AKSUM UNIVERSITY SHIRE CAMPUS

COLLEGE OF AGRICULTURE

DEPARTMENT OF AGRICULTURAL ECONOMICS

Value Chain Analysis of Cow Milk: The Case of Laelay Maichew Woreda, Central Zone of Tigray, Ethiopia.

By

Getachew Mekonnen

A thesis
Submitted in Partial Fulfillment of the Requirements for the Master of Agribusiness and Value Chain Management

Major Advisor: Yassin Ibrahim (PhD)
Co - Advisor: Berhanu Gebremedhin (PhD)

November 2015

Shire, Ethiopia

VALUE CHAIN ANALYSIS OF COW MILK: THE CASE OF LAELAY MAICHEW WOREDA, CENTRAL ZONE OF TIGRAY, ETHIOPIA.

By

Getachew Mekonnen

A thesis
Submitted in Partial Fulfillment of the Requirements for the
Master of Agribusiness and Value Chain Management

Major Advisor: Yassin Ibrahim (PhD)

Co - Advisor: Berhanu Gebremedhin (PhD)

Aksum University Shire Campus

College of Agriculture

Department of Agricultural Economics

November 2015

Shire, Ethiopia

AKSUM UNIVERSITY

APPROVAL SHEET
POSTGRADUAT PROGRAMME IN AGRIBUSINESS AND VALUE CHAIN MANAGEMENT

As thesis research advisors, we here by certify that we have read and evaluated this thesis prepared, under our guidance, by Getachew Mekonnen Gebru entitled **"Value Chain Analysis of Cow Milk: The Case of Laelay Maichew Woreda, Central Zone of Tigray, Ethiopia."** We recommend that it be submitted as fulfilling the thesis requirement.

Yassin Ibrahim (PhD) Major Advisor	Signature	25-12-2015 Date
Berhanu Gebremedhin (PhD) Co-Advisor	Signature	Dec 26/15 Date

As member of the Board of Examiners of the MSc. Thesis Open Defense Examination, We certify that we have read, evaluated the Thesis prepared by Getachew Mekonnen and examined the candidate. We recommended that the Thesis be accepted as fulfilling the Thesis requirement for The Degree of Master of Science in Agribusiness and value chain management.

Tsegay Berhane Chairperson	Signature	25-12-2015 Date
Internal Examiner	Signature	Jan, 22/15 Date
Dr. Hailay Gebretsadik External Examiner	Signature	25-12-2015 Date

አክሱም ዩኒቨርሲቲ ሽረ ካምፓስ
የግብርና ኢኮኖሚክስ ትምህርት ክፍል
AKSUM UNIVERSITY SHIRE CAMPUS
DEPARTMENT OF AGRICULTURAL ECONOMICS

Page ii

LIST OF ACRONYMS

AAFC	Agriculture and Agri-Food Canada
AI	Artificial Insemination
CC	Contingency Coefficient
CSA	Central Statistical Agency
DSCI	Dedebit Saving and Credit Institute
GDP	Gross Domestic Product
GMMP	Gross Marketing Margin for Producer
GMMCO	Gross Marketing Margin for Cooperative
GMMHC	Gross Marketing Margin for Hotel and Cafe
ILRI	International Livestock Research Institution
IMR	Inverse Mills Ratio
LIVES	Livestock and Irrigation Value Chain of Ethiopian Smallholder
MOA	Ministry of Agriculture
NGOs	Non-Government Organization
NMM	Net Marketing Margin
NMMCO	Net Marketing Margin for Cooperative
NMMHC	Net Marketing Margin for Hotel and Café
OLS	Ordinary Least Square
REST	Relief Society Of Tigray
TAMPA	Tigray Agricultural Marketing and Promotion Agency
TARI	Tgiray Agricultural Research Institute
TGMM	Total Gross Marketing Margin
UNCTAD	United Nations Conference on Trade and Development
VCA	Value Chain Analysis
LMOARD	Laelay Maichew Office of Agricultural and Rural Development

BIOGRAPHICAL SKETCH

The author was born to his mother Tideg Kindmen and his father Mekonnen Gebru in 1983 at Shire town, North West Zone, Tigray regional state, Ethiopia. He attended elementary in Endabaguna elementary school and junior secondary and high school education in Shire Senior Secondary Schools.

The author joined Ambo University on September 2003 and graduated with BSc degree in Animal production and health on 04 July 2006. He worked for Agricultural and Rural Developments Office of the Medebay Zana Woreda, North Western Zone as a Livestock and feed resource expert from November 2006 till May 2008. He is working as instructor for Shire Agriculture Technical and Vocational Education Training (ATVET) College, North West of Tigray since May 2008. Then he joined the School of Graduate Studies at Aksum University Shire Campus to pursue his MSc study in Agribusiness and value chain management.

ACKNOWLEDGMENT

First and foremost, I am thankful to the almighty God, for his protection, care and guidance leading to the successful completion of the work. With deep appreciation, I would like to acknowledge the help, valuable guidance, advice and constructive comments of my advisor Dr. Yassin Ibrahim and My special thanks also goes to my Co-advisor Dr. Berhanu Gebremedhin for his guidance, moral and encouragement he made to me while developing thesis manuscript.

I am indebted to many individuals for their help and encouragement rendered while conducting this study. First, I would like to appreciate to my friends namely, Mr. Gedam Birhan, Mr. Gidey Beyen, Ms. Selam Girmay, Mr. Teklay Tesfay, Mr. Mebrahatom Medhane, Mr. Hailemariam Gebrehaweria, Ms. Genet Hadgu and Mr. Zenebe Gebremedhin for their valuable comments, guidance and encouragement from proposal write up and questionnaire development up to synthesis of this final thesis write up. My special thanks also go to Daniel Desta for his guidance, moral and encouragement from proposal write up and questionnaire development up to synthesis of this final thesis write up, who is working for Tigray Agricultural Research Institute Shire branch and I owe him great respect and thanks**.**

I would like to thank to LIVES/ILRI for the financial grant allotted to my research works. I am duly indebted to Mr. Haile Tilahun, Coordinator of LIVES Project in central zone of Tigray for his all rounded help from proposal write up to thesis production.

I thank to all my colleagues of Shire ATVET College for their encouragement during my thesis work. My appreciation also goes to all sample respondents in this study. Finally, at last but not least, I am also grateful to my beloved family for the affections, care, and moral support made to me during my study.

Table of Contents

List of table

List of Figures

Appendix

VALUE CHAIN ANALYSIS OF COW MILK: THE CASE OF LAELAY MAICHEW WOREDA, CENTRAL ZONE OF TIGRAY, ETHIOPIA.

ABSTRACT

The purpose of this study was to analyze the value chain of cow milk in Laelay Maichew Woreda, Centeral Zone of Tigray, Ethiopia. The specific objectives of the study includes:- identifying and mapping the major milk value chain actors, functions and their relations; costs and margins of intermediaries along the milk value chain were also estimated, the main determinants of smallholder farmers' participation in lucrative markets and marketed supply of cow milk were identified in the study. Besides, key constraints and opportunities of dairy production and marketing were also assessed in the study area. Moreover, various marketing agents and their roles, linkages and functions in the cow milk value chain were identified and mapped. Alternative marketing channels from the point of production to the end users were identified and mapped. To address the aforementioned objectives descriptive statistics, econometric models and rank analysis were employed. Of all milk value chain actors producers, café and hotels and dairy cooperative had the highest gross marketing margin which they accounted for 100% in channel I and II, 60% in channel III, and 23.08% in channel VI of consumer's price, respectively. Heckmans' two stage models were employed to identify factors that determine the smallholder participation decision and the amount of milk supplied to the market in the year 2013/14. Hotel, café and dairy cooperative are played crucial roles in the sample markets in the transaction of milk from producers to consumers. Weak oligopoly market type was observed in Aksum town markets with 34 percent concentration ratio. From the Heckman first stage model factors that determine the farmers' participation decision are identified. These includes milk market information (MMI), distance to woreda market (DWM), breed type (BreedT), number of dairy cow exotic and local (NDCEL), milk yield (MilkYD), educational level of household (ELHH), market price of milk (MPM), anticipated market price of butter (AMPB) and Access to dairy production extension service (AcDPExS) have highly and significantly influenced producers' market participation decision. According to the result of second stage Heckamn, milk market information (MMI), distance to woreda market (DWM), breed type (BreedT), number of dairy cow exotic and local (NDCEL), milk yield (MilkYD), Family size (FS), market price of milk (MPM), Access to dairy production extension service (AcDPExS) and were identified to have and highly significantly influenced volume of milk supplied to the market. The milk production and marketing was also constrained by various challenges. According to the survey, producers are suffering from lack of marketing, lack of supplementary feed, water scarcity, low breed milk productivity and shortage of grazing land. Despite the numerous challenges the dairy production still remains profitable business for the smallholders.

Key words: smallholder dairy producers, costs and margin, determinants, Heckman selection model.

Chapter One: Introduction

1.1. Background

Value chain analysis (VCA) is a method for accounting and presenting the value that is created in a product or service as it is transformed from raw inputs to a final product consumed by end users (FIAS, 2007). According to FIAS's (2007) statement, VCA[1] typically involves identifying and mapping the relationships of four types of features: (i) the activities performed during each stage of processing; (ii) the value of inputs, processing time, outputs and value added; (iii) the spatial relationships, such as distance and logistics, of the activities; and (iv) the structure of economic agents, such as suppliers, the producer, and the wholesaler. Value chains can become complex when they reflect multi-stage production systems with multiple types of firms operating in different locations in one country or multiple countries around the world.

CSA (2011/12) reports that, Ethiopia is endowed with the largest livestock population in Africa. Although (Berhanu *et al.*, 2007) explain that, Ethiopia ranks first in Africa and tenth in the worldwide with respect to the livestock population. And (CSA, 2011/12) reports that, the cattle population was estimated at about 52.13 million. The indigenous breeds accounted for 98.88 percent, while the hybrids and pure exotic breeds were represented by 0.93 and 0.012 percent, respectively. From the total cattle population, 44.43 percent are males and 55.57 percent females. However, there are a number of fundamental constraints underlie these outcomes. These include traditional technologies, limited supply of inputs (feed, breed, stock, water) poor or non-existent of extension service, high diseases prevalence, poor marketing infrastructure, lack of marketing support service, lack of market information and limited credit services affect the livestock marketing conditions (Berhanu *et al*., 2007).

But (Berhanu *et al*., 2007) discusses the growing domestic demand, which results from increased urbanization, higher income due to economic growth, and rising population, offers significant incentive for increased market oriented livestock production.

[1] In this study, **VCA** is used to mean "value chain analysis" Not" value chain approach."

Moreover, Ethiopia produced 3.3 billion liters of milk in 2011/2, worth $1.2billion and imported an additional $10.6 million of dairy products. At 19 liters per annum, per capita, annual milk consumption is well below the world average of 105 liters and the African average of about 40 liters (FAOSTAT, 2011).

According to LDMPS (2007), the major sources of milk in Ethiopia are produced from cows (83% of total milk production in Ethiopia) and the remainder from goats and camels in certain regions is particularly in pastoralist areas. As dairying play significant role in the lives of the urban and peri-urban poor households (Yitaye *et al*., 2007), promotion of the dairy sector in Ethiopia can therefore contribute significantly to poverty alleviation as well as, availability of food and income generation. In Ethiopia, dairy value chain entailed about 500,000 smallholder rural farmers who produce about 1,130 million litres of milk of which 370 million litres of raw milk, 280 million litres of butter and cheese and 165 million litres is consumed by the calves (Mohammed, 2009 cited in Betela, 2015).

The majority of milking cows in the smallholders milk production are indigenous breeds which have low production performance with the average age at first calving is 53 months and average calving intervals is 25 months. The average cow lactation[2] yield is 524 liters for 239 days, of which 238 litres is off-take for human use while 286 liters is suckled by the calf. But also a very small number of crossbred animals are milked to provide the family with fresh milk butter and cheese. Surpluses are sold, usually by women, who use the regular cash income to buy household necessities or to save for festival occasions (Mugerewa *et al*., 2009)

Even though, the contribution of smallholder dairy producers to economic development is large but, this is realized if smallholder farmers are linked to high value markets and they became benefited from the market (Birthal *et al*., 2007). and the same author, indicates that Improving smallholders' access to markets requires close linkages between farmers, processors, traders, and retailers to coordinate supply and demand. Institutions such as cooperatives, producers' associations, and contract farming are important means of linking producers with markets, as well as a source of credit, inputs, technology, information, and services. But there is concern that

[2] **Lactation** describes the secretion of milk from the mammary glands or the process of milk production.

smallholders may be excluded from the institution-driven value chains. Agribusiness firms, to reduce the transaction costs of contracting with a large number of Smallholders, have tended to contract with a few large producers who can supply large volumes and are capable of complying with food-quality standards. There is also a fear that agribusiness firms may exploit smallholders by extracting monopolistic rent in the output market and manipulating the terms and conditions of contracts (Birthal. *et al*., 2007)

1.2. Statement of Problem

Ethiopian smallholder dairy producers are facing different problem to bring their fluid milk to the market and this remained a concern of different theoretical explanations and empirical investigations. Different factors which exclusion the producers to bring their product to market have been raised by different scholars for example, Ellen (2010) Smallholder dairy producer and Small scale dairy producer have a common interest to bring a product to the market. However, it is not simple to develop and maintain smooth working relations. Both the Smallholder dairy producer and small scale dairy producer operate in a specific context and face constraints that make it difficult for one to respond to the needs of the other. Smallholder producers generally do not have access to all factors that are needed for delivering a product that responds to market demand. They often face strong economic, social and physical disadvantages: in some areas the infrastructure is poor, while in other areas up to- date market information is not always available to everyone. Another challenge is the difficulty in accessing technical advisory services, agricultural inputs and financial services. Dairy sector is a risky business and lack of post-harvest facilities makes it difficult to deliver a consistent supply of good quality produce.

Similarly, Berhanu *et al*. (2006) have also identified different factors which inhibit to bring their product to the market, among the sectors of livestock production system, Dairy production is a crucial issue in Ethiopia where livestock and its products are important source of food and income, and dairying has not been fully exploited and promoted in the country. Despite its large numbers, the livestock subsector in Ethiopia is low in production in general, and compared to its potential, the direct contribution it makes to the national economy is limited. A number of fundamental constraints under lay these outcomes, including traditional technologies, limited supply of inputs (feed, breeding stock, artificial insemination and water), poor extension service,

high disease prevalence, poor marketing infrastructure, lack of marketing support services and market information, limited credit services, absence of effective producers' organizations at the grass roots levels, and natural resources degradation. However, the participation of smallholders to market and volume of milk supply is limited.

Lemma *et al*. (2008) and Yilma *et al*. (2011) reported that, weak linkages among the different actors in the dairy value chain are some of the important factors that contribute to the poor development of Ethiopia's dairy sector.

Although, many empirical studies (woldemicael, 2008; Berhanu, 2012; Eyassu, *et al.* 2011; Girma and Marco, 2013; Betela, 2015) conducted in South Nation Nationalities and Peoples, Dire Dawa city, and respectively most of the studies are on the socio-economic factors and the studies carried out in urban and peri-urban dairy producers those falling to show the factors which constraint the participation of smallholders to market and volume of milk supply and their share of profit margin in the chain.

Laelay maichew[3] Woreda has a potential for sustainable commercialization of dairy in the nearest pre-urban and urban towns to market milk and milk products in the form of fluid milk and butter. In this woreda, improved dairy development was started in 1998, with the introduction of Friesian crossbred dairy cows. Following the initial introduction and demonstration, farmers continued to own crossbred cows from different sources.

The utilization of These potentials as income generating have been limited due to the lack of capacity and access to knowledge on market oriented high value livestock. Part of the limitation is associated with traditional values and attitudes of farmers. For example smallholder farmers' value livestock number as household asset or reserves as security to maintain oxen supply and food in times of crises. This traditional value and attitude to livestock is less useful to advance market oriented livestock development. There is a crucial need to change the attitude of farmers towards livestock as income generating business.

[3]**Laelay maichew** is a woreda, which is located in Central zonal administration of Tigray region, specifically around Aksum town

There are a number of studies specifically examining the value chain of fluid milk of farmers/ producers to identify the actors participate in the fluid milk value chain, the factors which determine from participation and volume supply, profit margin and their constraints and opportunities in other parts of the world and in some part of Ethiopia. However, to the researcher best knowledge, no/little empirical study has been done to analysis value chain of cow milk in the study area as well as in Tigray Region.

Therefore, in the study area, there is a gap of information and knowledge on cow milk value chain. The existing information and knowledge gap in the study area are not well known, the actors participate in the chain, market participation, volume of supply, beneficiary from the participant in the chain and how it will develop the milk value chain in the study area. In line with this how smallholder dairy producer households can reach to market and sells its product.

So that, this study is proposed to fill the information and knowledge gap as to how the cow milk is reached to the market/customer and identify the actors, beneficiary, constraints and opportunities and how the producers market share.

1.3. Research Questions

This study tries to address the following questions:

1. What do the milk value chain map look like in the study area?
2. Who are the actors involved in the milk value chain?
3. How is the cost and margin distribution among milk value chain participants?
4. What are the main determinants for smallholder farmers' participation in markets and quantities of sales?
5. What are the key opportunities and constraints of dairy production and marketing in the study area?

1.4. Objectives of the Study

1.4.1. General objective

The overall objective of the study is to analysis value chain of cow milk in Laelay Maichew Woreda[4]; Centeral Zone of Tigray.

1.4.2. Specific objectives

The specific objectives of the study are:-

1. To identify and map the major milk value chain actors, functions and their relations;
2. To estimate the costs and margins of actors along the milk value chain;
3. To identify the main determinants of smallholder farmers' from participation in markets' and marketed surplus of cow milk and;
4. To identify the key constraints and opportunities of dairy production and marketing in the study area.

1.5. Scope and limitations of the Study

1.5.1. Scope of the Study

The scope of the study is described based on concept, methodology, geography and time.

Conceptual: This study had scope of fluid cow milk value chain, and to cover the identifying actors and mapping the value chain, beneficiary, producer market participation and volume of supply and constraints and opportunities of cow milk value chain.

Methodologically: It is a survey study on smallholder dairy producers in which representative sample size has been selected using probabilistic sampling techniques, simple random sampling lottery system. Both quantitative and qualitative data was collected. While analyzing the data, descriptive analysis, value chain analysis and econometric analysis technique was used in line with this the research is focused only analyzing of actors participate, beneficiary, producer market participation and volume supply, constraints and opportunities of cow milk value chain.

[4] **Woreda:** is an administration structure in the Federal Democratic Republic of Ethiopia. It is immediately above peasant Association and it is equivalent to district.

Geographically: This study was conducted in Laelay Maichew Woreda, in four purposively selected kebeles in the central Zone of Tigray.

Time: This study is a cross-sectional survey study.

1.5.2. Limitations of the Study

In similar fashion to the scope of the study, the limitations of this study are conceptually, methodologically geographically and time described as follows.

Conceptually, this study focuses only on specific dairy product commodity which is cow milk, it analysis cow milk value chain of smallholder dairy producers. It does not see other milk producers' such as small scale dairy producers and dairy products (butter, cheese etc.)

Methodologically, this study is limited to 4 kebeles of Laelay Maichew Woreda.

Geographically, this study is limited to Laelay Maichew Woreda in selected 4 'kebeles'. This geographic scope may limit the representativeness of the study while intending to use it at Zonal or some other higher level administrative structures. Therefore this limits to conclude at zonal.

1.6. Significance of the Study

The study have generated valuable information on the cow milk value chain in the study area and that might assist policy makers at various levels to make relevant decisions to intervene in the development of dairy cattle milk production, marketing, processing and designing of appropriate policies and strategies. Governmental and nongovernmental organizations that are intervening through their programs in the development of the dairy sub-sector are expected to benefit from the result of this study. The findings of the study might also be useful to input suppliers, producers, traders, consumers, and marketing agents to make their respective decisions. It may also serve as a reference material for further research on similar topics and other related subjects.

Chapter Two: Literature Review

In this part of the study the basic concepts of agricultural value chain, value chain, supply chain, value chain actors, dairy marketing systems in Ethiopia, Informal milk trade, formal milk trade, methods for evaluating efficiency of agricultural marketing system, market structure, market conduct, market performance, methods for evaluating marketing performance, marketing costs, marketing margin, empirical reviews and conceptual frame work would be discussed.

2.1. Basic Concepts and Definitions

2.1.1. Agricultural value chain and smallholder farmers

According to Baloyi (2010), the concept of agricultural value chain has attracted many scholars in the marketing environment. For smallholder farmers to be integrated along the value chain, they must able to comply with market requirement such as economies of scale, good quality and consistency. Transport logistics and the cold chain are necessities for smallholder farmers if they are to participate in the agribusiness value chain. The agricultural value chain is a vertical alliance of enterprise collaborating to ensure a more rewarding position in the market. The vertical alliance means that the agribusiness is connected from the production stage, through the processing stage to the market stage, until the products are in the hand of the consumer. Producer, processors and markers become interdependent in the chain and work together to discuss challenges and share information (AAFC, 2004).

2.1.2. Value chain

Full range of activities which are required to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers, and final disposal after use (Kaplisnky and Morris, 2001). According to Ssango (2006), value chain is a specific type of supply chain, one where the actors actively seek to support each other so that they can increase their efficiency and competitiveness. They invest time, effort, money and build relationships with each other to reach a common goal of satisfying consumer needs so as to increase their profits**.**

Moreover, Feller *et al*. (2006) defined that, value chain as the integration of key business processes from end user through original suppliers that provide products, services and information that add value for customers and other stakeholders. Supply chain, however does not necessarily add value. As described by Msuya (2009), value can be added by an increase in price as the result of higher value product, better quality and or better services. In addition, value can be added by increasing in quantity brought about by the larger organisation of smallholders, increased production and acquisition of market share. It is also possible for value to be added by cost reduction as a result of improved productivity.

In line to above, the basic characteristic of a value chain is market-focused collaboration: different business enterprise work together to produce and market products and services in an effective and efficient manner. Value chain allows business to respond to the market place by linking production, processing, and marketing activities to market demands.

There are three general triggers for developing a value chain:

Improve Quality: Competition is becoming increasingly fierce. There is an opportunity to produce the safest food in the world when producers, processors, and retailers track products through the food chain. Premiums also exist for a consistently high quality produced and processed food products.

Increase Efficiency: Opportunities exist to lower costs and increase efficiencies in the market by producers, processors and marketers working together.

Differentiate Product: Consumers are demanding new products that require supply chain partners to share information and systems or provide unique specialized inputs (e.g. special variety, trademarked process, and unique genetics). These products often require consistently high quality, proof of adherence to protocols and legislated standards throughout the production processing and marketing channels (Muren, 2004 as cited in Raihanul, 2012)

2.1.3. Supply chain

It is an integrated process where in a number of various business entities (i.e. suppliers, manufactures, distributors, and retailers) work together in an effort to acquire raw materials, convert these materials into specified final products, and deliver these final products to retailers. The chain is traditionally characterized by a forward flow of materials and backward flow of information (Beamon, 1998).

According to Dunne (2001), it is taken to mean the physical flow of goods that are required for raw materials to be transformed into finished products. Supply chain management is about making the chain as efficient as possible through better flow scheduling and resource use, improving quality control throughout the chain, reducing the risk associated with food safety and contamination, and decreasing the agricultural industry's response to changes in consumer demand for food attributes.

2.1.4. Value chain actors

Actors in a value chain may include input suppliers, producers, itinerant collectors (small and mobile traders who visit villages and rural markets), assembly traders (also called primary wholesalers who normally buy from farmers and itinerant collectors and sell to wholesalers), wholesalers (who deal with larger volumes than collectors and assemblers and often perform important storage functions), retailers (who distribute products to consumers), and processors (firms and individuals involved in the transformation of a product) (Kaplinisky and Morris 2001).

Moreover, Ssango (2006) defined that, chain actors are those involved in producing, processing, trading or consuming a particular agricultural product. The actors include direct actors who are commercially involved in the chain (producers, traders, retailers, consumers) and indirect actors who provide financial or non-financial support services, such as bankers and credit agencies, business service providers, government, researchers and extensionist[5].

[5] **Extensionist** means an expert of extension service

2.1.5. Concept of Value Chain Analysis

According to Kaplinsky and Morris (2001), Value chain analysis provides a way to understand problems and find ways of improving the situation of the weaker links in the chain, such as those with low returns and little bargaining power. Similarly, Tallec (2006) indicates that, value chain analysis is one of the ways of identifying which activities are best undertaken by a business and which are best provided by others**.**

Likewise, FIAS (2007), Value chain analysis is a method for accounting and presenting the value that is created in a product or service as it is transformed from raw inputs to a final product consumed by end users. Msuya (2009) reported that, value chain analysis is an effective means of conceptualizing the forms, functions and integration that actor takes in the production process, because it shifts the focus from production alone to the varied set of activities that make up the chain. Value chain analysis help in understanding challenges of market access through the identification of nature and extent of barriers to entry along the chain.

Moreover, Lusby and Panlibuton (2004), value chain analysis can help to (a) reveal links between producers, exporters and global markets (b) Identify constraints along the chain to competing in the market place (c) clarify the relationships in the chain from buyer to producers and (d) highlight the distribution of benefits among buyers, exporters and producers in the chain.

2.2. Dairy Marketing Systems in Ethiopia

As is common in other African countries (e.g., Kenya and Uganda), dairy products in Ethiopia are channeled to consumers through both formal and informal dairy marketing systems. Until 1991, the formal market of cold chain, pasteurized milk was exclusively dominated by the DDE which supplied 12 percent of the total fresh milk in the Addis Ababa area (Holloway *et al*., 2000). Recently, however, private businesses have begun collecting, processing, packing and distributing milk and other dairy products. Still, the proportion of total production being marketed through the formal markets remains small (Muriuki and Thorpe, 2001).

2.2.1. Informal Milk Trade

Milk and milk products in Ethiopia are channeled to consumers through both formal and informal marketing systems. About 95 percent of the marketed milk at national level is channeled through the informal system. In this marketing system, milk and milk products may pass from producers to consumers directly or through one or more market agents. Producers sell the surplus milk produced to their neighbors and/or in the local markets, either as liquid milk or in the form of butter and/or Ayib[6] (O'Connor, 1992). This system is characterized by no license to operate, low cost of operation, high producer prices as compared with formal market and no regulation of operation (SNV, 2008). The hygienic condition of milk and milk products channeled through this system is also poor. This is mainly due to the prevailing situation where producers have limited knowledge of dairy product handling coupled with the inadequacy of dairy infrastructure such as cooling facilities and unavailability of clean water in the production areas (Land o'lakes, 2010).

2.2.2. Formal Milk Trade

In the formal system, milk is collected at the cooperative or private milk collection centers and transported to processing plants. In this system, milk quality tests (principally acidity using alcohol and clot-on-boiling test, and density) are performed on delivery, thereby assuring the quality of milk. This has encouraged the producers to improve the hygiene conditions, storage and transportation of the milk in order to avoid rejection of the product on delivery to the collection center. The formal milk market appears to be expanding during the last decade with the private sector leading the dairy processing industry in Addis Ababa and other major regional towns. However, the share of milk sold in the formal market in Ethiopia (two percent) is much less than that sold in neighboring countries: 15 percent in Kenya and five percent in Uganda (Muriuki and Thorpe, 2001).

Although the price of the different inputs into the dairy production varies and is constantly increasing, milk producers continue to get very low amounts for their products as compared to the cost of production. It is therefore important to put a functional control mechanism in place so that producers can get what they deserve. Most farmers live in

[6] **Ayib** is Traditional Ethiopian cheese/ cottage cheese

remote areas not easily accessible by road to facilitate transportation of agricultural products including milk and milk products to places with storage facilities and selling points. Transportation of fresh milk to any market will take a number of hours to reach the market. The Livestock Development Master Plan Report indicated that only a few farmers live close to the main road system, which gives them basic access between farm and village and from the village to the market (GRM International BV, 2007).

2.3. Methods for Evaluating Efficiency of Agricultural Marketing System

Abbot and Makeham (1981) indicated that, factors accounting for efficiency can be evaluated by examining the characteristics of markets such as structure, conduct and performance. These elements measure the extent of deviation from the perfectly competitive norm. The larger the deviation, the more imperfectly competitive is the market, that is on extreme case would be monopoly.

According to Kohls and Uhl (1985), Evaluation of the efficiency with which the agricultural marketing system operates forms the crux of analysis of marketing problem. In line with this, the analysts of the market structure, behavior and quantitative evaluation of the efficiency of the marketing system requires concept, theories, methods, data and workable frame works and extremely difficult tasks (Branson and Norvell, 1983).

2.3.1. Market structure

According to Scott (1995), Market concentration refers to the number and relative size of buyers or sellers in a market. Similarly, Bain (1968) Market structure is defined as, those characteristics of the organization of the market that seems to exercise strategic influence on the nature of competition and pricing within the market. The characteristics usually stressed are the number and size distribution of firms in relation to the size of the market, the presence or absence of barriers to entry facing new firms, physical or subjective and product differentiation. Kohls and Uhl (1985), bring into play as a rule of thumb, four largest enterprises' concentration ratio of 50% or more (an indication of a strongly oligopolistic industry), 33-50 % (a weak oligopoly) and less than that (competitive industry). The problem associated with this index is the arbitrary selection of r (the number of firms that are taken to compare the ratio).

2.3.2. Market conduct

Market conduct refers to the patterns of behavior that firms follow in adopting or adjusting to the markets in which they sell or buy (Bain, 1968). Similar description by, Meijer (1994) said that, "conduct is pattern of behavior which enterprises follow in adopting or adjusting to the market in which they sell or buy", in other words the strategies of the actors operating in the market.

According to Wolday (1994), also the structure and conduct of market participants have a direct implication for the nature of production price relationships between different marketing levels. Market conduct refers to the practices or strategies of traders in maximizing their profits. Among these practices are the use of regular partners, long-term relations with clients, and suppliers, the use of intermediaries, and trade within personalized networks

Market conduct deals with the behavior of firms that are price-searchers are expected to act differently than those in a price-taker type of industry (Cramers and Jensen, 1982). Price searchers can determine their selling prices or quantity of output they sell. In addition, they could use their market power to weaken or eliminate competitors example reducing price. According to Abbott and Makeham (1981), conduct refers to the market behavior of all firms. In what way do they compete? Are they looking for new techniques and do they apply them as practicable? Are they looking for new investment opportunities, or are they disinvesting and transferring funds elsewhere?

2.3.3. Market performance

According to Abbott and Makeham (1981), market performance is how successfully the firm's aims are accomplished, which shows the assessment of how well the process of marketing is carried out. Is produce assembled and delivered on time and without wastage? Is it well packed and presented attractively? Is its quality reliable and are terms of contract observed? Is the consumption of the products increasing and sales in competitive market expanding? There are such practical indicators of how well a certain marketing system is operating. As a method for analysis, the SCP paradigm postulates that the relationship exists between the three levels distinguished. Performance of the market is reflection of the impact of structure and conduct on product price, costs and the volume and quality of output (Cramers and Jensen, 1982). If the

market structure in an industry resembles monopoly rather than pure competition, then one expects poor market performance. Similarly, Meijer (1994) describe that, one can imagine a causal relations starting from the structure, which determine the conduct, which together determine the performance (technological progressiveness, growth orientation of marketing firms, efficiency of resource use, and product improvement and maximum market services at the least possible cost) of agricultural marketing system in developing countries .

2.4. Methods for Evaluating Marketing Performance

Market performance can be evaluated by analysis of costs and margins of marketing agents in different channels. A commonly used measure of system performance is the marketing margin or price spread. Margin or spread can be useful descriptive statistics; it is used to show how the consumer's food price is divided among participants at different levels of marketing system (Getachew, 2002 as cited in Dirriba, 2013).

2.4.1. Marketing costs

According to Holloway *et al*. (2002), Marketing costs are the embodiment of barriers to access to market participation by resource poor smallholders. It refers to those costs, which are incurred to perform various marketing activities in the transportation of goods from producer to consumers. Marketing costs includes handling cost (packing and unpacking, costs of searching for a partner with whom to exchange, screening potential trading partners to ascertain their trustworthiness, bargaining with potential trading partners (and officials) to reach an agreement, transferring the product, monitoring the agreement to see that its conditions are fulfilled, and enforcing the exchange agreement. In line the above, the costs and returns of actors playing various market functions are affected by differences in enterprise size and location, vertical integration of functions, the internal organization of enterprise operations and the nature of horizontal and exchange relations, particularly where the latter are linked with credit (Scarborough and Kydd, 1992).

2.4.2. Marketing margins

Cramers and Jensen (1982) indicated that, a marketing margin is the percentage of the final weighted average selling price taken by each stage of the marketing chain. The total marketing margin is the difference between what the consumer pays and what the producer/farmer receives for his product. In other words, it is the difference between retail price and farm price. According to Wolday (1994), a wide margin means usually high prices to consumers and low prices to producers. The total marketing margin may be subdivided into different components: all the costs of marketing services and the profit margins or net returns. The marketing margin in an imperfect market is likely to be higher than that in a competitive market because of the expected abnormal profit.

2.5. Empirical Literature on Market participation decision and volume supply

Many studies were conducted to determine factors that affect market participation and volume supply of different agricultural commodities. Some of these studies which consider two dependent variables which are market participation decision and marketed volume are stated below.

Abay (2007), conducted a study on vegetable market chain analysis in Fogera woreda. He adopted Heckman two-stage model to estimate the probability of farmer's participation in a market and market supply level.

Abraham (2013), conducted another Study on value chain analysis of vegetables: the case of Habro and Kombolcha woredas in Oromia region, Ethiopia. He adopted Heckman two-stage model to estimate the probability of farmer's participation in a market and market supply level.

Bedilu (2013), conducted a study on factors affecting camel and cow milk marketed surplus: the case of eastern Ethiopia. Heckman's sample selection and multiple linear regression models were used to investigate the factors affecting marketed supply of cow and camel milk in the study area, respectively.

Dawit (2010), conducted a study on market chain analysis of poultry: the case of Alamata and Atsbi-Wonberta woredas of Tigray region. He used in the ecometric analysis Heckman two-stage

model to estimate the probability of farmer's participation in poultry market and poultry market supply level.

Woldemichael (2008), conducted another Study on Dairy marketing chains analysis in Hawassa-Yergalem milk shed. He used Heckman two-stage model to estimate the probability of participating in milk market and marketed milk volume. Factors affecting market participation and volume of supply can differ from one commodity to the other depending on the nature of the commodity under consideration.

Holloway *et al.* (2002), analyzed factors affecting volume of milk supply and milk market entry decision by dairy households using data from 68 sampled dairy households in Ethiopia high lands (Lemu Ariya, Arsi and Shoa regions) using Probit and Tobit models. Their findings indicated that number of cross breed and local breed dairy cows owned, education level of the household head, and number of extension visits exhibited positive relationship with milk market entry decisions and marketed milk surplus; however, distance from milk market centers exhibited negative relationship with milk market entry decision and marketed surplus.

Study conducted by Pomerory (1989), on four fish market using concentration ratio (market share ratio) in Philippines found that 50% of the industry made 80% of the fish purchases. Similarly study conducted by Scott (1995), on potato marketing using marketing margin analysis in Bangladesh indicated that producer's price and margin were 1.27 and 67 %, respectively.

Rehima (2006), conducted study on pepper marketing chains analysis in Alaba and Siltie Zones in southern Ethiopia using marketing margin analysis found that the gross marketing margin obtained by pepper retailers was 43.08% of the consumer's price. The same study reported that producer's share and net marketing margins obtained by retailers were 50.7% and 29.47% of the consumer's price.

2.6. Conceptual Framework of Milk Value Chain

Figure 1: below indicates a flow diagram of the conceptual framework for this study. This framework is a Milk value chain of smallholder which provided a visual view of interactions between smallholder milk producers' internal and the external environmental factor with in fluid milk marketing chain actors'. At this conceptual framework, smallholder milk producers characteristics (such as education level of the individual milk producers, sex of household milk producers, farming experience of producers, available number of children below five years old, family size, and income from non-dairy farm) and Institutional factors (such as input suppliers like credit access and extension service). Production factors (such as dairy breed type, number of dairy cows and milk yield). Marketing factors (are Distance to woreda market, milk marketing information, marketing price of milk and anticipating marketing price of butter) influences the level of milk production and marketing.

Positive interaction among smallholders' milk producer's characteristics, institutional factors, production factors and marketing factor, leads to sustainable increasing milk production and participation in milk marketing in the woreda. However production constraints (for example: dairy breed type, number of milk cow, milk yield, feed, water and disease) have direct influence in amount of milk produced and this has influence on milk marketing participation and volume of sales. This is because when the production is more constrained, the milk marketing system tends to in efficient and imperfect.

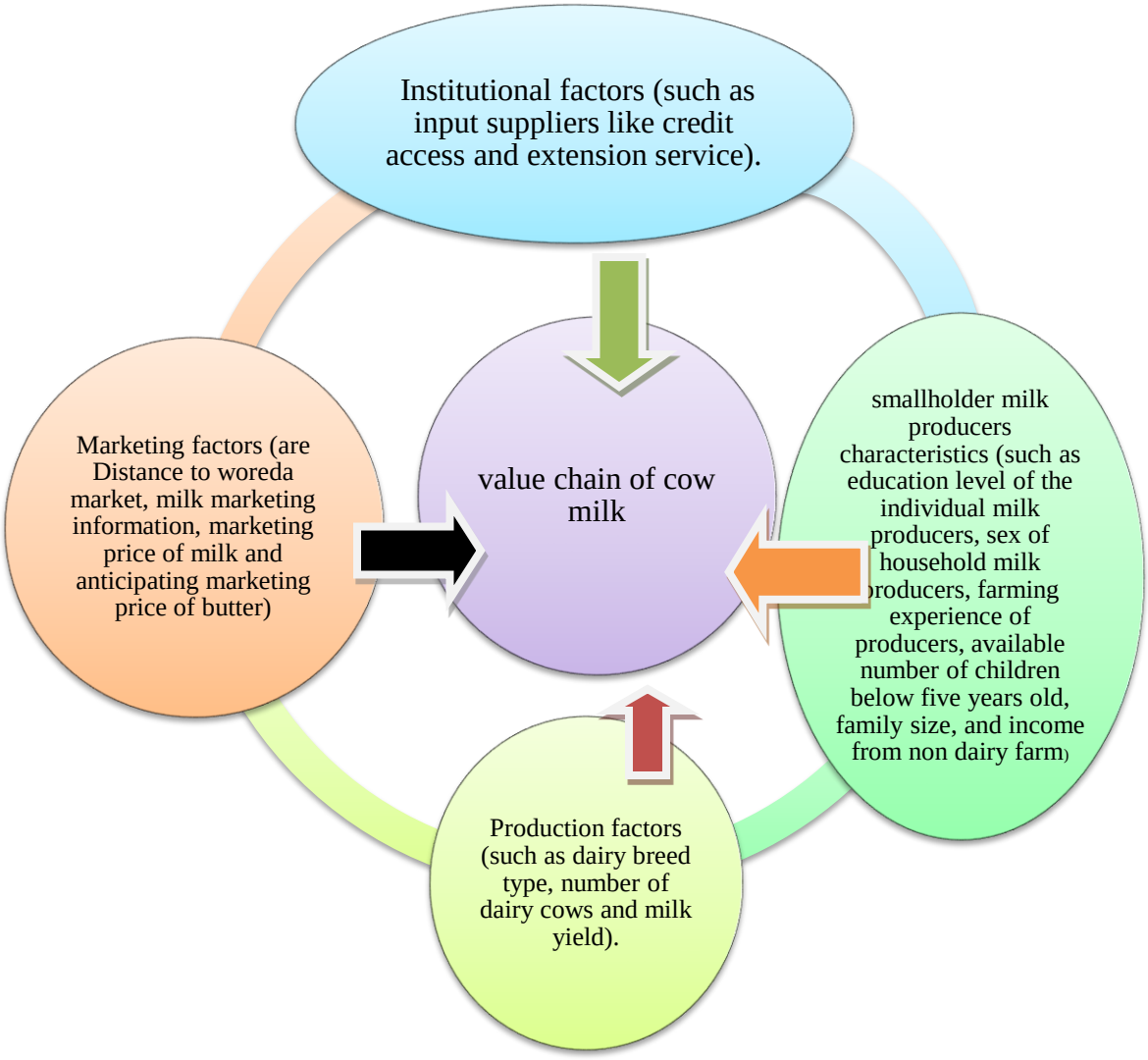

Figure 1: Milk value chain conceptual Framework
Source: own competition

Chapter Three: Materials and Methods

This chapter consists of seven sections. The first section presents a description of the study area, The second section justifies research strategy and design of the study, Section three describes sampling design and procedure, While section four explains the data type, source and collection instrument, fifth section dwells on data collection methods, The sixth section elaborates on method of data analysis, whereas, the seventh section describes on variable definition and hypothesized.

3.1. Description of the study area

Laelay Maichew Woreda has a good agricultural potential and has relatively better agricultural marketing activities due to its location advantage in being closer to the main road and Aksum town. Four kebele's were selected for the study. The nearest, medium and distant kebele's from Aksum town in order to see the value chain of cow milk in market and to see how the smallholder reach to the market. These kebeles are Dura, Medego, Debrebirhan and Mahibereselam respectively. Dura and Medego are from the nearest distant kebeles the main reason to select these two kebeles from the nearest distant is, both of them are potential in cow milk production but the socio economic of the smallholders in these two kebeles are different and Dura have large irrigation land this is one of source income and this have an advantage to have high dairy green feed therefore these two kebeles are selected from the nearest distant to Aksum town through this reason in order to reduce selection bias.

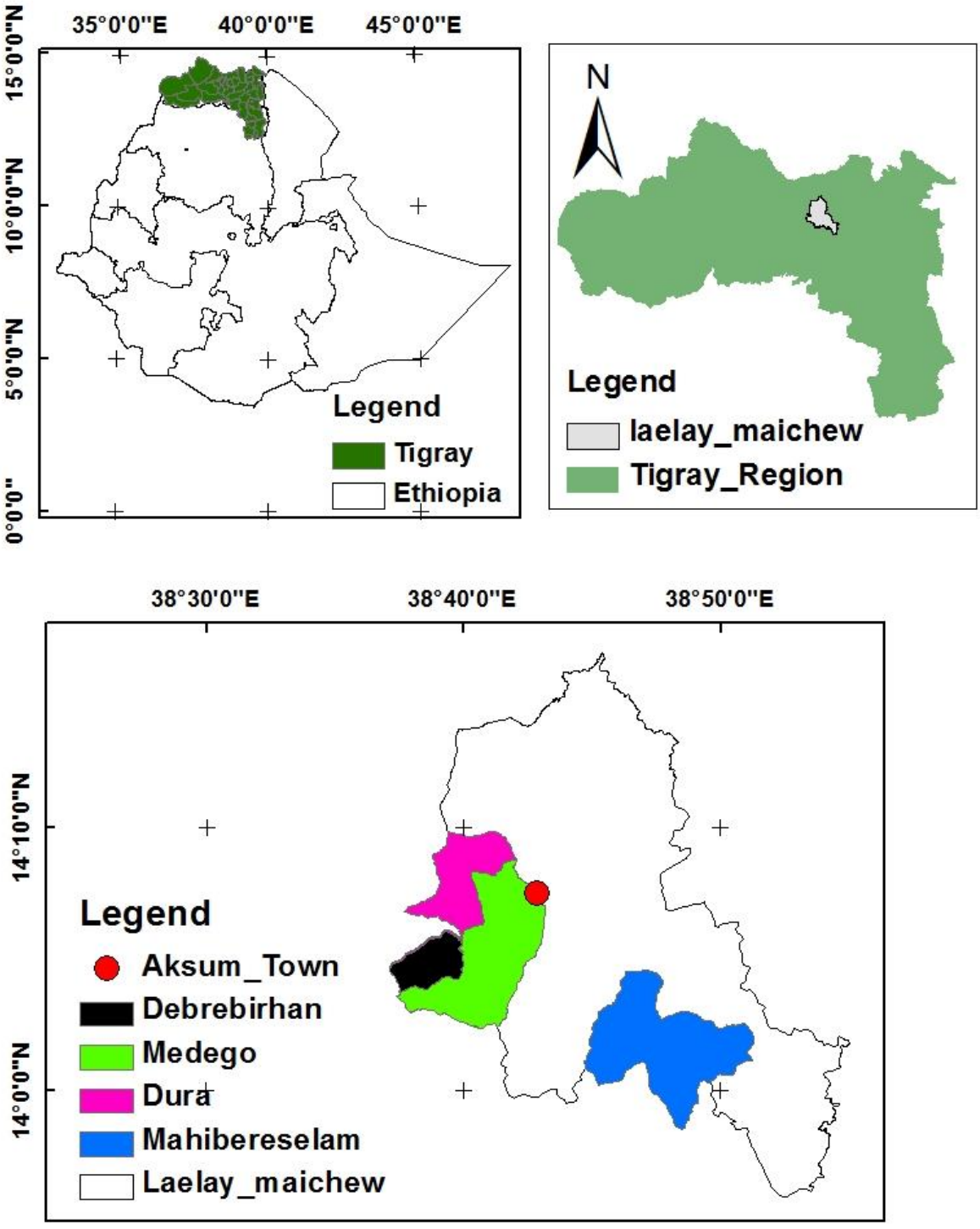

Figure 2: Map of study area

3.1.1. Climate

The area has good climatic conditions and this is an opportunity for rearing dairy cows. The agro ecology of the area is tepid to cool sub-moist mid highlands or weinadega. The elevation of the area ranges between 2050-2200masl. The mean annual temperature ranges from a minimum of 12^{o}C to an average annual maximum of 28^{o}c and the annual rainfall varies between 500-900mm and rainfall starts in June and ends in September (Laelay Maichew OARD, 2014).

3.1.2. Land use

Laelay Maichew Woreda has various land use types that could be classified into arable land, irrigated land, grazing land and forest land. The woreda has a total area of 32833 ha of which 9533.57 ha arable land, 7720 ha forest land and 4405.5 ha grazing land. From the land under cultivation 6317.5 ha is rain fed land and 2639.85 ha irrigated land (Laelay Maichew OARD, 2014)

3.1.3. Farming system

Agriculture is the mainstay of the community. The economic activity of the study area is predominantly crop and livestock production (mixed farming system).The crop production system of the study area is dependent on both rain fed and irrigation. Of the community members, 7466 male household head and 1369 female household head a total of 8835 households are irrigation users. The average landholding for households was 1.37 ha with minimum of 0.5 and maximum of 2.25ha (Laelay Maichew woreda OARD, 2014).

3.1.4. Crop production

The major crops grown in the woreda include Teff, wheat, barley, field pea, faba bean, lentil, fenugreek and maize. Teff and wheat are the major sources of daily food of the population. Farmers of the woreda use different soil fertility management practices such as inorganic fertilizing (Urea and DAP) and organic like farmyard manure, compost, crop rotation, intercropping and to build up the supply of available nutrients so as to increase crop productivity as poor soil fertility is one of the crop production constraints in the woreda their crop production system is integrated in such a way that crop residue and straw feeds their animals while the

animal waste used as manure and to prepare compost to improve their crop productivity by improving soil fertility (Laelay Maichew woreda OARD, 2014).

3.1.5. Livestock production

Livestock constitute an essential part of the farming system in the study area. Major livestock herds in the woreda are cattle, goats, sheep, donkey, chicken, camel, mule and beehive. Oxen are the main source of farm power for plowing, and threshing. In general the study area practices both grazing and cut and carries system for their livestock management (Laelay Maichew woreda OARD, 2014). Hence farmers of the area are a potential prepare compost from the animal wastes and crop residue as both production system are well practiced.

3.1.6. Commodity description in the study area

Simple assessment was conducted by ILRI on Commodities development potential at kebele levels. The three clusters of action woredas in the central zone of Tigray consist of 63 Kebeles. The field survey showed that dairy is potentially produced at about 77.78% and poultry on about 82.54%. The survey also showed that small ruminants potentially produced on about 77.78% and irrigated crops on about 77.78% of the total kebeles.

The clustering kebele potential for specific commodities showed a clear pattern of commodity combinations. For instance, in most of the irrigated sites of Laelay Maitchew Woreda, dairy and poultry has been reported as potential commodities in synergy with irrigation development (Table 1). In the less irrigated potential kebeles, small ruminant and poultry has been reported as dominant commodity combinations. The same is true for Adwa and Ahferom action woredas. Thus, the delineation of kebeles into commodity potential combinations or recommendation domains is useful for developing context specific livestock and irrigation interventions.

Table 1: Relative potential of Kebeles for livestock and irrigated crops commodity development in Laelay Maitchew Woreda, central zone of Tigray

Farming system type	Kebeles	Relative potential of kebeles for commodity development				Key target commodity
		SR meat/ live animals	poultry	dairy	Irrigated crops	
Midland irrigated with mixed crop-livestock FS	Lesalso	1	3	3	2	Poultry, dairy, sheep and irrigated agriculture
	Hatsebo	2	3	3	3	
	Medego	2	3	3	3	
	Debre Birhan	2	3	3	3	
	Dura	3	3	3	3	
	Dereka	2	2	3	3	
	Mahibere Selam	3	3	2	3	
Lowland rainfed with mixed crop-livestock FS	Edaga Arbi	3	3	2	2	Small ruminant and poultry
	May Weini	3	2	2	1	
	Sagilamen	2	1	1	1	
	Adi Tsehafi	2	3	1	1	
	Ketema Dego	1	3	1	1	
	Mihe	3	1	1	1	
	Natika Bilae	3	2	1	1	
	Awlieo	3	1	1	1	
	Welel	2	1	1	1	

Relatively commodity potential of Kebeles was assessed using 0-3 scales. Scores indicating 0 = no potential, 1= limited potential, 2 = medium potential and 3 = high potential.
Source: LIVES project enteral zone report, June 2013.

3.1.7. Socio –economy

Laelay Maichew Woreda has an estimated total population of 77,672 of which 35,177 are males and 42,495 are females. From the total 12,231 rural household heads of whom male headed household accounts for 8257 which is about 67.5 percent while female headed households' accounts for 3974, which is about 32.5 percent. The average household size of the study area is 6 heads per household. The population density of the study area is about 255 people per square kilometer (Laelay Maichew Woreda OARD, 2014). Followed to farming, supportive activities like food for work programs of governmental and non-governmental organizations and selling labor in different infrastructure development projects and in construction building are common off-farm economic source of the of the people**.**

3.2. Research Strategy and Design

3.2.1. Research Strategy

The research was conducted starting from October 2014 to October 2015 and it was based on a cross-sectional survey data in the sense that relevant data was collected at some point in time. The reason for preferring a cross sectional study is due to the nature of the study which is survey on value chain analysis of cow milk and time limitation. The study used both qualitative and quantitative data.

3.2.2. Research Design

3.2.2.1. Target Population

The population about which assessment was made is smallholder dairy producer households located in Laelay Maichew Woreda. Those total accounts for 1286 smallholder dairy producer households in the study area.

3.2.2.2. Unit of Analysis

Shortly, the unit of analysis is at household level of smallholder dairy producers in the woreda.

3.3. Sampling Design and Procedure

To address the objectives of this study, a multi stage sampling method was used to obtain the necessary information. In the first stage the study area (woreda) was selected purposively considering its agro ecological suitability for dairy production, dairy production potentials and based on sponsors' interest. Secondly, stratified sampling was also adopted in order to come up with homogenous kebele's. Hence, the kebeles were selected based on two basic criteria, one distance to Aksum town and potentially for dairy production. Thirdly, smallholder dairy producer households were selected by using simple random sampling.

Lastly, sample size of smallholder dairy producers was determined using the table developed by (Bartlett *et al*. 2001) (annex, 6). According to those authors for 1500 population size and 95% confidence interval 110 sample sizes were determined. By doing so, in this study from 1286 population size, 110 of smallholder dairy producers were selected. Then, value chain actors

(input suppliers, traders, collectors, milk processors, etc.) sample was determined based on availability and size. Accordingly, total sample for this study was used 130 (110 are smallholder dairy producers and 20 are other market actors participating in the milk value chain). Finally respondents were proportionally and randomly selected from each kebeles and stated as follows.

Table 2: Proportion of farmer households in each kebele that are produce milk

Name of Kebele	Total number of households	proportion of households sample
Dura	339	29
Medego	561	48
Debre Birhan	234	20
Mahibere selam	152	13
Total	1286	110

Source: Woreda Agricultural Office, kebele administrations and own computation, 2015

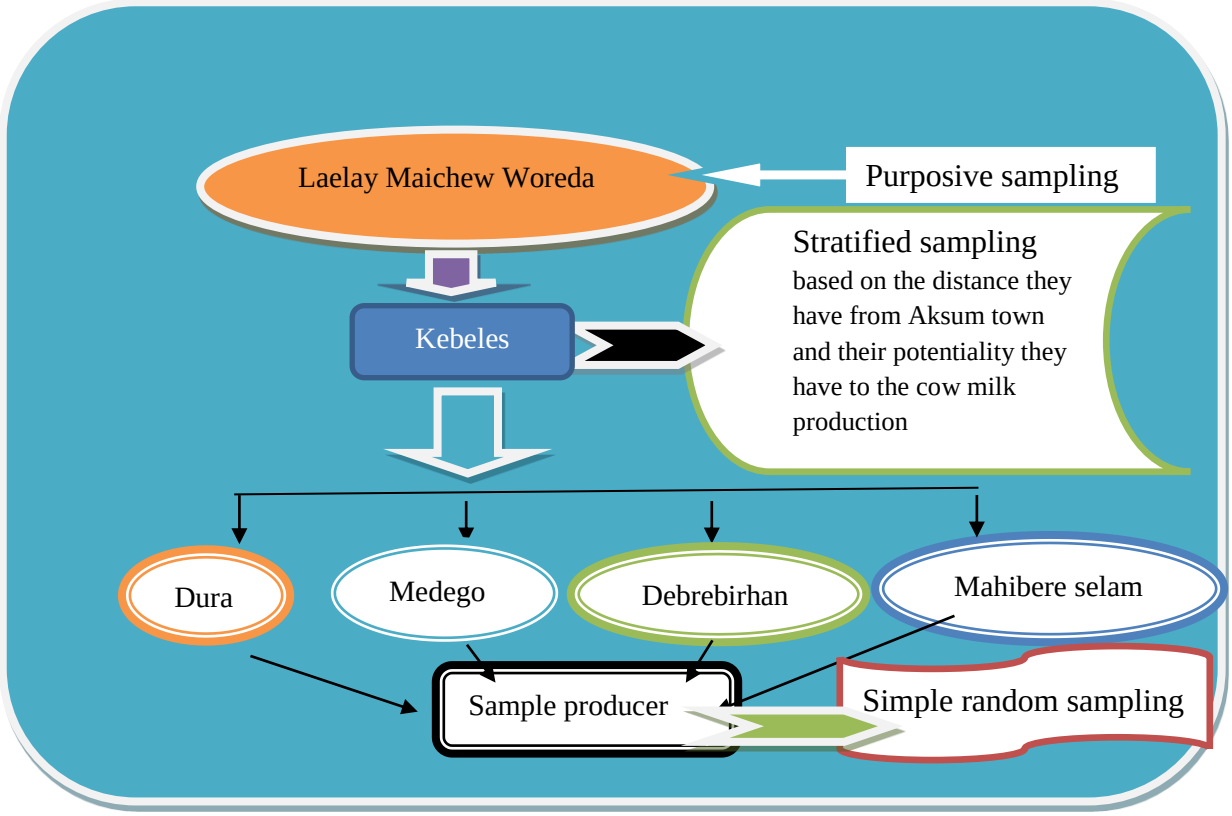

Figure 3: Sampling frame

3.4. Data Types, Sources and Collection Instruments

For this research the main sources of data were both primary and secondary data sources. And both qualitative and quantitative data were used.

Primary data was collected using semi-structured questionnaires from smallholder dairy producers. Personal interview were conducted with dairy production experts from Laelay Maichew Office of agricultural and rural development. Personal interview were conducted in order to gain feedback and for probing purposes; because individuals may be reluctant to issues which they thought are sensitive.

The main sources of secondary data for the study included reports of organizations concerning their daily performance and registered problems and businesses books that deal with the business environment, journal articles, different related manuals and reports of other stakeholder institutions.

3.5. Data collection methods

A survey questionnaire for collecting data on the socio-economic characteristics of the target population was designed with a scope limited to only the information that the researcher thought vital for the study. Trained enumerators administered the questionnaire and the essence of each question was discussed before the data collection was actually begun.

This fact requires studying the main aspects of a questionnaire viz., the general form, question sequence and question formulation and wording in addition in designing the questionnaire, a series of stages was involved. First, initial set of questions were settled for each respondent group which is then discussed with advisors. Next the questionnaire was translated through translation techniques first prepared in English then forward translation was done in to Tigrigna, then debriefing was conducted on the translated questioner. After that backward translation was also conducted in to English. Finally, comparison was conducted with the original questioner prepared in English. Then, the questionnaire was pre-tested on the study area on 10 randomly selected respondents (approximately 10% of the sample size). And further, it was refined and distributed.

After distributing the questionnaire, the researcher arranged an interview schedule on issues related to current cow milk value chains in smallholder dairy producer households in particular. The interviewees were done with the woreda Agriculture and Rural Development dairy production expert. The structure of the interview schedule was semi-structured so as to get general information as well as to extract some specific data. Personal interview mode of data collection is preferred due to its high response rate as compared to either mail or telephone interview. Further, the mode provides clarification of the questions.

3.6. Method of Data Analysis

In this study, descriptive analysis, value chain mapping, and econometric methods of data analysis were used to analyze the data collected from the respondents to meet the set objectives of the study.

3.6.1. Descriptive statistical analysis

Demographic and socio economic conditions/ features of the sampled household in the study area were analyzed by using descriptive statistics and summarized in table using percentage, frequency, mean and ranking. It was employed in the process of examining and describing marketing functions, farm household characteristics, role of intermediaries, marketing margin value and profit share among milk value chain actors. STATA version 10 statistical package was employed to compute these statistical tools.

3.6.2. Mapping the value chain and measuring distribution of benefits

Mapping a value chain facilitates a clear understanding of the sequence of activities and the key actors and relationships existed in the value chain. This exercise was carried out in qualitative and quantitative terms through graphs presenting the various actors of the chain, their linkages and all operations of the chain from pre-production (supply of inputs) to consumption. In order to map a diagram that clearly depicts the structure and flow of the value chain, the following questions may rise:

•What are the main activities carried out in the value chain to obtain the final product?
•Who are the operators involved in these activities and what are their roles?
•What are the flow of products, information and knowledge in the value chain?
•What are the production volumes and the number of actors?
•Where does the product (or service) originate from and where does it go?
•How does value change through the value chain?
•What types of relationships and linkages exist among the various chain actors?
•What types of business services are feeding into the chain, including the regulatory and policy framework in which the sector is operating?

3.6.3. Market structure, conduct and performance analysis (S-C-P) model

3.6.3.1. Market Structure

Structural characteristics like market concentration, product differentiation, barriers to entry, and diversification were some of the basis considered in the study. Barriers to entry: A barrier to entry is simply any advantage held by existing firms over those firms that might potentially produce in a given market. Market concentration: this refers to the number and size, distribution of sellers and buyers in the market. The greater the degree of concentration the greater will be the possibility of non-competitive behavior, such as collusion existing in the market. The concentration ratio is given as:

$$C=\sum_{i=1}^{r} Si \qquad i= 1, 2, 3, 4\ldots.r \qquad (1)$$

Where, C = Concentration ratio

Si = the percentage market share of the i^{th} firm

r = the number of relatively larger firms for which the ratio is going to be calculated

Kohls and Uhl (1985) bring into play as a rule of thumb, four largest enterprises' concentration ratio of 50% or more (an indication of a strongly oligopolistic industry), 33-50% (a weak oligopoly) and less than that (competitive industry). The problem associated with this index is the arbitrary selection of r (the number of firms that are taken to compare the ratio).

3.6.3.2. Market conduct

It is a systematic way to detect indication of unfair price setting practices and the conditions under which practices are likely to prevail. Meijer (1994) said that, "conduct is pattern of behavior which enterprises follow in adopting or adjusting to the market in which they sell or buy", in other words the strategies of the actors operating in the market.

3.6.3.3. Marketing Margin

After having developed the general conceptual map of the value chain, the next step is to analyze the chain's economic performance. Production costs margins and price markups, are among the possible measures of chain performance. Here, descriptive analysis was employed to examine marketing costs, margins and value share of the different marketing participants. Marketing margin analysis deals with comparison of price at different levels of marketing over the same period of time. It measures the share of the final selling price that is captured by a particular agent in the marketing chain and always related to the final price or the price paid by the end consumer, expressed in percentage (Mendoza, 1995).

No other term associated with agricultural marketing is more misunderstood than the concept of a marketing margin. A big marketing margin may, in fact, result in little or no profit or even a loss for the seller involved. That depends on the marketing costs as well as on the selling and buying price. Because precise marketing costs are frequently difficult to determine in many agricultural marketing chains, the gross and not the net marketing margin is calculated. Thus, the marketing margin should be understood as the gross marketing margin.

The formula to calculate total gross marketing margin (TGMM) is given as:

$$TGMM = \frac{\text{End Buyer price} - \text{Farmer's Price}}{\text{End Buyer Price}} \times 100 \qquad (2)$$

The gross (profit) margin is the difference between sales revenue and cost price, expressed as percentage of the cost price or as discounted percentage of the sales price. The net (profit) margin is the same as that of gross margin excluding Value Added Tax. It is useful to introduce here the idea of producer participation, farmer's portion or producer's gross margin (GMM) which is the portion of the price paid by the end consumer that belongs to the farmer as a producer. The producer's margin or share in the consumer price GMM_P is calculated as:

$$GMM_P = \frac{\text{Price paid by End Buyer} - \text{Gross Marketing Margin}}{\text{Price Paid by End Buyer}} \times 100 \qquad (3)$$

The consumer price share of market intermediaries is calculated as:

$$MM = \frac{SP - BP}{EBP} \times 100 \quad (4)$$

Where: MM = Marketing margin (%)

SP = Selling price at each level

BP = Buying price

EBP = End buyer price

In marketing chain with only one trader between producer and consumer, the net marketing margin (NMM) is the percentage over the final price earned by the intermediary as his net income once his marketing costs are deducted. The percentage of net income that can be classified as pure profit (i.e., return on capital) depends on the extent to which factors such as the middleman`s own, often imputed, salary are included in the calculation of marketing costs.

$$NMM = \frac{\text{Gross Margin - Marketing Cost}}{\text{Price Paid by End Buyer}} \times 100 \quad (5)$$

Finally, profit margin can be calculated by deducting operating expenses from marketing margin (Dawit, 2010).

$$TGPM = TGMM - TOE \quad (6)$$

Where, TGPM is total gross profit margin, TGMM is total gross marketing margin and TOE is total operating expense.

Profit margin at stage "i" is given as:

$$GPMi = \frac{GMMi - OEi}{TGPM} \times 100 \quad (7)$$

GPM_i is gross profit margin at i^{th} link; GMM_i is gross marketing margin at i^{th} link;

OE_i is operating expense at i^{th} link and TGPM is total gross profit margin.

3.6.4. Econometric analysis

Heckman selection model was used to identify the main determinants of smallholder farmers' participation in lucrative markets and marketed supply of cow milk, which is the third objective of the study.

If two decisions are involved, such as participation and volume of supply and there is selection bias, in this case Heckman's sample selection model is appropriate (Heckman, 1979). The Heckman two-step procedures first estimate the participation equation (the probability of participating in milk market) and derive maximum likelihood Probit estimates from the coefficient of the participation equation. Using these estimates, a variable known as the inverse mills ratio is calculated. The inverse Mills ratio is a variable for controlling bias due to sample selection (Heckman, 1979). The second stage involves including the mills ratio to the milk supply equation and estimating the equation using Ordinary Least Square (OLS) technique to estimate the model.

The participation/the binary probit model is specified as:

$$Y_i = X_i + \varepsilon_i, i = 1,2,...., n \quad (8)$$

$$MMP = 1 \text{ if } Y_{1i} > 0 \text{ and } MMP = 0 \text{ if } Y1i \leq 0$$

Where MMP is milk market participation; Y_i is a dummy variable indicating the market participation; X_i are the variables determining participation in the probit model; β_i is unknown parameter to be estimated in the probit regression model; ε_i is random error term.

Then the parameters can consistently be estimated by OLS over n observations reporting values for Y_i by including an estimate of the IMR denoting λ_i as an additional regressor in equation (7). More precisely the observation equation/the supply equation is specified as:

$$Y_i = X_i \beta_i + \mu_i \lambda_i + \eta_i \quad (9)$$

where Y_i is the volume of marketed milk supply in the second step; X_i are the explanatory variables determining the quantity supply; β_i is unknown parameter that shows estimated in the quantity supply; μ_i is a parameter that shows the impact of participation on the quantity supply; η_i is the error term.

3.6.5. Rank analysis

Constraints of cow milk value chain in Laelay Maichew woreda were ranked based on the principle of weighted average using MS excel 2007 auto ranking method. The following formula was used to compute index as employed by Musa *et al* (2006):

Index = Rn*C1+Rn-1*C2…. +R1*Cn / Σ Rn*C1+Rn-1*C2…. +R1*Cn;

Where, Rn=Value given for the least ranked level (example if the least rank is 10th, then Rn=10, Rn-1=9, R1 = 1).

Cn = Counts of the least ranked level (in the above example, the count of the 10th rank =Cn, and the count of the 1st rank = C1).

3.7. Variable Definition and Hypothesis

Different variables were expected to affect the value chain of cow milk in the study area. Thus, it is important to define their measurement and identify the potential explanatory variable as well as the symbol to represent them. Accordingly, the major variables expected to have an influence on the cow milk value chain are explained below.

3.7.1. Dependent variables

This study uses the following two dependent variables in two stages of the value chain analysis

Milk Market Participation decision (MMP): Is a dummy variable that represents the probability of market participation of the household in the milk market that is regressed in the first stage of the Heckman two stages estimation procedure. It was taking 1 for the respondents who participate in milk market and 0 for respondents who do not participate in the market.

Marketed Milk Volume (**MMV):** It is a continuous variable in the second step of Heckman selection equation. It is measured in liters and represents the actual supply of milk by sample households to the market which is selected for regression analysis that takes positive values.

3.7.2. Independent (explanatory) variables

Credit access: This is a dummy variable which enables milk producers to increase their financial capacity to participate in milk market and to supply more volume milk to the market. Therefore, it is expected to have positive impact on milk market participation and milk marketed volume surplus. 1 for access credit, 0 otherwise.

Milk market information: It is a dummy variable. Market information is the information on price, demand, buyers and other relevant information that could contribute for a good decision of sellers. The better information farmers had about the milk marketing the higher would be their participation level and supply volume of milk. Therefore, it is hypothesized that market information is positively related to market participation and supply of marketed milk volume. 1 for access to milk market information, 0 otherwise.

Distance to the woreda market: It is a continuous variable measured in kilometer. The closer the market the lesser the transportation charges, reduced trekking time, reduced loss to spoilage, reduced transaction costs, and reduce other marketing costs. A study conducted by Holloway etal. (2002) on expanding market participation among smallholder livestock producers in the Ethiopia highlands revealed that distance to market was negatively related to market participation decision by dairy household. Therefore, in this study distance to woreda milk market is hypothesized to affect market participation decision and volume surplus negatively.

Breed type: it is a dummy variable which takes 1 if the cow milk is exogenous breed and 0 if local breed. It is assumed that the exotic breeds are relatively high productive than the local breeds and is hypothesized that this variable is positively related to market participation and marketed surplus.

Number of dairy cows (exogenous breed, local breed): This variable is a continuous variable measured in number of milking cows owned. The entry to milk market and marketed milk

volume are assumed to be positively influenced by the number of exogenous breed and local breed dairy cows.

Milk yield: It is a continuous variable measured in liters. A marginal increase in dairy production has obvious and significant effect in motivating market participation and volume of milk supply. The variable is expected to have a positive contribution to market participation and marketed volume.

Education level of household head: It is a continuous variable and measured in years of schooling of the household head. Formal education is hypothesized to have positive influence on market participation and marketed surplus.

Farming experience: it is a continuous variable measured in terms of the number of year of cow milk farming experience of the household head; it is expected to have a positive effect on milk market participation and milk supply to market.

Sex of household head: This is dummy variable that takes a value of 1 if the household head is female and 0 otherwise. It is assumed that the female are responsible for managing and caring of milk related activities and is expected that this to have positively related with milk market participation and milk sales volume.

Children below five years old: continuous variable measured in terms of the number of children below age of five in the sample household. Mostly milk as a major food and its importance in children growth is widely accepted and recognized both in rural and urban areas. An increase in the number of children in this age category usually decreases the marketed surplus and therefore it is expected to have negatively related to marketed surplus of milk and reduces the ability of the smallholder in market participation.

Family size: this variable is a continuous explanatory variable and measured in terms of adult equivalent. Families with more household members tend to have more labour. Production in general and marketed surplus in particular is a function of labour. Thus, family size is expected to have positive impact on market participation but larger family size requires larger amounts for consumption, reducing marketed surplus.

Market price of milk: This is the price offer a farmer receives from selling his produce. It is a continuous variable Birr[7] (ETB) and expected to influence market participation and supply decisions positively. As farmer sees better price the probability of entering a market and volume of milk supply was increase.

Anticipated market price of butter: it is a continuous variable measured in Birr (ETB). It is expected to influence supply decisions negatively. As farmer expects better price volume of milk supply was decrease.

Income from the non-dairy sources: It is continuous variable measured in Birr (ETB).The variable represents income originating from different sources and obtained by the sample household. Through improving liquidity, this income makes the household to expand production and or/ purchase from market. It also strengthens the household position in coping with different forms of risks. Thus, income from non-dairy source is hypothesized to affect milk market entry decision by household and sale volume of milk positively. Should be also negatively

Access to dairy production extension service: This variable is measured as a dummy variable taking a value of 1 if the dairy household has access to dairy production extension service and 0 otherwise. It is expected that extension service widens the household's knowledge with regard to the use of improved dairy production technologies and has positive impact on milk market participation decision and sale volume of milk. Therefore contact with extension agent is assumed to have direct relation with market participation and volume of marketed surplus.

[7] **Birr** (ETB) is an Ethiopian currency

Table 3: Description of the dependent and independent variables used in the model

Variables used in the model	Explanation	Category	Value	Expacted Sign
MMP	Milk Market Participation decision	dummy	0= Not to participate 1= participate	
MMV	Marketed Milk Volume	Continuous	Birr (ETB)	
	Independent explanatory variables			
CreditA	Credit access	Dummy	0= Not access 1= Access	Positive
MMI	Milk market information	Dummy	0= No 1=Yes	Positive
DWM	Distance to woreda market	Continuous	Kilometer	Negative
BreedT	Breed type	Dummy	0= Local breed 1= Improved	Positive
NDCEL	Number of dairy cows (exogenous breed, local breed)	Continuous	Number of milking cow	Positive
MilkYD	Milk yield	Continuous	Milk production in liters	Positive
ELHH	Education level of household head	continuous	Years of schooling	Positive
FExp	Farming experience	Continuous	years	Positive
SHH	Sex of household head	Dummy	0= male 1=Female	Positive
CBFYO	Children below five years old	Continuous	Number	Negative
FS	Family size	Continuous	Number	Positive
MPM	Market price of milk	Continuous	Birr	Positive
AMPB	Anticipated market price of butter	Continuous	Birr	Negative
IFNDS	Income from the non-dairy sources	Continuous	Birr	Positive/ Negative
AcDPExS	Access to dairy production extension service	Dummy	0= No 1=Yes	Positive

Before running the model it is important to check multicollinearity problem for continuous and dummy variables. According to Gujarati (2003) multicollinearity refers to a situation where it becomes difficult to identify the separate effect of independent variables on the dependent variable because of there exists strong relationship among them. Moreover, multicollinearity is a situation where explanatory variables are highly correlated. There are two measures, which are often suggested to test the existence of multicollinearity.

These are Variance Inflation Factor (VIF) for association among the continuous explanatory variables and Contingency Coefficients (CC) for dummy variables.

Variance inflation factor (VIF) is used to check multicollinearity of continuous variables. As R_j^2 increase towards unity, that is, as the collinearity of X_j with the other repressors increase, VIF also increases and in the limit it can be infinite. The larger the value of VIF, the more troublesome or collinear is the variable X_j. As a rule of thumb, if the VIF greater than 10, which will happen if R_j^2 is greater than 0.90, that variable is said to be highly collinear (Gujarati, 2003). Multicollinearity of continuous variables can also be checked using Tolerance. Tolerance is unity if X_j is not correlated with the other explanatory variable, whereas it is zero if it is perfectly correlated with other explanatory variables. The popular measure of multicollinearity is defined as…….

$$VIF\left(X_j\right) = \left(1 - R_j^2\right)^{-1} \quad \text{..... (10)}$$

Where, Rj^2 is the coefficient of determination in the Auxiliary regression

Contingency coefficient is used to check multicollinearity of discrete variables. It measures the relationship between the raw and column variables of a cross tabulation. The value ranges between 0 - 1 , with 0 indicating no association between the raw and column variables and value close to 1 indicating a high degree of association between variables. The decision criterion (CC < 0.75) is that variables with the contingency coefficient is computed as follows

$$CC = \sqrt{\frac{\chi^2}{N + \chi^2}} \quad \text{..... (11)}$$

Where, CC is contingency coefficient, χ 2 is chi-square test and N is total sample size.

STATA 10 was used to compute both VIF and CC.

Chapter Four: Result and Discussion

This section of the thesis discusses the findings of the study such as results of descriptive, value chain and econometrics analysis's that are found in relation to the research questions and objectives. The descriptive analysis has been done to describe the general socio-economic and demographic characteristics of the sampled smallholder dairy producer householders, the characteristics of milk production and marketing in the study area, and the costs and benefits of milk marketing channels in the area. Mean, percentage, standard deviations and marketing margins were employed to obtain the results. In the value chain analysis description of major actors and their functions were done and developed value chain map of the commodity. Econometric model was also employed to identify the factors affecting farmers' participation in milk marketing and volume marketed in the study area.

4.1. Descriptive Analysis

For the descriptive statistics, sampled smallholder dairy producer householders were divided into participants and non-participants of milk marketing. The descriptive statistical analysis was run to assess the differences and similarities among sellers and non-sellers of milk producers in terms of their demographic and socio-economic characteristics.

4.1.1. Demographic and Socio-Economic characteristics of sample households

The sampled population of household respondents handled during the survey was 110. The survey data shows that, age of the sampled household respondent was ranged from minimum 28 to maximum 61 years, with a mean age of 42.95 years. Average age of milk market participation was found to be 41.54 years. While the average age of the non-participants was 44.21 years. Comparing these two groups, the milk market participants were relatively younger than the non-participants and statistically significant mean difference in age was analyzed which suggests that as age increases the probability of participation in milk marketing will be decrease. The average family size of the milk market participants and non-participants was 6.19 and 6.31 respectively, with no statistically significant mean difference. Similarly, farming experience of participant (5.63) and non- participant (4.52) was analyzed to be non-significant.

Table 4: Demographic and Socio-Economic characteristics of sample households

Variables	Participant (52)		Non-participant (58)		P-Value	Total sample (110)	
	Mean	**Std**	**Mean**	**Std**		**Mean**	**Std**
Age	41.54	8.1685	44.21	7.6474	0.079*	42.95	7.9745
Family size	6.19	1.9708	6.31	1.7392	0.739	6.25	1.8446
Farming Experience	5.63	5.2582	4.52	4.5199	0.233	5.05	4.8922
Variables	**Frequency**	**%**	**Frequency**	**%**	**P-value**	**Frequency**	**%**
Sex							
Male	45	40.91	45	40.91	0.224	90	81.82
Female	7	6.36	13	11.82		20	18.18
Education level							
Grade 1-4	38	34.55	42	38.18		80	72.73
Grade 5-8	12	10.91	14	12.73	0.401	26	23.64
Grade 9-10	2	1.82	2	1.82		4	3.64
Marital status							
Single	8	7.27	12	10.91		20	18.18
Married	40	36.36	42	38.18	0.445	82	74.55
Divorced	4	3.64	4	3.64		8	7.27

*Where, *, signifies probability level of significance 10%.*
Source: Survey result, 2015.

Among the total sample households heads 82.82% were male and the remaining 18.18% were female headed implying that more of the sample dairy producer households were male. Proportionally, from milk market participants of sampled households, 40.91%, and 6.36% were male and female headed respectively and from milk market non-participants of sampled households, 40.91%, and 11.82% were male and female headed respectively. Regarding their marital status, majority (74.55%) were married and the rest (18.18%) single and (7.27%) divorced. During the survey, there were no households in the sample who has educational background above preparatory level and non-educated.

4.1.2. Milk Production overview of sample households

The average number of dairy cow owned by milk market participant (2.25) and non-participant (1.36) showed statistically highly significant difference (table 5). Moreover, highly significant difference in average milk produced per year by participant (1377.98) and non-participant (527.85) was observed. Consequently, the average milk produced per cow per year, by those two groups (participant and not participant) was 689.69 and 425.5 respectively with highly significance difference at less than 1% significance level. It is obvious that milk sold on those participants and not participants were 4.92 liter and 0 respectively and this shows highly significance difference at less than 1% significance level. This might be due to, non-participant households have limited access to milk market information, they have a long distance to woreda market compared to participant and they need to process it.

Table 5: Milk production of Households and kebele's

	Variables	Participant (52)		Non-participant (58)		P-Value	Total sample (110)	
		Mean	**Std**	**Mean**	**Std**		**Mean**	**Std**
Total HH	Total cow (no)	2.25	1.0455	1.36	0.7422	0.0000***	1.78	0.9989
	Total milk per year (liter)	1377.98	916.6019	527.85	213.9747	0.0000***	929.73	773.8492
	Milk per cow per year (liter)	689.69	462.5398	425.5	155.0833	0.0001***	550.39	360.8821
	Milk sold (liter/day)	4.92	2.8687	0	0	0.0000***	2.33	3.1539
Dura	Total cow (no)	1.93	0.9973	1.27	0.4577	0.0279**	1.59	0.8245
	Total milk (liter)	1125	698.3029	470	214.7424	0.0018***	786.21	600.3417
	Milk per cow (liter)	635.36	344.654	385	132.193	0.0143**	505.86	283.0165
	Milk sold (liter/day)	4.64	3.1035	0	0	0.0000***	2.24	3.1697
Medege	Total cow (no)	2.33	1.0646	1.41	0.9306	0.0024***	1.81	1.0848
	Total milk (liter)	1831.43	1072.368	505	168.3232	0.0000***	1085.31	973.2504
	Milk per cow (liter)	893.48	548.1312	420.15	173.8285	0.0001***	627.23	448.1889
	Milk sold (liter/day)	6.10	2.9815	0	0	0.0000***	2.67	3.6222
Debrebirhan	Total cow (no)	2.57	1.0894	1.5	0.8366	0.0462**	2.25	1.1180
	Total milk (liter)	1089.64	657.046	630	144.4991	0.1119	951.75	589.5566
	Milk per cow (liter)	495.07	359.9232	490	180.6654	0.9745	493.55	311.8189
	Milk sold (liter/day)	3.71	2.0913	0	0	0.0004***	2.6	2.4581
Mahbereselam	Total cow (no)	1.67	0.5774	1.3	0.4831	0.2904	1.39	0.5064
	Total milk (liter)	730	360.4164	615	319.7655	0.6044	641.54	317.6173
	Milk per cow (liter)	425	99.8749	462	112.4278	0.6203	453.46	106.7978
	Milk sold (liter/day)	3.67	1.5275	0	0	0.0000***	0.85	1.7246

*Where, ***, **, *, signifies probability level of significance at 1%, 5% and 10% respectively.*

Source: survey result, 2015

4.1.3. Access to services

Access to services like credit, agricultural extension and market information has vital importance to promote agricultural households' production and productivity which thereby increase marketable surplus and ultimately farm income. For farmers, knowing where and when to sell their output is one of the most difficult challenges. If they have no knowledge of current market prices, they can easily be exploited. But gathering information about markets may not be easy, especially for people living in very remote areas (CTA, 2008). Addressing new challenges requires extension to play an expanded role with a diversity of objectives, which include: linking farmers more effectively and responsively to domestic and international markets; enhancing crop diversification; coupling technology transfer with other services relating to input and output markets; poverty reduction and environmental conservation; viewing agriculture as part of a wider set of rural development process that includes enterprise development and non-farm employment; and capacity development in terms of strengthening innovation process, building linkages between farmers and other agencies, and institutional development to support the bargaining position of farmers (Sulaiman *et al.*, 2006).

Household respondents were also interviewed whether or not they have access for services like credit, extension service and market information and as depicted in table 6. 75.5%, 65.5% and 31.8% of the total household respondents replied as they have the access for credit services, extension service and market information respectively for their dairy production. The main purpose why they took the money was for fertilizer, seed purchasing and dairy improved breed purchasing. As indicates in table 6, from the total sample respondents 31.8 % get current market information on milk from different sources. There is also statistically significance difference between the participants and non-participants' access to current market information at less than 1 % significance level. The access to service of the sampled households of the two groups (participant and non-participant) by kebeles credit service was not statistically different in all the sampled kebels but extension service is statistically significance at less than 10 % only at Debrebirhan kebele. Moreover, access to milk market information was statistically significance at less than 1 % at both Dura and Debrebirhan kebeles but in Medego kebele it is statistically significance at less than 5% whereas in Mahibereselam it was insignificant.

Table 6: Access to service

	Access to service	Description	Participant (52)		Non-participant (58)		χ^2-value	P- value	Total sample	
			No	%	No	%			No	%
Total household (N= 110)	Credit	Yes	40	36.4	43	39.1	0.115	0.735	83	75.5
		No	12	10.9	15	13.6			27	24.5
	Extension	Yes	32	29.1	40	36.4			72	65.5
		No	20	18.2	18	16.3	0.669	0.413	38	34.5
	Market information	Yes	29	26.4	6	5.4			35	31.8
		No	23	20.9	52	47.3	26.078	0.000***	75	68.2
Dura (N= 29)	Credit	Yes	12	41.38	11	37.93			23	79.31
		No	2	6.90	4	13.79	0.677	0.411	6	20.69
	Extension	Yes	10	34.48	9	31.03	0.417	0.518	19	65.52
		No	4	13.79	6	20.69			10	34.48
	Market information	Yes	7	24.14	1	3.45			8	27.59
							6.807	0.009***		
		No	7	24.14	14	48.28			21	72.41
Medoge (N= 48)	Credit	Yes	17	35.42	20	41.67	0.316	0.574	37	77.09
		No	4	8.33	7	14.58			11	22.91
	Extension	Yes	15	31.2	22	45.83	0.676	0.411	37	77.07
		No	6	12.5	5	10.42			11	22.92
	Market information	Yes	9	18.75	3	6.25			12	25
							6.349	0.012**		
		No	12	25	24	50			36	75
Debrebirhan (N= 20)	Credit	Yes	9	45	4	20	0.011	0.919	13	65
		No	5	25	2	10			7	35
	Extension	Yes	6	30	5	25	2.780	0.095*	11	55
		No	8	40	1	5			9	45
	Market information	Yes	12	60	1	5			13	65
							8.802	0.003***		
		No	2	10	5	25			7	35
Mahibers elam (N= 13)	Credit	Yes	2	15.38	8	61.54	0.231	0.631	10	76.92
		No	1	7.69	2	15.38			3	23.08
	Extension	Yes	1	7.69	4	30.77	0.043	0.835	5	38.46
		No	2	15.38	6	46.15			8	61.54
	Market information	Yes	1	7.69	1	7.69			2	15.38
							0.965	0.326		
		No	2	15.38	9	69.23			11	84.62

*Where, ***, **, *, signifies probability level of significance at 1%, 5% and 10% respectively.*

N= Sample size

Source: survey result, 2015.

4.2. Value Chain Analysis

This part discusses the structure, the function and actors of milk value chain in the study area. The objective is to map and describe the function of milk value chain actors and to identify the costs and benefits of the actors in the chain.

4.2.1. Actors in milk value chain and their marketing functions

According to Anandajayasekeram and Berhanu (2009), the focus of value chain framework is in developing an effective way of coordinating the hierarchical stages in the value chain to meet consumer demand in an efficient manner. Effective vertical coordination of value chain stages requires partnership, actor interactions, information flow along the chain and coordination of the activities of chain actors. Hence, the competitiveness of a value chain is greatly influenced by the partnership and collaboration for innovation that can be realized by chain actors. Moreover, the development and operation of enabling and supportive business development services (e.g. market information, transport, credit) play critical role in how well the value chain responds to consumer demands.

In this study, different milk market participants were identified in the exchange functions between producer and the final consumer. The main actors participating in milk value chain are input suppliers, smallholder dairy producer, dairy producer cooperatives, hotel & café and consumers for milk market.

4.2.1.1. Input suppliers

Milk value chain starts from the input suppliers. Improved breed, Feed, AI service, and medicament service are the key inputs of milk production. So, input suppliers play an important role in the milk value chain as they supply those inputs to the farmers. Farmers of the study area collect feeds, feeding equipment and medicine from the traders of local market. For AI service the producers depends on woreda Agricultural office, whereas supply of improved breeds, from their own source or getting from government by loan and also they can get from local farmers on cash payment. Input suppliers in the study area are predominantly governmental organization such as Woreda Agricultural and Rural Development office, Tigray Agricultural Research Institute, and Tigray Agricultural Marketing and Promotion Agency. In the study area NGOs are

the next input suppliers and the Existing NGOs are two types one local NGO Relief Society of Tigray and Dedebit Saving and Credit Institution and the second international NGOs like, ILRI lives project. Their aim is supply of improved dairy cow breed at reasonable prices, facilitating AI services and necessary medicament for their dairy cow and supporting of the producers in Knowledge and skill of dairy cow husbandry and milk marketing and processing.

4.2.1.2. Smallholder Dairy producers

Milk producers are very important actor in the milk value chain. They are the producer - sellers. Milk producing smallholder farmers generally sold their milk to the intermediaries and directly to consumer either in the woreda markets or at the neighbuor and thus formed a link in the milk value chain map. Those are the second actors in the value chain of milk and the basis of market participant in milk markets. The producers are mostly smallholder farmers and they are always supplied milk for consumption to rural and urban area in the most efficient way to dispose of surpluses quickly and cost effectively for payment. Traditionally, smallholder dairy producers work as integrated actor and perform two or more functions of value chain. They make husbandry practice, feeding, breeding and milking for their dairy cows and transporting and selling the milk to processer, dairy cooperative and consumers.

4.2.1.3. Dairy Cooperatives

The dairy cooperatives found in the study area are the second and third link in the milk value chain. They are engaged in producing and buying of milk from farmers and sell it to rural and urban consumers and processers (hotel and café). Dairy cooperatives play important roles in collecting even the small amount of milk which is not encouraged to sell by individuals because the distant they have from the town and selling the collected milk to the various market outlets.

4.2.1.4. Processers (hotel and café)

These are the last link in the milk value chain they are engaged in buying, processing and selling milk to any consumer coming to their service area. They are sometimes considering as processers and retailers of milk.

4.2.1.5. Consumers

Consumers are the final users and the most important actor of milk value chain. There were two types of consumer in this milk value chain. Those are consumers from smallest size rural community and from the largest size urban consumers of the study area.

4.2.1.6. Support service providers

Support services do not directly perform the basic functions in a value chain. They refer to general investment and preparatory activities benefiting all or at least several value chain actors simultaneously. They remain outsiders to the regular business process and restrict themselves to temporarily facilitating a chain upgrading strategy. Typical facilitation tasks include creating awareness, facilitating joint strategy building and action and the coordination of support activities (like training, credit, etc). In the study area the support service providers in the milk value chain were credit organizations and extension services.

4.2.1.6.1. Credit organization

Credit organizations were those organizations which provide credit for milk production and other related activities. The existing credit organizations in the study area are NGOs (Relief Society of Tigray (REST) and LIVES/ILRI) and Dedebit Saving and Credit Institute (DSCI).

4.2.1.6.2. Extension Services

Farmers can get the facilities of extension services from the woreda Agricultural and Rural Development Office at individual and group level. They can get advice from Lealay Maichew extension and agriculture officer and LIVES/ILRI.

Milk Value chain map

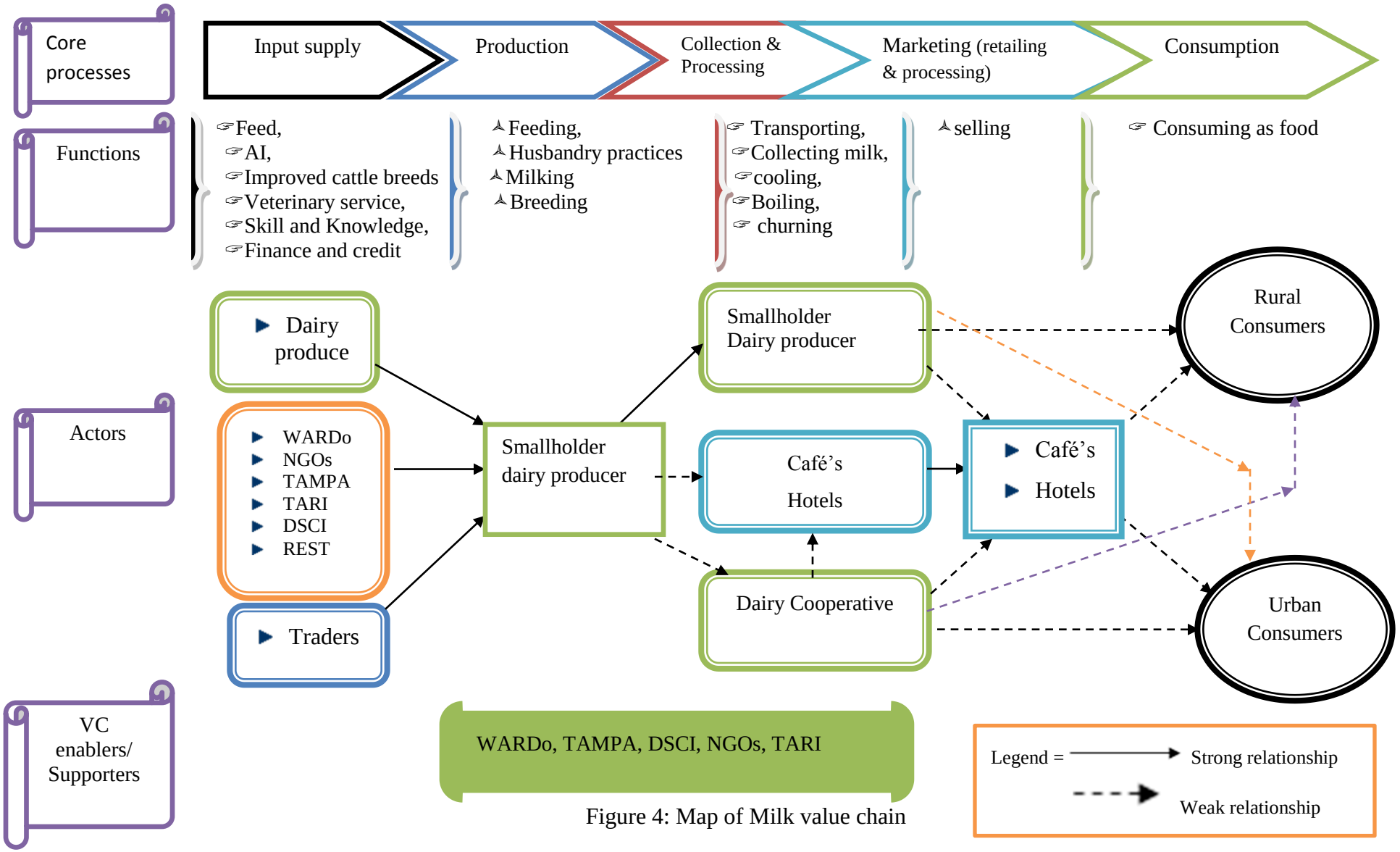

Figure 4: Map of Milk value chain

4.2.2. Milk marketing channels

Milk market channels connect producers, dairy cooperatives, and hotels/restaurants and café to consumers as shown in Figure 5. Six types of market-outlets to sell milk were identified in the study area and the starting point in the milk market channels is the producers and the final users of the products are the consumers. Generally, milk is channeled either to dairy cooperatives, hotels/restaurants and café and then to consumers. Milk marketing channels for the four selected sample kebeles are similar nature as shown below but in kebele Debrebirhan there are Dairy cooperatives which is facilitate the marketing of fluid milk in the area. In the study area the total milk volume marketed per day per total sampled milk marketed was through informal marketing system.

Marketing channels in the study area

Channel 1: Producer → Rural Consumer
Channel 2: Producer → Urban Consumer
Channel 3: Producer → Processer → Urban Consumer
Channel 4: Producer → Dairy cooperatives → Rural consumer
Channel 5: Producer → Dairy cooperatives → Urban consumer
Channel 6: Producer → Dairy cooperatives → processers → Urban consumer

Figure 5: Milk marketing channels of the study area

4.3. Structure, Conduct and Performance (S-C-P) of Milk Market

4.3.1. Measure of market concentration ratio

According to, Scott (1995) Market concentration refers to the number and relative size of buyers or sellers in a market. Similarly, Bain (1968) defined Market structure as those characteristics of the organization of the market that seems to exercise strategic influence on the nature of competition and pricing within the market. Many studies indicate the existence of some degree of positive relationship between market concentration and gross marketing margins. It is generally believed that, higher market concentration implies a non-competitive behavior and thus inefficiency. However, some studies also warn against the interpretation of such relationships in isolation from other determinant factors like barriers to entry and scale economies.

Concentration ratio for fluid milk market was calculated by taking the annually purchased volume of milk by market participants in liter. In this study, the degree of market concentration was measured using the common measures of market concentration that is Concentration Ratio (C_4).

Four processors'/Retailers (Hotel and café) with the largest volume of milk handled were used for the calculation of market concentration ratio of milk traders. As indicated in Table 7, market concentration ratio of the four milk processors'/retailers in Aksum town was 34% and this figure suggested that the market type is weak oligopoly market type and this result is supported by Kohls and Uhl (1985). This indicates that there are many dairy producers in the Aksum town.

Table 7: Milk traders' concentration ratio in Aksum town

No. of traders (A)	Cumulative frequency of traders (B)	% of traders $\left(D=\frac{A}{20}\right)$	Cumulative % of traders (E)	Quantity purchased in liter (F)	Total quantity purchased in liter (G)= A*F	% share of purchase $Si=\frac{G}{39785}$	% cumulative purchase $C=\sum_{i=1}^{r} Si$
1	1	5	5	4745	4745	12	12
1	2	5	10	3650	3650	9	21
1	3	5	15	2920	2920	7	28
1	4	5	20	2190	2190	6	34***
10	14	50	70	1825	18250	45	79
4	18	20	90	1460	5840	15	94
2	20	10	100	1095	2190	6	100
20		100		17885	39785	100	

Source: survey result, 2015

4.3.2. Market conduct

Market conduct refers to the patterns of behavior that firms follow in adopting or adjusting to the markets in which they sell or buy (Bain, 1968). According to Abbott and Makeham (1981), conduct refers to the market behavior of all firms. In what way do they compete? Are they

looking for new techniques and do they apply them as practicable? Are they looking for new investment opportunities, or are they disinvesting and transferring funds elsewhere?

In this study, the smallholder dairy producers in Laelay Maichew woreda have weak or no organizations. Thus, they lack the power to negotiate. Due to this, they simply take price and other terms like payment deadline from input suppliers and buyers of milk. Therefore, they are not in a position to interact effectively with other stakeholders in the milk market chain. Out of the selected milk producer households, 47.3% are engaged in selling fluid milk whereas 52.7 % are not selling their product. The market participant producers are selling their product through informal marketing system.

4.3.3. Milk market performance (marketing costs and margin)

4.3.3.1. Marketing costs

The costs and returns of actors playing various market functions are affected by differences in enterprise size and location, vertical integration of functions, the internal organization of enterprise operations and the nature of horizontal and exchange relations, particularly where the latter are linked with credit (Scarborough and Kydd, 1992).

The performance of milk market was evaluated by considering associated costs and marketing margins. Price per litter for milk was used for the marketing margin calculations. Results of marketing costs and margins analysis were used to determine whether there were excess profits and serious inefficiencies or wide margins are due to technical constraints (such as transportation bottleneck). Margin and cost calculation was carried only for key milk marketing channels.

Table 8 indicates different types of marketing and production costs related to the transaction of milk by producers, Dairy Cooperative and retailers (café and Hotel). The structure of production cost indicates that cost of feed was highest in all channels whereas the highest marketing costs (labour and transport) for the dairy cooperative were observed in channel IV, VI and VII. On the other hand highest marketing cost of sugar was recorded for cafe and hotel in channel III and VII.

Table 8: Average price and marketing costs/litter of milk in the study area

Actors	Channel		Channel		Channel		Channel		Channel		Channel	
	I		II		III		IV		V		VI	
Producer	**Cost**	**%**	**Cost**	**%**	**Cost**	**%**	**Cost**	**%**	**Cost**	**%**	**Cost**	**%**
Operating cost												
Veterinary	0.115	12.10	0.115	12.03	0.115	12.03	0.115	12.10	0.115	12.03	0.115	12.03
Feed	0.485	51.05	0.485	50.73	0.485	50.73	0.485	51.05	0.485	50.73	0.485	50.73
Labor	0.315	33.16	0.315	32.95	0.315	32.95	0.315	33.16	0.315	32.95	0.315	32.95
Material	0.035	3.68	0.035	3.66	0.035	3.66	0.035	3.68	0.035	3.66	0.035	3.66
Transport	0	0	0.006	0.63	0.006	0.63	0	0	0	0.63	0	0.63
Total operating cost	0.95		0.956		0.956		0.95		0.95		0.95	
Selling price	10		12		12		10		10		10	
Net profit	9.05		11.04		11.04		9.05		9.05		9.05	
Dairy Cooperative	Cost	%	Cost	%	Cost	%	Cost	%	Cost	%	Cost	%
Purchasing price							10		10		10	
Operating cost												
Labor cost							0.5	65.79	0.5	39.53	0.5	39.49
Transport cost							0	0	0.5	39.53	0.5	39.49
Material							0.25	32.89	0.25	19.76	0.25	19.75
Others							0.01	1.32	0.015	1.90	0.016	1.26
Total operating cost							0.76		1.265		1.266	
Total cost of production							10.76		11.265		11.266	
Selling price							11.50		13		14	
Gross margin/profit							1.50		3		4	
Net margin/profit							0.74		1.735		2.734	
cafe/ hotel	Cost	%	Cost	%	Cost	%	Cost	%	Cost	%	Cost	%
Purchasing price					**12**						**14**	
Operating cost												
labor					0.05	2.5					0.05	2.5
House rent					0.1	5.05					0.1	5.05
Electric power					0.08	4.04					0.08	4.04
Water					0.25	12.62					0.25	12.62
Sugar					1	50.51					1	50.51
Material					0.4	20.2					0.4	20.2
Other					0.1	5.05					0.1	5.05
Total operating cost					1.98						1.98	
Total cost of production					13.98						15.98	
Selling price					30						30	
Gross margin/profit					18						16	
Net margin/profit					16.02						14.02	

Source: own computation, 2015. Where, selling price and purchasing price are settled here in ETB and one USD is Equivalent to = 19.50 birr ETB, in the survey time.

4.3.3.2. Marketing margin

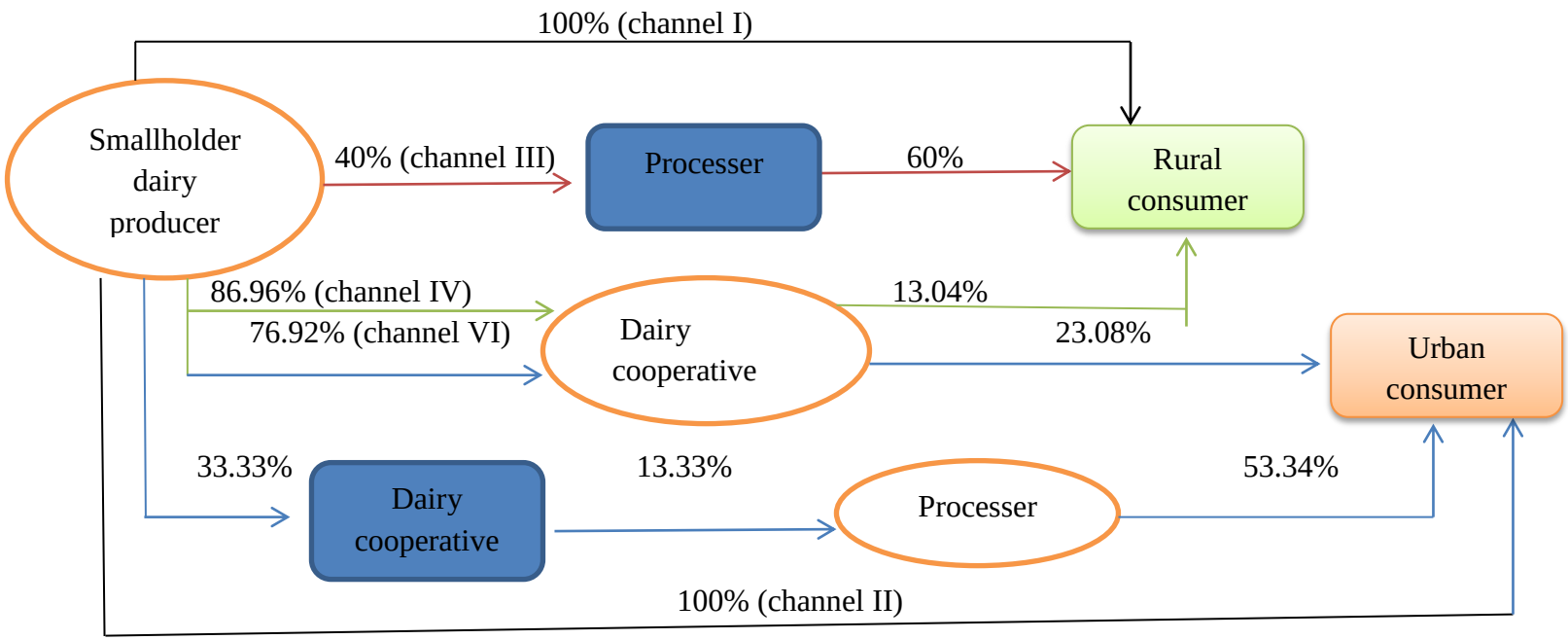

Figure 6: Market price shares of actors from final consumer

Source: own computation, 2015.

Table 9 gives an overview of the marketing margin among different actors in different channels. The total gross marketing margin (TGMM) is highest in Channel VII and followed by channel III which accounts for 66.67% and 60% of the consumer's price, respectively. Whereas, the milk traders' (producer, café and hotel and dairy cooperative) accounts highest gross marketing margin 100% in channel I and II, 60% in channel III, and 23.08% in channel VI of consumer's price, respectively.

Table 9: Marketing margins for milk traders in different marketing channels

Marketing	Marketing Channels					
Margin	I	II	III	IV	VI	VII
TGMM	0	0	60	13.04	23.08	66.67
GMMP	100	100	40	86.96	76.92	33.33
GMMCO				13.04	23.08	13.33
GMMCH			60			53.34
NMMCO				6.43	13.35	9.11
NMMCH			53.4			46.73
FCP	10	12	30	11.50	13	30

Source: own computation, 2015.
Where FCP is stated in ETB, one USD is Equivalent to = 19.50 birr ETB in the survey time.

TGMM is lowest which accounts 0% of the consumer's price and producer's share (GMMp) is highest (100%) in consumers' price in Channel I and II but lowest (33.33% and 40%) in consumer price in channel VII and III respectively. This is because of, relatively those channel is long from other marketing channels. NMM is highest for café and hotel in channel III and VII which accounts 53.4% and 46.73% respectively. The reason is highest consumer price (30 ETB/liter) in both marketing channels.

4.4. Results from the Econometrics model

Heckman's two stage model was used for the econometric analysis of milk market participation decision and volume of supply. If two decisions are involved, such as participation and volume of supply, a Heckman is desirable. This model allows the supplier to choose whether or not to participate in a particular market, and if so, to choose the volume of supply. Thus, a Heckman (1979) two-stage procedure is used in which the inverse mill's ratio to overcome the problem of selectivity bias and this is calculated from a probit estimation of the decision to sell and introduced into the supply equations.

The Heckman two-stage model result for both outcome and selection variables are presented and discussed in the next subsections. Moreover, it is important to check multi co-linearity problem before running the model for both the continuous as well as the dummy variables. The usual measure of multi co-linearity among continuous and dummy variables is Variance Inflation Factor (VIF) for association among the continuous explanatory variables and Contingency Coefficients (CC) for dummy variables. To check the multi co-linearity problem STATA 10 was employed and the VIF and CC result are stated in the hypothesized continuous and dummy variables (Annex 3, 4).

4.4.1. Determinants of milk market participation decision

Results of the binary Probit (participation) equation are summarized in Table 10. In the first stage, households decide whether they will be sellers or not. The decision to participate in the binary market was estimated by Probit maximum likelihood method**.** Out of the sampled smallholder dairy producer households 47.3 % were milk market participants whereas 52.7 % households were not participants.

From fifteen explanatory variables, nine were found to determine the probability of cow milk market participation in the Probit/participation equation. The determinant variables are milk market information (MMI), distance to woreda market (DWM), breed type (BreedT), number of dairy cow exotic and local (NDCEL), milk yield (MilkYD), educational level of household

(ELHH), market price of milk (MPM), anticipated market price butter (AMPB) and Access to dairy production extension service (AcDPExS).

Milk market information (MMI): has a positive and highly significant effect on probability milk market participation decision of cow milk producer households. At less than one significant level (Table 10). The positive and significant relationship indicates that, state of change to access milk market information, probability of participation in milk market increased. Thus, the result implied that, as households accessed to /gets milk market information, probability of milk market participation decision increases by 116% from non-getting/not accessed milk market information dairy producers of households. This result agrees with the finding of Bedilu *et al*., (2013) who illustrated access to market information by farming households increase market participation of milk significantly.

Distance to the woreda market (DWM): as expected distance to the woreda market has a negative relationship with household cow milk market participation decision and was statistically significant at less than 5% probability level. The negative and significant relationship shows that may be due to the reason that the distance to the woreda market increases transportation cost; since milk is highly perishable product and it requires on time delivery and the non-availability of milk collection centers near to producer also the other reason. Hence, the result implied that, as the distance to the woreda market increased by 1 Km, probability of milk market participation decreased by 25%. In other word, as the dairy households become closer to milk market center by one kilometer, the probability of dairy households' participation in milk market increases by 25%. This is in line with Woldemichael (2008) and Holloway *et al*. (2002) on expanding market participation among smallholder livestock producers in the Ethiopia highlands revealed that distance to market was negatively related to market participation decision by dairy household.

Breed type (BreedT): as it was hypothesized that this variable has positively effect on the household milk market participation decision and was found statistically significant ($P<0.10$) level. The result indicates that may be the household dairy producers owning exotic breed cow increases milk production per cow, as a result of this, the household increases surplus of milk and this leads to the producer to participate in sells of milk. Therefore, the result of marginal effect indicates that, as households owning exotic breed than local breed cow, probability of milk

market participation increased by 245%. This result agrees with the finding of Woldemichael (2008) who illustrated number of cross breed milking cows Shashemane, Hawassa and dale districts' milk shed.

Number of dairy cow exotic and local (NDCEL): It was positive and significantly associated with households milk market participation decision at less than 10% significant level. This result indicates that the highest number of dairy cows exotic and local may have the probability of getting high milk production and this leads the household to make milk market participation decision. Thus, the marginal effect result implied that, as farmer's owning number of dairy cow exotic and local increased by 1 dairy cow, probability of milk market participation increased by 43%. This result agrees with the finding of Woldemichael (2008) and Bedilu *et al*., (2013) who illustrated number of milk cow by farming households increase market participation of milk significantly the case of eastern Ethiopia.

Milk yield (MilkYD): The model result depicts that Milk yield as expected had a positive and significant (*P<0.1*) impact on households milk marketing participation decision. The result indicated that as milk yield gain per dairy cow is increased the household get milk surplus and this may probably have on household's milk market participation. Thus, the result implied that, as milk yield increased by 1 liter, probability of milk market participation increased by 0.1%. This is in line with Abraham (2013) who illustrated quantity produced, positive and significant the case of Habro and Kombolcha woredas.

Table 10: First-stage probit estimation results of determinants of probability of milk market participation decision

Variables	Coefficient	z	P>|z|	Marginal effect
_cons	-0.6989208	-0.10	0.924	-15.05817
CreditA	0.795419	1.32	0.186	0.5161436
MMI	1.7167993	2.59	0.009***	1.168801
DWM	-0.1987745	-2.45	0.014**	-0.2506818
BreedT	2.162975	1.84	0.066*	2.454457
NDCEL	0.5721574	1.68	0.093*	0.4301522
MilkYD	0.0022388	1.74	0.082*	0.0011134
ELHH	-0.3514782	-2.00	0.046**	-0.1483192
FExp	0.050745	1.03	0.301	0
SHH	-0.0392743	-0.06	0.956	-0.6899146
CBFYO	0.1023255	0.29	0.771	0.3731413
FS	-0.0678004	-0.41	0.684	-0.313033
MPM	1.111759	2.76	0.006***	1.08205
AMPB	-0.0445712	-1.76	0.078*	-0.0186532
IFNDS	-0.0000565	-1.61	0.108	0.0000254
AcDPExS	-1.346946	-2.44	0.015**	-0.9672598

Dependent variable = household milk market participation (MMP),
Number of observation = 110 Predicted Success = 95%
Censored observations = 58 Chi-squared = 160.32
Uncensored observations = 52 Prob > χ^2 = 0.0000
Where, ***, ** and * indicated that statistically significant level at 1%, 5% and 10% respectively
Source: own computation, 2015.

Educational level of household (ELHH): it is not found as hypothesized educational level of household has negative effect probability on households milk market participation decision and it was found significant (*P<0.05*) level. Hence, the result implied that, as Educational level of household increased by one years of schooling, probability of milk market participation decreased by 14.8%. The negative and significant relationship indicates that as educational level of the dairy household improves, may have the probability to see the comparative advantages participating in the other dairy products rather than fluid milk market participation decision and

here also improving the level of education of household may be understand the nutritional value of milk therefore household milk consumption improves and satisfying the nutritional requirement. This leads to not to participate the households in fluid milk market. This result not agreed with the finding of Woldemichael (2008) who illustrated educational level of household has a positively effect on households milk market participation decision on shashemane, hawassa and dale districts' milk shed. But this result agrees with the finding of Dawit (2010) who illustrated educational level of household has a negatively effect on households poultry market participation decision the case of Alamata and Atsbi-wonberta woredas of Tigray.

Market price of milk (MPM): As it was hypothesized market price of milk has positive effect probability on household milk market participation decision and it is significant less than 1% probability level. Thus, the result indicates that, as market price of milk increased by 1 ETB, probability of milk market participation increased by 108%. The positive relationship between the variables indicates that the higher market price of milk may have the probability of an effect to encourage household on milk market participation decision.

Anticipated market price butter (AMPB): had negative effect on cow milk market participation of household and was found to be significant at 10% probability level. Therefore, the result of marginal effect implied that, as anticipated market price of butter increased by 1 ETB, probability of milk market participation decreased by 1.8%. The negative relationship between the variables indicates that, have a probability of decreases the fluid cow milk market participation of household for small amount milk producer households as a result of long distance to woreda market and the nature of the product perishability and they may also see the comparative advantages of value added milk product.

Access to dairy production extension service (AcDPExS). This variable was expected to positively affect households' milk market participation decision. However, the divergent has been observed in the result. Access to dairy production extension service was significantly ($P<0.05$) and negatively affected households' milk market participation decision. Thus, the result implied that, as access to dairy production extension service contact increased probability

of milk market participation decreased by 96%. The possible reason for the negative sign may be is due to the effect of extension system on dairy production this means the households may get an advice on how to improve their productivity and converting the product to long shelf life product rather than participating fluid milk marketing. Therefore, extension service given to the farmers affects the household milk market participation decision.

4.4.2. Determinants of milk market supply

Estimation result of second stage Heckman selection model: This second step is an OLS regression of the milk sales volume on the reduced regresses and the Inverse Mills ratio (IMR) derived from the first-stage probit regression, which controls for the probability of households milk market participation decision in order that, the remaining regresses are explaining sales volumes conditional on a given probability of market participation.

The results of second stage Heckman selection estimation for the determinants of milk volume supply to market are stated in table 11. Heckman's second stage of estimation identifies the significant factors that affect volume of milk marketed surplus by using the selection model which included the inverse Mill's ratio calculated from a maximum likelihood probit estimation of cow milk market participation decision. Out of fourteen hypothesized explanatory variables in the selection equation of the model, nine explanatory variables were found to be significant determinants of the level of cow milk volume marketed surplus including inverse Mill's ratio (LMBDA).

These explanatory variables are milk market information (MMI), distance to woreda market (DWM), breed type (BreedT), number of dairy cow exotic and local (NDCEL), milk yield (MilkYD), Family size (FS), market price of milk (MPM), Access to dairy production extension service (AcDPExS) and inverse Mill's ratio (IMR).

Milk market information (MMI): as it was hypothesized this also another factor, which positively affects milk quantity supply at less than 5% significance level. The coefficient result indicates that, as households getting milk market information, increases sales of milk by 1.16 liters from non-getting milk market information households. This result is plausible and suggests

that marketable milk surplus of the household in the study area was more responsive to milk market information.

Distance to the woreda market (DWM): as expected distance to the woreda market has a negative relationship with household volume of cow milk market supply and was statistically highly significant at less than 1% probability level. The coefficient variable result implies that, as the distance of dairy household farm increase by one kilometer, the sales volume of milk decrease by 0.25 liter of milk. This means in other way, as the dairy households' dairy farm become closer to milk market center by one kilometer, the dairy households' milk sales volume increases by 0.25 liter of milk. The negative and significant relationship indicates that may be due to the reason that as the distance to the woreda market increases transportation cost; since milk is highly perishable product and it requires on time delivery and the non-availability of milk collection centers near to producer also the other reason. This is in line with Woldemichael (2008) and Holloway *et al*. (2002) on expanding market participation among smallholder livestock producers in the Ethiopia highlands revealed that distance to market was negatively related to market participation decision by dairy household.

Breed type (BreedT): this variable has positively effect on the household milk volume supply to market participation and was found statistically significant (*P<0.01*) level as hypothesized. Hence, the coefficient independent variable implies that as the household owning exotic breed than local breed cow milk, the milk volume sales increased by 2.45 liter. The result indicates that may be the household dairy producers own exotic breed cow increases milk production per dairy, household also increases surplus of milk and this leads the producer to increase volume of sales of milk. This result agrees with the finding of Woldemichael (2008) who illustrated number of cross breed milking cows Shashemane, Hawassa and dale districts' milk shed.

Number of dairy cow exotic and local (NDCEL): It was positive and significantly associated with households milk marketed volume at less than 10% significant level. Thus, the coefficient variable indicates that as the households' owning number of dairy cow exotic and local breed increased by one cow milk, the supply level of milk volume increased by 0.43 liter of milk. This result indicates that the highest number of dairy cows exotic and local may have the probability

of getting high milk production and this leads the household to supply more amount of milk to the market. This result agrees with the finding of Woldemichael (2008) and Bedilu *et al*., (2013) who illustrated number of milk cow by farming households increase market participation of milk significantly the case of eastern Ethiopia.

Milk yield (MilkYD): as it was expected the result had a positive and significant ($P<0.1$) impact on households milk marketing surplus volume. The coefficient variable indicates that as households' gaining milk yield increased by one liter, the level of milk supply to the market increased by 0.001 liter of milk. The result indicated that as milk yield gain is increased the household get milk surplus and this leads household's to supply more amount of milk to market. This is in line with Abraham (2013) who illustrated quantity produced, positive and significant the case of Habro and Kombolcha woredas.

Family size: it is not found as hypothesized this variable has negative effect on marketable surplus of milk households and statistically significant at less than 5% probability level. The negative and significant coefficient of family size indicates that the lager the family size, small volume of milk is supplied to market; this means there is high consumptions of milk in the households. The coefficient of the variable confirms that as the member of household family size increases by one person, volume of milk sales decreased by 0.31 liters. In this there is a fact the large size of household has a high labor resource these is also an opportunity for better management of dairy cows but those are needs more volume milk for consumptions as a food.

Table 11: Estimation result of Cow milk supply equation model

Variables	Coefficient	z	P>|z|
_cons	-4.363756	-0.71	0.479
CreditA	.5161436	0.96	0.337
MMI	1.168801	2.19	0.029**
DWM	-.2506818	-3.23	0.001***
BreedT	2.454457	3.97	0.000***
NDCEL	.4301523	1.90	0.057*
MilkYD	.0011134	3.51	0.000***
ELHH	-.1483192	-1.54	0.123
SHH	-.6899146	-0.97	0.333
CBFYO	.3731413	1.54	0.123
FS	-.313033	-2.34	0.019**
MPM	1.08205	2.70	0.007***
AMPB	-.0186532	-1.02	0.309
IFNDS	.0000254	1.17	0.244
AcDPExS	-.9672598	-2.22	0.026**
IMR	1.359063	2.39	0.017**
rho	0.96761		
Sigma	1.4045505		
lambda	1.3590631	.5695234	

Dependent variable = household milk market participation (MMP),

Number of observation	= 110	Predicted Success	= 95%
Censored observations	= 58	Chi-squared	= 160.32
Uncensored observations	= 52	Prob > χ^2	= 0.0000

Where, ***, ** and * indicated that statistically significant level at 1%, 5% and 10% respectively
Source: own computation, 2015.

Market price of milk (MPM): As it was hypothesized market price of milk has positive effect probability on household milk market supply volume and it is significant less than 1% probability level. Hence, the coefficient variable implies that, as market price of milk is increased by one birr (1 ETB), milk market volume sales increased by 1.08 liters of milk. The positive relationship between the variables indicates that the higher market price of milk have an

effect to bring high amount of volume milk to market. Bedilu *et al*., (2013) who illustrated higher market price of milk increases supply of milk to market the case of eastern Ethiopia.

Access to dairy production extension service (AcDPExS). This variable was expected to positively affect households' milk marketed volum. However, the divergent has been observed in the result. Access to dairy production extension service was significantly (*P<0.05*) and negatively affected households' milk supply to market. Thus, the result of coefficient variable implied that, as access to dairy production extension service contact increased, the amount of milk supplied to the market decreased by 0.96 liter of sales milk. The possible reason for the negative sign is due to the extension system giving to dairy producers this means the households get an advice on how to improve their productivity and as they are far from the woreda market they are encouraged to converting the product to long shelf life product rather than participating fluid milk marketing. Therefore, extension service given to the farmers affects the household milk marketed supply volum. This is in line with Bedilu *et al*., (2013) and Abraham (2013) who illustrated access to extension service negatively and significant the case of Habro and Kombolcha woredas.

Inverse Mill's Ratio: According to the model output, the inverse Mill's Ratio or selectivity bias correction factor (LMBDA) affected the amount of milk supplied to market positively and statistically significant (*P<0.01*) level and indicates that in Heckman two-stage model, the correction for selectivity bias is significant therefore this model is an appropriate model for this investigation.

4.5. Key Constraints and opportunities in cow milk value chain

In order to utilize the resource potentially from dairy sub sector, it is better to identifying the existing constraints and opportunities are paramount importance. Accordingly, the research revealed various challenges faced by smallholders' dairy producers and other market agents in the cow milk value chain as shown in table 12. The constraints were ranked with 1 as the topmost problem (constraints).and 13 the least problem (constraints). In the study area the cow milk value chain was found to be constrained by a number of factors related to production and

marketing which hinder the productivity of the dairy cow and marketability of fluid milk product.,

4.5.1. Dairy production constraints

In the discussion part, dairy productivity face problems with plethora of constraints impeding a flourishing the cow milk value chain, of which those considered as major bottlenecks are presented briefly in table 12. The existing constraints was identified and stated in the selected kebeles and woreda level and the extent and significance of the problems and constraints was found differed between Kebeles in the ranking result. Hence, one constraint may be a problem for one kebeles but the constraint may not be necessary a problem for the other kebeles.

According to the respondents, there were different challenges in dairy production and marketing system and these are ranked as the major problems and constraints from first to thirteen as stated in table 9. However, the top five constraints recognized by stallholders are critical problem for dairy production and these are the common problems in the selected kebeles. Thus, rank analysis depicts that, the top five constraints are lack of market, lack of supplementary feed, water scarcity, low breed performance and Shortage of grazing land respectively. This is in line with Nardos (2010) reported that, shortage of feed, high costs of feeds, lack of raw materials (ingredients like maize boon and meat, vitamin premix,) for concentrate preparation, milk demand seasonality, lack of formal marketing systems, limitations of land for sustainable dairy development, shortage of animal drug and high price, knowledge gap regarding improved dairying and access for credit for expansion., which leads them to reduce the dairy cow milk productivity.

Lack of milk market

The research revealed that lack of milk market was the topmost problem facing the dairy producers and other market agents (dairy cooperative, hotel and café and consumer) in laelay maichew woreda. The reason is that, low milk productivity, seasonality of the product, religion of the society exist in the woreda market, lac of milk market information, lack of transport, high

travel distance to woreda market and perishable nature of the fluid milk these makes it difficult to get accessible market.

In the study area, fluid milk reaches to customers through one or a combination of close to 6 marketing channels. Accordingly, the major market participants of milk trade include producers, cooperatives hotel and café (as milk retailers) and consumer. Generally, the marketing chain for fluid milk in the study area remains relatively short, with the majority of consumer purchases made directly from producers, which in turn confirms the relatively unsophisticated nature of the market.

Almost all smallholders dairy producer households engage in milk value chain confirmed that there is marketing problems in milk value chain and they ranked it first (Table 12). The major milk marketing constraints mentioned by producers are related with the, problem in information flow and lack of support from concerned bodies and lack of processing and short chain condition of the market.

Table 12: Ranks of producers' constraints/ problems in woreda level

Constraints/Problems	Selected Kebeles								Woreda level	
	Dura		Medego		Debre Birhan		Mahibere selam			
	Index	Rank	Index	Rank	Index	Rank	Index	Rank	Index	Rank
Shortage of grazing land	0.1286	5	0.1325	6	0.1376	7	0.1538	3	0.1189	5
Disease	0.1225	6	0.1101	8	0.1818	1	0.0977	6	0.1085	7
Scarcity of labor	0.1051	7	--------	-----	-------	----	-------	-----	0.101	9
Predator	--------	-----	0.1363	5	0.1474	5	-----	--------	0.1135	6
water scarcity	0.141	2	0.138	4	0.1625	4	0.1282	5	0.122	3
lack of supplementary feed	0.1301	4	0.1488	2	0.166	3	0.1333	4	0.1249	2
Market	0.1452	1	0.1492	1	0.1393	6	0.1726	2	0.1313	1
low breed performance	0.1379	3	0.1448	3	0.1696	2	0.1777	1	0.129	4
lack of shelter	0.1018	9	0.113	7	0.1284	9	0.0444	9	0.102	8
drought	0.0982	10	0.1	10	0.1338	8	0.0888	7	0.1007	10
lack of veterinary service	0.1025	8	0.106	9	0.0787	10	0.0666	8	0.0919	11
Mastitis	0.0769	11	0.0822	11	------	-----	-----	-----	0.0805	12
Abortion	--------		-----	-----	-----	-----	-----	-----	----	-----
Dystocia	0.0769	11	----	-----	-----	----	------	----	0.0769	13

Where, ------ not recognized as constraint/problem at the selected area.

Source: own computation, 201

Lack of supplementary feed

Even though, producers are self-source for most of the feed but the lack of supplementary feed is the second most limiting constraint. The available feed resources in the study area are crop residues and hay. So that, the smallholder dairy producers are dependent on these feed type but in todays the producers use concentrated feed to some extent. However, the availability and the price of the concentrated feed was a bottle neck for the producers. This is confirmed by the finding of Nardos (2010) that lack of supplementary feed remains a dominant constraint to small and medium enterprises in Mekelle city.

Water scarcity

The research shows that water scarcity is the third most important challenge for smallholders' dairy producers. Water in dairy production is the most important thing for milk production and lives of the animal. According to the respondent water scarcity recognized as an important constraint because of the producers travel to get water on average 1.5 km from the dairy farm of the households and this leads them to reduce productivity of milk gain from individual cow milk.

Low breed performance

Improved breed cows also require a complementary investment in improved feeds (dairy meal concentrates) to achieve the desired productivity levels. From the research, smallholder dairy producers recognized the low breed performance as fourth most problems. This was explained that low breed performance was limited due to the huge capital requirement. Farmers thus face a decision to remain with local or slightly improved breeds that are generally resistant to diseases and relatively easy to maintain, versus investing in a more costly, risky venture that has implicit regular animal health and improved feeding requirements. Most of the smallholder producers rearing local breed and this lead them to produce low milk product. This is in line with the finding of Woldemichael (2008) and Nardos (2010) that low breed performance remains a dominant constraint to small and medium enterprises in Mekelle city.

Shortage of grazing land

Smallholder dairy producers are ranked shortage of grazing land as their fifth topmost constraint. The reason for Shortage of grazing land is recognized as topmost problem in the study area, most of the land available in the study area is used for crop production purpose, urbanization and infrastructures such as school, health center and farmer training center. This is in line with the finding of Nardos (2010) that low breed performance remains a dominant constraint to small and medium enterprises in Mekelle city.

4.5.2. Opportunities for developing cow milk value chain in the study area

In the study area, there are huge opportunities for improving the productivity dairy cow and marketing of fluid milk. The existing opportunities for developing the milk value chain in the study area are:

- Availability of suitable agro-ecology for dairy cow production, growing of different crops and forages. This realized the potentiality of the area for milk production.

- The Availability of huge market potential for fluid milk is other opportunity. As Aksum is the center of tourist and the hotels and restaurant requires huge amount of milk to provide fluid milk for their tourist. The town also endowed with market opportunity including university and college staff and students, restaurants and hotels in Akum.

- Relatively well developed infrastructures (asphalted road access to major towns) and communication facilities and telephone access in the woreda and kebeles.

- Relatively there are emerging small towns in most of the kebeles and urbanization is growing schools are opened staffs and student require milk and other product.

Chapter Five: Conclusion and Recommendation

5.1. Conclusion

The study was aimed at analyzing value chain of cow milk the case of Laelay Maichew Woreda Centeral Zone of Tigray. The specific objectives of the study include identify and map the major milk value chain actors, functions and their relations; estimate the costs and margins of intermediaries along the milk value chain, to identify the main determinants of smallholder farmers from participation in lucrative markets' and marketed supply of cow milk and to identify the key constraints and opportunities of dairy production and marketing in the study area.

Accordingly, this research reveals that the main actors participate in the milk value chain in woreda and those are smallholder dairy producers, dairy cooperative, hotel and café (retailers) and supportive actors. Furthermore, the participant actors identified in the milk value chain are small actors as compared to other agricultural product value chain (milk value chain around Addis Ababa). Likewise, the map of the existing milk value chain simple and short. Therefore, the milk value chain in the study area is not well- developed

Additionally, in the study area six market channels were identified. Out of the six market channels, three of them are relatively the highest price market share of actors from final consumer and it accounts 100% in channel I and II and 60% in channel III, and 23.08% in channel VI of consumer's price, for producers, hotel and café and dairy cooperatives respectively. This is mainly due to the study area milk producers prefer to sell their milk directly to consumers. However, market prices share of each actor depends on the length of the market chain. So that, as the market chain increased the producers' price market share decreased or else as the market chain is short the producers price market share increase.

Regarding the costs, smallholder dairy producers in the study area incur high costs mostly when they start the dairy production through purchasing of investment items (dairy cow) rather than marketing their produce. The findings in the research indicate that, different types of marketing

and production costs related to the transaction of milk by producers, Dairy Cooperative and retailers (café and Hotel). The structure of production cost reveals that feed cost is the highest cost for producer in all channels whereas the marketing costs for dairy cooperative is labor and transport the highest cost in channel IV, V and VI. Whereas, the highest cost for cafe and hotel was recorded cost of sugar in channel III and VI.

According to Heckman's two stage model the research illustrates that, milk market information (MMI), breed type (BreedT), number of dairy cow exotic and local (NDCEL), milk yield (MilkYD) and market price of milk (MPM) variables have positively and significantly affect the income of smallholder dairy producer households.

The empirical result shows, distance to woreda market (DWM), Access to dairy production extension service (AcDPExS) educational level of household (ELHH) anticipated market price butter (AMPB) and family size (FS) have negative and significantly affect related to milk market participation as well as volume supply to market. As a result, those have negative impact in the income of smallholder dairy producer households.

While the variables credit access (CreditA), sex of household head (SHH), children below five years old (CBFYO), income from the non-dairy source (IFNDS) and farming experience are recognized as insignificant in the market participation decision and in volume supply. Therefore those variables do not have an impact in the income of smallholder dairy producer householders.

In line with the above, the study also points out different challenges in dairy production and marketing system and these are ranked as the major problems and constraints. The top five constraints are lack of market, lack of supplementary feed, water scarcity, low breed performance and Shortage of grazing land respectively. Therefore, due to those reasons milk productivity of the smallholders become low production and this also leads to producers not to participate in milk marketing.

To development the dairy sub-sector it requires to provide some insights and this study has made a careful assessment on the Laelay maichew smallholder dairy sector opportunities and major constraints. From the findings of the study it emerges that the woreda's dairy sector requires

minimum initial capital to be engaged in and has a good opportunity of being a development practice for the rural poor if some of the constraints of the sector are solved.

Some of the drawbacks of the sector in the woreda include the milk value chain actors in the study area and the channels of milk marketing are few as compared to other agricultural outputs. Most smallholder dairy producers sell their milk directly to consumers at the rural neighbor and Aksum town implying that there is lack of organized marketing channel. Lack of knowledge and skill on dairy production, lack of other market agents (milk collector), lack of availability of processers, and lack of institutional linkages, lack of two way flow of information, little or no product promotion and lack of appropriate extension service especially on fluid milk marketing were identified as the major constraints that the sector is facing in the woreda.

5.2. Recommendations

From the aforementioned conclusions, the following recommendations are given depending on the nature of production and marketing of milk in the study areas.

From the rank analysis result of the study, the most prevalent problem of dairy production was market, which hinders profitability of smallholder dairy producers from the sector. To solve this problem establishment of processor in the nearby area of the producers, collectors, easy access to milk market information those are the best alternative to save the producers from loses of milk due to lack of market. TAMPA should work here as main actor in accessing them to milk market information and others concerned bodies can do this by using establishing milk processors.

The other production problem was lack of supplementary feed. Most of the sampled households were in need of supplementary feed (concentrate feed) for their dairy cattle but they were not easily accessible in the market and the price is too high it is not affordable by smallholder dairy producers. Addressing these problems require various stakeholders, such as, feed manufacturer, input suppliers, traders, research and extension groups, NGOs and other actors interested.

The third production problem was water scarcity. To solve this problem smallholder dairy producer should be actively participating in soil and water conservation activities and afforestation. Government should also mobilize them to rehabilitate their natural water source.

Fourth problem found in the study area, is low breed performance. Most of the sampled households were in need of improved breed for their improved milk production but they were not easily accessible improved breed and the price is too much high it is not affordable by smallholder dairy producers.to address this problems it require various stakeholders, such as, farmers having participate in dairy breeding, input suppliers, traders, research and extension groups, finance institutions, NGOs, government and other actors interested.

Finally it is observed that, most of the smallholder dairy producers in the woreda have been using traditional dairy production technique that result in low milk production. Creating awareness and building capacity of smallholder dairy producer for quality milk production is one of the ways to assist dairy producers to build on their resources to create more income by managing their dairy farm skillfully, and fetch a good price in the market. Hence, all concerned organizations (chain enablers) should focus on the provision of appropriate training for both farmers and woreda's agricultural development agents on how to manage improved breed dairy cattle and incorporate new technologies profitably in to farm level production strategies.

Reference

AAFC (Agriculture and Agri-Food Canada), (2004). Value-added agriculture in Canada. Report of the standing senate committee on agriculture and forestry 2004, Agriculture and Agri-Food, Canada.

Abay, A. (2007). Vegetable market chain analysis in Amhara National Regional State: the case of Fogera woreda, South Gondar zone. M.Sc thesis presented to the school of graduate studies, Haramaya University. pp70.

Abbot J.C. and Makeham J.P., (1981). Agricultural Economics and Marketing in the Tropics.Wing Tai Cheung Printing Co. Ltd, Rome. 58p Amsterdam

Abraham, T. (2013). Value chain analysis of vegetables: the case of habro and kombolcha woredas in oromia region, Ethiopia. M.Sc. Thesis presented Haramaya University, Ethiopia.

Anandajayasekeram, P. and Berhanu G. (2009). Integrating innovation systems perspective and value chain analysis in agricultural research for development: implications and challenges. Improving Productivity and Market Success (IPMS) of Ethiopian farmers project working paper 16. ILRI (International Livestock Research Institute), Nairobi, Kenya.

Awol, Z. (2010). Analysis of poultry market chain: The Case of Dale and Alaba Special Woredas of SNNPRS, Ethiopia. Thesis for Award of MSc. Degree at Hamaraya University. Ethiopia. 127 pp.

Bain, J.S.(1968). Industrial Organization. 2ndEdition, John Wiley and Sons, New York. 258p.

Baloyi, J. K. (2010). An Analysis of Constraints Facing Smallholder Farmers in the Agribusiness Value Chain: A Case study of Farmers in the Limpopo Province. University of Pretoria, Pretoria.

Bartlett, J. E, Kotrlik, J. W and Higgins, C.C, (2001). Organizational Research: Determining Appropriate Sample Size in Survey Research. Information Technology, Learning, and Performance Journal, Vol. 19, No. 1, Spring 2001

Beamon, B. (1998). 'Supply chain design and analysis: models and methods'. *International Journal of Production Economics*, 55(3) 282–294.

Bedilu, D., Hussien, H. Komicha, and Adem, K., (2014). Factors affecting camel and cow milk marketed surplus: the case of eastern Ethiopia. African Journal of Agricultural Science and Technology (AJAST) Vol. 2, Issue 2, pp. 54-58. February, 2014

Berhanu G., Hoekstra D. and Samson J. (2007). Heading towards commercialization? The case of live animal marketing in Ethiopia. Improving Productivity and Market Success (IPMS) of Ethiopian Farmers Project Working paper 5. ILRI (International Livestock Research Institute), Nairobi, Kenya. 73pp

Berhanu, G., Hoekstra, D. and Azage, T., (2006). Commercialization of Ethiopian agriculture: extension service: from input supplier to knowledge broker and facilitator. *IPMS Project Working Paper 1*. (International Livestock Research Institute), Nairobi, Kenya. 36 pp.

Betela, B. (2015). Review on Value Chain Analysis of Dairy Products in Ethiopia College of Agriculture and Veterinary Medicine. Journal of Economics and Sustainable Development, Vol.6, No.1, 2015

Birhanu, K. (2012). Market access and value chain analysis of dairy industry in Ethiopia. PhD. Dissertation submitted to Haramaya University.

Birthal, P. S., P. K. Joshi and Gulati. (2007). Vertical coordination in high value food commodities: implications for Smallholders. Chapter No.14 Book Agricultural Diversification and Smallholder in South Asia. Edited by Joshi, P.K., A. Gulati and R.Cummings, Academic Foundation, New Delhi.

Branson, R. E. and Norvell, D. G. (1983). Introduction to Agricultural Marketing, Mc Graw-Hill Book Company, New York.Countries. International Potato Center (CIP).

Cramer, G.L. and Jensen, W., (1982). Agricultural Economics and Agribusiness, 2nd Edition. McGraw Hill Book Company, USA. 222p.

CSA. (2011/12). Agricultural Sample Survey. Livestock, Poultry and Beehives population (private peasant holdings). Federal Democratic Republic of Ethiopia Central Statistical Authority (CSA), Addis Ababa, Ethiopia**.**

CTA (Technical Centre for Agricultural and Rural Cooperation), (2008). Rural Radio Resource Pack: Marketing for small scale farmers. Wageningen, the Netherlands. Working Paper 5:9.

Dawit, G. (2010). Market Chain Analysis of Poultry: The Case of Alamata and Atsbi-Wonberta Woredas of Tigray Region. M.Sc. Thesis presented Haramaya University, Ethiopia 80p

Dirriba, I. (2013). Sheno butter market chain analysis: the case of kimbibit district in north shewa zone of oromia national regional state, Ethiopia. MSc thesis submitted to Haramaya University.

Dunne, A. (2001). Supply chain management: fad, panacea or opportunity? Occasional paper Vol 8(2) 1–40. School of Natural and Rural Systems Management, University of Queensland, Gatton, Queensland, Australia.

Ellen, M. (2010). *Dealing with small scale producers: Linking buyers and producers. Amsterdam.*

Eyassu Seifu, Kurt-Johannes Peters and Wolfgang Bokelmann, (2011). Analysis of Dairy Value Chain: A Case Study of Dire Dawa City, Eastern Ethiopia. Bonn, Germany

FAOSTAT. (2011). Food and Agriculture Organization of the United Nations. <http://faostat.fao.org/>.Farmer, Elizabeth. End Market Analysis of Ethiopian Livestock and Meat. Rep. no. MicroReport #164. USAID, Mar., 2010

Feller, A. Shunk, D. and Callarman, T. (2006). Value chain versus supply chains.[http://www.bptrends.com] site visited on 30/09/2015.

FIAS (2007). Moving toward competitiveness: A value chain approach toward competitiveness [http://www.ifc.org/…/fias…/ …/value+chain+…] site visited on 20/9/2015.

Girma, D. and Marco, V. (2014). Assessment of factors and factors affecting milk value chain in smallholder dairy farmers: A case study of Ada'a District, East Shawa Zone of Oromia regional State, Ethiopia. African Journal of Agricultural Research, Vol. 9(3), pp. 345-352 ,16 January, 2014

GRM International BV. (2007). Livestock Development Master Plan Study. Phase I Report – Data Collection and Analysis. Volume 1 – Dairy.

GRM International BV. (2007). Livestock Development Master Plan Study. Rep. Vol. 1. Ministry of Agriculture and Rural Development (MoARD),Dairy

Gujarati, D. (2003). Basic Econometrics. 4th edition. Tata McGraw-Hill Publishing Company Limited, New Delhi, India. 614p.

Heckman, J.J. (1979). Sample selection bias as a specification error, *Econometrica*. 153-161p.

Halloway, G.C., C. Nichlson, C. Delgado, S. Staal and S. Ehui, (2000). How to make milk market: A case study from Ethiopian high lands. Socio-economics and Policy Research Working Paper 28. ILRI, Nairobi, Kenya. 85p.

Kaplinsky, R. and M. Morris, (2001). A handbook for value chain research, prepared for the IDRC in the Bellagio workshop.

Kaplinsky, R. and Morris, M. (2001). *A Handbook for value chain research*, Institute of Development Studies, Brighton. 109 pp.

Kohls.R.L and J.N.Uhl. (1985). Marketing of Agricultural Products.6thEdition, Macmillan - Publishing Company. USA

Lealay Maichew woreda office Agricultural and rural development. report, (2014).

LIVES Project Central Zone Report by, Gebremedhin Woldewahid and Dawit Weldemariam, (2013). Processes, Description and Potential Commodity intervention in Central Zone of Tigray.

Land O'Lakes, (2010). Inc. The Next Stage in Dairy Development for Ethiopia. Rep. Addis Ababa: 2010. Livestock and Livestock Characteristics. Rep. Vol. II. Addis Ababa: Federal Democratic Republic of Ethiopia, 2012.

Lapar, M.L, G. Holloway and S. Ehui, (2002). Policy options promoting market participation of smallholder livestock producers: A case study from Philippines. *Socioeconomics and Policy Research Working Paper* 47. ILRI (International Livestock Research Institute), Nairobi, Kenya. 27p. Lele, U.J., 1967. Market integration: A study of sorghum prices

LDMPS (Livestock Development Master Plan Study) (2007). Phase Report – Data Collection and Analysis Volume I – Dairy. GRM International BV.

Lemma, T., Tegegne, A., Puskur, R., Ranjitha, P. and Hoekstra, D. (2008). Moving Ethiopian smallholder dairy along a sustainable commercialization path: missing links in the innovation systems: Improving Productivity and Market Success (IPMS) Project, ILRI, Addis Ababa, Ethiopia.

LMD Research Interviews and Reports. Unpublished research documents from LMD Research, 2012-13 Land O'Lakes Annual reports, several issues (2010).
London, England. 551-573p.

Lusby, F. and Panlibuton, H. (2004). Value chain analysis. SEEP Network Annual General *Manual Marketing Series 5,* Chatham. UK: Natural Resource Institute. 172pp.

.Meijer, P.W.M., (1994). The Function of Maize Market in Benin, Bert Broundjin, Benin. 11-32p.

Mendoza, G., (1995). A premier on marketing channel and margins. Lyme Rimer Publishers Inc., USA.

Msuya, E. E. (2006). Unlocking Smallholders' potentials in Tanzania; Value Chain and Other analyses: A case study of Maize in Kiteto and Mbozi Districts. Dissertation for Award of PhD. Degree at Kyoto University. Kyoto, Japan.159 pp.

Mugerewa et.al (2009). Milk yield and reproductive performance of dairy cattle under smallholder management system in north-eastern Amhara region of Ethiopia

Muriuki, H.G. and Thorpe, W. (2001). Smallholder Dairy Production and Marketing in Eastern and Southern Africa. In the Proceedings of the South – South Workshop on Smallholder Dairy Production and Marketing – Constraints and Opportunities. March 12th–16th2001, Annand, India.

Musa, L., Peters, K. and Ahmed, A. (2006). On farm characterization of Butana and Kenana cattle breed production systems in Sudan. Livestock Research for Rural Development. Vol. 18, pp 56 61.

Nardos, E. (2010). Determinants, challenges and prospects of dairy production and marketing in Mekelle city. M.Sc. Thesis presented to Mekelle University, Ethiopia.

O'Connor, C.B. (1992). Rural smallholder milk production and utilization and the future for dairy development in Ethiopia. Dairy marketing in Sub-Saharan Africa. Proceeding of a symposium held at ILCA, Addis Ababa, Ethiopia. 26-30 November 1990. International Livestock Centre for Africa, Addis Ababa, Ethiopia. pp. 123-130.

Rehima, M. (2006). Pepper Marketing Chains Analysis. A case of Alaba and Siraro Districts, Southern Ethiopia. M.Sc. Thesis presented to Haramaya University,Ethiopia. .96-97p.

Scarborough, V. and J. Kydd, (1992). Economic analysis of agricultural markets. A manual of marketing series 5, Chatham, UK: Natural Resource Institute: 172p.

Scott, A. (1995). "Pricing for profitability", *Journal of Foundry Management and Technology* 1:51 - 52.

SNV. (2008). Dairy Investment Opportunities in Ethiopia. By TAM Consult, Netherlands Development Organization (SNV), Addis Ababa, Ethiopia. pp 59.

Ssango, F. (2006). Chain empowerment; supporting African farmers to develop markets. English press ltd. Oxford. pp. 3 – 28.

Sulaiman, V.R., Hall A., Raina R., (2006). From disseminating technologies to promoting innovation: implications for agricultural extension, paper prepared for the SAIC Regional Workshop on Research-Extension Linkages for Effective Delivery of Agricultural Technologies in SAARC Countries (20-22 November, 2006).

Tallec, F. (2006). *Commodity chain analysis – constructing the commodity chain and functional analysis and flow charts*. Agricultural policy support services. FAO Publication. London.150 pp.

Wolday, A. (1994). Food grain marketing development in Ethiopia after reform 1990. A case study of Alba Seraro. The PhD Dissertation presented to Verlag Costar University. Berlin. 293p

Woldemichael, S. (2008). Dairy Marketing Chain Analysis: The Case of Hawassa-Yergalem Milk Shed, Southern Ethiopia. M.Sc. Thesis presented to Haramaya University, Ethiopia.

Wooldridge, M., (2002). Econometric Analysis of Cross Section and Panel Data. MIT Press.

Yilma, Z., G.B., Emannuelle and S., Ameha. (2011). A Review of the Ethiopian Dairy Sector. Ed. Rudolf Fombad, Food and Agriculture Organization of the United Nations, Sub Regional Office for Eastern Africa (FAO/SFE), Addis Ababa, Ethiopia, pp 81.

Yitaye, A., M. Wurziger, T. Azage and W. Zollitsch, (2007). Urban and peri-urban farming system and utilization of the natural resources in the north Ethiopian highlands: In Proceedings of Conference on International Agricultural Research for Development.' 9-11 October 2007, University of Gottingen, Germany.

Appendix

Annex 1: Semi-Structured Questionnaires for household survey

AKSUM UNIVERSITY SHIRE CAMPUS

COLLEGE OF AGRICULTURE

DEPARTMENT OF AGRICULTURAL ECONOMICS

Field of Study Agribusiness and Value Chain Management

Value Chain Analysis of Cow Milk: The Case of Laelay Maichew Woreda, Central Zone of Tigray, Ethiopia.

Questionnaire number/ID: _____ Region: _____

Zone:_____ Kebele/Tabia: _____

Wereda/District: _____

Name of Interviewer: _____ Date Interviewed: _____

Distance to woreda market _____(km)

A. Demographic characteristics of household head

1. Sex of the household head: **0.** Male **1**. Female
2. Age of the household head_____ in years
3. Marital status of the household head:
   1. Married 2**.** Single 3. Divorced 4. Widow 5. Widower
4. Family size: Male:____ Female:_____ Total____
5. Number of family members below five years old: _____
6. Education/Literacy level of the household head
   1. Illiterate 2. If literate specify in years of schooling: _____
7. For how long you work in dairy farm?_____ In month/years

B. Asset ownership/Wealth, activities and income of household other than milk production

1. Average Major crops grown in 2014/15 production seasons

No	Crop type	Area (ha)	Average Yield (qt)	Average price per qt	Monetary value (in ETB)
1	Annual				
1.1					
1.2					
1.3					
1.4					
1.5					
2	Perennial				
2.1					
2.2					
2.3					
	Total				

2. Do you or any member of your family involve in any off-farm activities in 2014/15?

1. Yes **0.** No

3. If Yes, what are the off-farm activities and their incomes you or your family member?

A	B	C	D	E							F=D+E
No	Off-farm activity (excluding milk production)	Yes=1, No=0	If yes, any monthly income of household head/Birr	If yes, any monthly income of family members							Total sum of income
				1	2	3	4	5	6	Total	
1	Carpentry										
2	Construction										
3	Daily laborer										
4	Homemade drinks										
5	Animal renting										
6	Guarding										
7	Milling (metehan)										
8	Grain Trading										
9	Spices (pepper) Trading										
10	Livestock Trading										
11	livestock products Trading										
12	Traditional medicine										
13	House renting										
14	Food or cash for work										
15	Governmental Employee										
16	Remittance/gifts/transfers										
17	Others										

4. Average amount of income obtained from animal and animal products (other than milk production) _____ ETB

C. Dairy production Activities

1. Which type of management system do you employ to raise cattle?

   1. Extensive 2. Semi-intensive 3. Intensive 4. Other (specify) ___

2. Do your cattle have separate shelter from the residential house? 1. Yes 0. No

3. If the answer is Yes for Q.2 For which categories of cattle do you have separate pen?

   1. pregnant cow/heifer 2. calf 3. lactating cow/heifer 4. Others

4. If the answer is No for Q.2 , what is your reason?

   1. Lack of knowledge 2. Limited land resource 3. Security 4. Other (Specify)

5. What are the major available dairy cattle feed types in your area among different months?

S.N	Months	Feed types	Source	Access	Remark
1	September				
2	October				
3	November				
4	December				
5	January				
6	February				
7	March				
8	April				
9	May				
10	June				
11	July				
12	August				

Code: Feed Type

1. Crop residue
2. Green forage
3. Hay
4. Other

source:

1. Own land
2. Pasture land
3. Other

6. What are the major water sources?

	River	Dam/pond	Borehole /well	Spring	Pipe water	Rain water	Other Specify)
Dry season							
Wet season							

6.1 Distance to the nearest water point for your dairy cattle herd during dry season_____ _____ in Km?

6.2 Distance to the nearest water point for your dairy cattle during wet season_____ _____ in Km?

6.3 What is the watering frequency that you practice?

1. Freely available 2. twice a day 3. Once a day 4. Once in 2 days

5. Once in 3 days 6. Other (specify) _____

7. Do you have access for veterinary service? 1. Yes 0. No

8. If your answer to Q7 is Yes, amount of fees charged by the expert for that particular production season(total expense) _____ in ETB

9. How many dairy cows do you have? And their breed types?

S.N	Animals Category	Cattle Breeds	Number
1	Milking cow/s	A. Holstein Frisian	
		B. Crossbred (HFXlocal)	
		C. Crossbred (JerseyX local)	
		D. Local breed (specify it)	
2	Dry cow/s	A. Holstein Frisian	
		B. Crossbred (HFXlocal)	
		C. Crossbred (JerseyX local)	
		D. Local breed (specify it)	
3	Pregnant cow/s	A. Holstein Frisian	
		B. Crossbred (HFXlocal)	
		C. Crossbred (JerseyX local)	
		D. Local breed (specify it)	
4	Pregnant heifer/s	A. Holstein Frisian	
		B. Crossbred (HFXlocal)	
		C. Crossbred (JerseyX local)	
		D. Local breed (specify it)	
5	Heifer/s	A. Holstein Frisian	
		B. Crossbred (HFXlocal)	
		C. Crossbred (JerseyX local)	
		D. Local breed (specify it)	

10. Milk Production Performance

Breed of cow	Number of Cow	Number of milking cow	Av. daily milk yield per cow per litre	Av. daily milk yield in litre	Average lactation length (months)	Lactation/ Total Yield (liter)	Dry period (days)
Cross breed							
Local breed							

10.1. Milking frequency: 1. Once time a day 2. Two times a day

3. Others (specify it)

10.2. Milking interval

1. Morning milking time (local timing):_____

2. Evening milking time (local timing): _____

3. Other (specify)_____

11. Amount of milk provided for calves on daily basis by liter?_____

12. What was your expense for labor costs in 2014/15

A	B	C	D	E	F	G	H	I=G+H
Activity	No. of family members worked on the dairy farm	Days spent	average hours worked each day	Total hours worked	Rate per labor hour (Birr)	Total family labor value (Birr)	Payment for hired labor (Birr)	Total labor cost (Birr)
Feeding								
Cleaning								
Washing								
Milking								
Milk/Output transportation to selling point								
Other labor costs								
Total labor cost								

13. Indicate if any equipments and materials has been bought, rented, in 2014/15

A	B	C	D	E	F	G	H	I	J=F+I	K
Type of material/ equipment	Life span of the item	Items (number)	Items purchased unit costs (Birr)	CXD	E/B=cost for the past year	Rented items (number)	Items rental unit fees paid (Birr)	FXG		Use Freely from BOA in their FTC
Milk jar										
Rope										
Towel										
Shovel										
Wheelbarrow										
Gloves										
Overalls										
Other costs (specify)										
Total purchase and rental cost										

14. Other than labor and material costs, Please mention the costs of the following?

1. Transportation cost?_____Birr per liter average

2. Marketing cost?_____Birr per liter average

3. Miscellaneous cost?_____Birr per liter average

15. Supplementary feeding

15.1. Do you provide supplementary feed to your milk cow? **1**. Yes **0**. No

15.2. If your answer to Q 15.1 is Yes, when do you feed your cow?

1. Every day 2. Every three days 3**.** Weekly 4**.** Others please specify

15.3. If your answer to Q 15.1 is Yes, how much amount of feed do you give per day for different categories of animal?

S.N	Category of animals	Amount hay (kg)	Amount of concentrate mixture (kg)	Amount Atella (kg)	Amount Green forage (kg)	Salt	Others, kg (Specify it)
1	Milking cow/s						
2	Dry cow/s						
3	Pregnant cow/s						
4	Pregnant heifer/s						
5	Heifer/s						
6	Calf a. Male b. Female						
7	Bull						
8	Price each feed						

D. Milk processing and consumption

1. For what purposes do you use the produced milk?

   1. Consumption 2. Processing 3. Sell 4. Other (Specify)_____

2. How much amount of the produced milk do you use for Consumption _____, and selling_____?

3. Frequency of butter making during fasting period

   1. Three times per week 2. Two times per week 3. One times per week

   4. One times per two week 5. One times per month 6. Others (specify it)

E. Credit and Extension Services

1. Did you have access to credit? **1**. Yes **0**. No
2. If your answer to Q 1 is Yes, who is the service provider?
   1. Gove't organizations 2. NGO 3. Friends 4. Relatives 5. Money lenders
   6. Others (specify)_____

3. On what basis did you get credit?
   1. Individual basis 2. Group basis
4. If you got credit for crossbred cows, in what form did you receive?
   1. In kind 2. In cash
5. If you did obtain credit for crossbred cow, how mach was the loan?_____ Birr

6. What was the duration of loan repayment?_____ Years

7. What was the interest rate for the credit you received? _____ %

8. If you have not used credit so far for dairy cows, what were the main reasons?
   1. Due to high interest rate 2. Shortage of down payment
   3. Inaccessibility to credit 4. Unavailability
   5. Others (specify)
9. If your answer for Q 1 is Yes, for what purpose do you take the credit?
   1. For milk production 2. To purchase fertilizer 3. To purchase livestock
   4. To purchase feed grains **5**. To purchase grain seed 6. Others (specify)_____
10. Do you have access to dairy production extension service? **1**. Yes **0**. No
11. How often did you got technical advice on milk production and/or marketing by the extension service providers?

   1**.** Regularly 2. Some times 3. Rarely 4. Not at all/never

G. Milk marketing

1. Do you sell your milk? **1**. Yes **0**. No
2. If your answer to Q 1 is Yes, where do you sale the Milk (multiple answer is possible).
   1**.** At Rural 2. At Urban 3. Others (specify)_____
3. If your answer to Q1 is yes to whom do you sell your milk for? (Multiple answers are possible).
   1. Neighbors/ local consumers 2. Rural cafeteria/rural processors 3. Rural Dairy Cooperative 4. Producer association 5. Rural collectors 6. Urban collector 7. Urban dairy cooperative 8. Urban hotels/cafeteria/ restaurant 9.urban consumer 10. Others
4. Did the local farm get market absorb all the quantity milk you produced to sell in 2014/15?
   1. Yes 0. No
5. If your answer for Q4 is No, where do you sale the milk then? 1. Aksum town 2. Other _____
6. How far is the woreda market place from your residential area? _____kms
7. Do you have accesses to update milk market information? 1. Yes 0. No

8. What is the major source of updated information for farm households on milk?
   1. shopping around 2. milk traders 3. Friends 4. Others_____

9. Do you ask your customers to comment about your product and your business in general?
1. Yes 0. No

10. What is the annual income from sale of milk and milk products?

No	Types of produce	Quantity	Unit price (Birr)	Total price (Birr)	When do you sell
1	milk				
2	Butter				
3	Others				

11. What are the factors that govern the price of the milk in your locality?
1. Seasons of the year 2. Cleanliness 3. Distance from market 4. Traditional ceremonies
5. Fasting period 6. Others (specify): _____

H. Dairy Production Constraints and opportunities

1. Major Constraints of dairy cattle production *(prioritize by their importance)*

SN	**Constraint/ problems**	**1. Yes 0. No**	**Rank**
1	Shortage of grazing land		
2	Health/Disease problem		
3	Scarcity of labor		
4	Predator		
5	Water scarcity		
6	Lack of supplementary feed		
7	Market problem		
8	Low breed performance		
9	Lack of shelter		
10	Drought problem		
11	Lack of veterinary service		
12	Mastitis		
13	Abortion		
14	Distocia		
15	Others (specify)		

2. What are the dairy cattle production opportunities in your localities?

_____

_____

_____

_____

_____

Annex 2: **Checklist for other participants/actors in the milk value chain**

A. Local milk collectors

1. Estimated cost for milk market monthly

No	Different costs	Unit	Amount	Unit Cost	Total Cost
1	Purchased milk	Liter			
2	Purchased butter	Kg			
3	Labor cost	Day			
4	Transportation cost	Trip			
5	milk Container *	Number			
6	Distribution Cost	Birr			
7	Others (specify)_____				

2. Please tell me the selling price of the milk?_____ Birr/liter
3. Please tell me the selling price of the butter?_____ Birr/kg
4. Tell me your function in the value chain
   A. Engaged in buying of milk from farmers
   B. Sell milk to traders
   C. Sell milk to retailers
   D. Sell milk to consumers
   E. Sell milk to processors
   F. Others (specify)_____
5. Did you undertake milk processing to increase shelf life of milk? Yes No.
6. If processing and produce butter and other milk products how do you store?
   _____
   _____
   _____
7. Is there any association which participate in milk collection? (Yes, No)
8. What is the function of the association?
   _____
   _____
9. Which of the following products you process?
   A. butter
   B. cheese
   C. others_____

10. Among your functions, what is your primary function?

    _____

11. From where do you collect milk?
    A. From farmers
    B. traders in the area
    C. Others_____

12. Your task in the chain?
    A. As collectors
    B. Processors
    C. Others
13. To whom do you sell the milk?

    _____

B. Hotels, cafes and restaurant milk processer/ <u>retailer</u>?????

1. Which of the following describes your position in the value chain
   A. Producers B. Agricultural input suppliers: please specify C. Collector D. Retailer E.Processor F. Others(Specify)_____
2. Estimated cost for milk market monthly

No	Different costs	Unit	Amount	Unit Cost	Total Cost
1	Purchased milk	Liter			
2	Purchased butter	Kg			
3	Labor cost	Day			
4	Transportation cost	Trip			
5	milk Container *	Number			
6	Distribution Cost	Birr			
7	Tax	Birr			
8	Shop Rent	No			
9	Miscellaneous cost	Birr			
10	Others (specify)_____				

3. What are the functions of your business? Please tell me regarding milk and milk products_____
4. From whom do you buy milk?
   A. Farmers/milk producers B. Collectors C. Retailers D. Processors E. Others/specify__
5 What type of processed milk did you prepared for sale?
   A. Makiato?___
   B. Boiled milk?____
   C. Pasteurized and cooled milk?_____
   D. Yogurt
   E. Whole milk
   F. Others

6 Please tell me the sell price of the following milk products?
A. Makiato?___
B. Boiled milk?____
C. Pasteurized and cooled milk?_____
D. Yogurt?_____
E. Whole milk?_____
7 Generally, to whom do you sell your milk and milk value added products?
A. To consumer B. Retailer C. Other(specify)_____
8. What is the future plan to sustain your processing and selling?
_____
_____

C. Urban milk collector

1. What is your function in the chain?
2. Which of the following describes your position in the value chain
   A. Producers B. Agricultural input suppliers: please specify C. Collector D. Retailers E. Processor F. Others(Specify)_____
3. From whom do you buy milk?
   A. Farmers/milk producers B. Collectors C. Processors D. Others/specify__
4. To whom do you sell your milk?
   A. To consumer B. To Processors/ hotels, cafes and restaurant
   C. Other(specify)_____
5. Which of the following milk and milk product did you sell?
   A. milk?
   B. Butter?
   C. others _____
6. Estimated cost for milk and butter market monthly

No	Different costs	Unit	Amount	Unit Cost	Total Cost
1	Purchased milk	Liter			
2	Purchased butter	Kg			
3	Labor cost	Day			
4	Transportation cost	Trip			
5	milk Container *	Number			
6	Distribution Cost	Birr			
7	Tax	Birr			
8	Shop Rent	No			
9	Miscellaneous cost	Birr			
10	Others (specify)_____				

7. Please tell me the selling price of the milk?_____Birr/liter
8. Please tell me the selling price of the butter?_____Birr/Kg

D. Supportive actors

1. What is your function in the chain?
   A. Facilitation tasks
   B. If others_____
2. If it is facilitation, please mention the different facilitation tasks?
   A. Creating awareness?_____
   B. Facilitating joint strategy building and action?_____
   C. Coordination of support activities (like training, credit, input supply, etc.)?____
   D. Others (specify)?_____

E. Interaction among the actors or stakeholders in the chain(For all actors)

1. How do you see your relationship with your milk stakeholders?
   A. Strong B. Weak C. Doesn't exist
2. Do you collect and give information from your sellers and buyers on the amount and quality of milk required?
   A. Always B. Some times C. Not at all
3. What factors constrain the linkages between actors
   A. Policy B. Organizational C. Infrastructure D. KSA(knowledge, skill, attitude and motivation E. Others (specify)___

Annex 3: Result of contingency coefficient of dummy variables

	CreditA	MMI	BreedT	SHH	AcDPExS
CreditA	1.0000				
MMI	- 0.2000	1.0000			
BreedT	0.1121	0.2390	1.0000		
SHH	- 0.0050	- 0.1702	- 0.1299	1.0000	
AcDPExS	0.0743	0.0448	- 0.0273	- 0.0045	1.0000

Annex 4: Result of variance inflation factor (VIF)

Variable	VIF	1/VIF
MilkYD	1.64	0.609144
NDCEL	1.40	0.716572
DWM	1.32	0.758377
MPM	1.31	0.760984
CBFYO	1.31	0.763708
IFNDS	1.27	0.789752
FS	1.26	0.793598
FExp	1.23	0.815917
ELHH	1.13	0.886385
AMPB	1.05	0.953754
Mean VIF	1.29	

Annex 5: Heckman model output

Heckman selection model -- two-step estimates (Regression model with sample selection)

Number of observations =110
Censored observations =58
Uncensored observations =52
Wald χ^2 (28) =160.32
Prob > χ^2 =0.0000

No	Variables	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval
MMV	CreditA	.5161436	.5373403	0.96	0.337	-.5370241	1.569311
	MMI	1.168801	.5337438	2.19	0.029**	.1226822	2.21492
	DWM	-.2506818	.0776533	-3.23	0.001***	-.4028795	-.0984842
	BreedT	2.454457	.6177025	3.97	0.000***	1.243782	3.665132
	NDCEL	.4301523	.2259563	1.90	0.057*	-.012714	.8730185
	MilkYD	.0011134	.0003175	3.51	0.000***	.0004911	.0017357
	ELHH	-.1483192	.0961247	-1.54	0.123	-.3367203	.0400818
	SHH	-.6899146	.7125053	-0.97	0.333	-2.086399	.7065702
	CBFYO	.3731413	.2416369	1.54	0.123	-.1004582	.8467409
	FS	-.313033	.1340126	-2.34	0.019**	-.5756929	-.050373
	MPM	1.08205	.4012481	2.70	0.007***	.2956181	1.868482
	AMPB	-.0186532	.0183289	-1.02	0.309	-.0545771	.0172707
	IFNDS	.0000254	.0000218	1.17	0.244	-.0000173	.0000681
	AcDPExS	-.9672598	.435675	-2.22	0.026**	-1.821167	-.1133524
	_cons	-4.363756	6.16148	-0.71	0.479	-16.44004	7.712523
MMP	CreditA	.795419	.6016037	1.32	0.186	-.3835797	1.974663
	MMI	1.7167993	.6617993	2.59	0.009***	.4196693	3.0138751
	DWM	-.1987745	.081205	-2.45	0.014**	-.3579334	-.0396156
	BreedT	2.162975	1.176877	1.84	0.066*	-.1436623	4.469612
	NDCEL	.5721574	.3404215	1.68	0.093*	-.0950565	1.239371
	MilkYD	.0022388	.0012862	1.74	0.082*	-.0002821	.0047597
	ELHH	-.3514782	.1758011	-2.00	0.046**	-.696042	-.0069144
	FExp	.050745	.0490345	1.03	0.301	-.0453609	.1468509
	SHH	-.0392743	.7077328	-0.06	0.956	-1.426405	1.347856
	CBFYO	.1023255	.3514633	0.29	0.771	-.58653	.791181
	FS	-.0678004	.166751	-0.41	0.684	-.3946264	.2590256
	MPM	1.111759	.4034437	2.76	0.006***	.3210237	1.902494
	AMPB	-.0445712	.0252585	-1.76	0.078*	-.0940769	.0049346
	IFNDS	-.0000565	.0000352	-1.61	0.108	-.0001254	.0000125
	AcDPExS	-1.346946	.5526001	-2.44	0.015**	-2.430022	-.26387
	_cons	-.6989208	7.32628	-0.10	0.924	-15.05817	13.66032
	mills lambda	1.359063	.5695234	2.39	0.017**	.2428178	2.475308
	rho	0.96761					
	sigma	1.4045505					
	lambda	1.3590631	.5695234				

Annex 6: Sample size determination table

Table 1: Table for Determining Minimum Returned Sample Size for a Given Population Size for Continuous and Categorical Data

Population size	Sample size					
	Continuous data (margin of error=.03)			Categorical data (margin of error=.05)		
	alpha=.10 t=1.65	alpha=.05 t=1.96	alpha=.01 t=2.58	p=.50 t=1.65	p=.50 t=1.96	p=.50 t=2.58
100	46	55	68	74	80	87
200	59	75	102	116	132	154
300	65	85	123	143	169	207
400	69	92	137	162	196	250
500	72	96	147	176	218	286
600	73	100	155	187	235	316
700	75	102	161	196	249	341
800	76	104	166	203	260	363
900	76	105	170	209	270	382
1,000	77	106	173	213	278	399
1,500	79	110	183	230	306	461
2,000	83	112	189	239	323	499
4,000	83	119	198	254	351	570
6,000	83	119	209	259	362	598
8,000	83	119	209	262	367	613
10,000	83	119	209	264	370	623

NOTE: The margins of error used in the table were .03 for continuous data and .05 for categorical data. Researchers may use this table if the margin of error shown is appropriate for their study; however, the appropriate sample size must be calculated if these error rates are not appropriate. Table developed by Bartlett, Kotrlik, & Higgins.