	-.0422242	.0138917	-3.04	0.003	-.0696422	-.0148062
memberofgroup	-.0247451	.0212637	-1.16	0.246	-.0667132	.0172229
accesstocredit	.0358578	.017852	2.01	0.046	.0006236	.0710921
yourmainsourceofincome	.0318637	.0141657	2.25	0.026	.003905	.0598225
costoffodder	.00071	.0000931	7.63	0.000	.0005263	.0008936
costofconcentrates	.0002542	.0001224	2.08	0.039	.0000125	.0004959
_cons	.5621492	.0669024	8.40	0.000	.4301045	.6941939
/sigma	.0875262	.0045836			.0784796	.0965729

```
  Obs. summary:          1  left-censored observation  at EE<=.28929633
                       183     uncensored observations
                         0 right-censored observations
```

.

Appendix 5 Mean of EE ,TE and AE

```
Mean estimation                     Number of obs    =     184
```

	Mean	Std. Err.	[95% Conf.	Interval]
TE	.8482983	.0063126	.8358434	.8607531
AE	.7811957	.0086435	.7641419	.7982495
EE	.6634838	.0090375	.6456527	.6813149

Appendix 6 VIF Test Result for SFA Model Continues Variables

. vif

Variable	VIF	1/VIF
lnfooder	1.80	0.554575
lnconcent~es	1.72	0.580314
lnoperatin~s	1.13	0.883835
lnherdsize	1.11	0.897995
lnanimalhe~t	1.02	0.981336
Mean VIF	1.36	

Appendix 7 Pair Wise Correlation Test Result for Dummy and Categorical variables

	sex	educat~n	family~e	Typeof~d	employ~r	access~t	member~p	yourma~e
sex	1.0000							
education	0.3804	1.0000						
familysize	-0.0222	-0.0808	1.0000					
TypeofBreed	-0.0389	0.1146	0.0874	1.0000				
employedla~r	-0.1112	-0.0304	0.0300	0.0377	1.0000			
accesstocr~t	-0.0232	0.0262	-0.0153	0.1744	0.0705	1.0000		
memberofgr~p	-0.0261	-0.0878	-0.0112	-0.0323	0.0480	0.3611	1.0000	
yourmainso~e	-0.0360	-0.0643	0.1357	0.1699	-0.0689	0.0606	0.0442	1.0000