

**DETERMINANTS OF COW MILK COMMERCIALIZATION IN
YABELLO DISTRICT, BORANA ZONE OF OROMIA NATIONAL
REGIONAL STATE, ETHIOPIA**

MSc THESIS

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**Determinants of Cow Milk Commercialization in Yabello District, Borana
Zone of Oromia National Regional State, Ethiopia**

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DEDICATION

I dedicate this thesis work to my beloved family for their encouragement, support and partnership in the success of my academic career.

STATEMENT OF THE AUTHOR

By my signature below, I declare that this Thesis is my own work. I have followed all ethical and technical principles of scholarship in the preparation, data collection, data analysis and compilation of this Thesis. Any scholarly matter that is included in the Thesis has been given recognition through citation.

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LIST OF ABBREVIATIONS AND ACRONYMS

ADEA	Association for the Development of Education for Africa
ATA	Agricultural Transformation Agency
CSA	Central Statistical Agency
ETB	Ethiopian Birr
FAO	Food and Agricultural Organization of the United Nations
GDP	Gross Domestic Product
DH	Double Hurdle
GTP	Growth and Transformation Plan
GDP	Gross Domestic Product
HCI	Household Commercialization Index
MLM	Multinomial Logit Model
MoA	Ministry of Agriculture
MoFED	Ministry of Finance and Economic Development
OLS	Ordinary Least Squares
SML	Simulated Maximum Likelihood
TLU	Tropical Livestock Unit

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Determinants of Cow Milk Commercialization in Yabello District, Borana Zone of Oromia National Regional State, Ethiopia

ABSTRACT

Milk is an important dairy product, particularly in Yabello district and generally in the pastoral area of Ethiopia. It is a source of food and cash income for the majority of the smallholder milk producers. Especially for poor households, transforming the subsistence-oriented production system into a market-oriented production system serves as a way to increase the smallholder farmer's income and reduce rural poverty. This needs a deliberate improvement in smallholder commercialization decision as well as the level of commercialization to facilitate stable incomes and sustainable livelihoods. This study was aimed at identifying determinants of cow milk commercialization. Data were collected from 154 randomly selected producers in the district through a structured questionnaire. Both descriptive statistics and econometric models were used to analyze the data. The double hurdle model was used for analyzing cow milk market participation (first hurdle) and determinants of cow milk commercialization (the second hurdle). In first hurdle, the result of Probit Regression Model revealed that owned (TLU), Cooperatives membership, production experience, market place, availability of labor force (Adult equivalent) and age of the household head played a significant role in cow milk market participation. In the second hurdle, the result of Truncated Regression Model revealed that out of explanatory variables used in the model; cow owned (TLU), milk production experience (year), market distance and age of household were found to significantly influencing the cow milk commercialization of producers in the study areas. Therefore, focuses are needed to support households in the study area for dairy commercialization in the study area. Especially, focus should be given to the improvement of a market place for milk product, supporting cooperative, market distance and cow owned which determines the cow milk commercialization of producers in the study area.

Keywords: dairy commercialization, Oromia, Yabello, Smallholder, Market Participation, Tobit, probit

1. INTRODUCTION

1.1. Background of the Study

Agriculture sector remains a key for the national economy of Ethiopia. It accounts for 36.7% of overall GDP, 70% of foreign exchange earnings and also the sector provides employment opportunity for 72.7% of the population and is a means of generating livelihood for about 83% of the rural population (ATA, 2017). The Ethiopian government, in its two-consecutive five years Growth and Transformation Plan (GTP-I and GTP-II), has given much emphasis on agricultural commercialization, among which the second pillar aims to achieve growth and thereby improve people's livelihoods and reduce poverty (MoFED, 2015). The market-oriented production can allow households to increase their income by producing output with higher returns to land and labor and using the income generated from sales to purchase goods for consumption (Schneider and Gugerty, 2010).

Commercialization of the smallholder farmers has been seen by the government as the major source of agricultural growth in Ethiopia. The government of Ethiopia implemented agricultural commercialization clusters with the primary goal of commercialization of smallholders' agriculture and agro-industrial development, contributing to a strategic access point for private sector engagement (Pauw, 2017).

Commercialization of agricultural production is considered as the process of agricultural modernization, specialization, and structural transformation of the economy toward more rapid and sustainable growth. It is stated as a process involving a transformation of agriculture to market-oriented production to have a positive impact on income, consumption and nutritional setup of the farm households. It also has a significant effect on the level of household food security (Braun, 1995). Agricultural commercialization welfare gain can be achieved through specialization, comparative advantage, economies of scale and flow of ideas due to regular interaction (Barrett, 2008).

Livestock production as one component of the agriculture industry plays an important role in the economic and social development of Ethiopia at national and household level. At a national level, livestock contributes 10 percent of all formal export earnings (US\$ 150 million

per annum) and US\$ 300 million per annum to the informal market. Moreover, livestock sector adds about 12-16% of national GDP, about 30-35% of agricultural GDP, about 30% of agricultural employment and give livelihoods for 60-70% of the population (REGLAP, 2012). According to FAO (2010), in terms of total number of ruminants Ethiopia ranks 9th in the world. But, Sintayehu *et al.* (2010) argues that comparable statistics for Sudan and Nigeria are inflated, which would give Ethiopia the largest livestock herd in Africa, with seventh place globally. In addition to this, the central statistical agency of Ethiopia (CSA, 2017) show that the livestock population in Ethiopia has about 59.5 million heads of cattle, 30.70 million sheep, 30.20 million goats, 2.16 million horses, 8.44 million donkeys, 410 thousand mules, 1.21 million camels, and 56.53 million poultry.

Ethiopia holds large potential for dairy development due to its large livestock population, the favorable climate for improved, high-yielding animal breeds, emerging market opportunity, improved policy environment for involvement of private sectors, and the relatively disease-free environment for livestock (Matawork, 2016).

In the economy of the country, livestock is the main household asset and a key productive resource for pastoralist communities especially living in the border areas of Ethiopia. Thus, the pastoral area owns about 40 percent of the country's total livestock population.

The livelihood of pastoral communities of the Oromia lowlands mainly Borana based on livestock and livestock products. Borena zone is one of the pastoralist zones depending on livestock rearing, which have livestock population of 1,056,040 cattle, 868,571 goats, 573,369 sheep, 1096 horses, 3149 mules, 81,023 donkeys, 51,607 camels' 490,717 poultry and 64,699 bee-keeping (CSA, 2017).

Milk is one of the most important livestock products and the main diet for pastoralists in the Borena pastoral communities. It is also used as the main income sources for the women pastoralists (CARE, 2009). As indicated on the PADS (2005), milk and milk products take the shares of 45% and 24% of the livestock products and overall the annual pastoral household income generation sources, respectively.

In Borana Pastoral communities the total overall average milk produced is estimated to be 129,029 tons. Daily it is 353,504 liters, of these milk constitutes 69,864, 58,016, 1,149 tons from cows, camel and shoat milk, respectively. On the market share cow, camel and shoat milk constitute 59.4%, 39.4% and 31.2% respectively (CARE, 2009). However, Borana pastoralists were not economically benefited to the extent it should be. Similarly, both the productivity and price variability is higher in pastoral areas whereas the product may vary due to unpredictable rains and other natural hazards (Yacob and Catley, 2010). The issue of pastoralist vulnerability and how best to respond to it remains a key development challenge.

Therefore, identifying the factors that determine cow milk commercialization is very important for both research and development interventions to improve and diversify the income of households.

1.2. Statements of the Problem

Recently, the governments of developing countries have sought to promote diversification of production and exports away from the traditional commodities in order to accelerate economic growth, expand employment opportunities, and reduce rural poverty (Solomon *et al.*, 2010). The government of Ethiopian follows the strategy of agricultural commercialization to bring a dynamic change by transforming the traditional agriculture of smallholder farmers (Afework and Endrias, 2016). Commercialization of agriculture is a process of transformation of subsistence agriculture to market-oriented production trends to have a positive impact on income, consumption and nutrition security (Braun, 1995).

Market oriented production can allow households to increase their income by producing output with higher returns to land and labor and using the income generated from sales to purchase goods for consumption (Schneider and Gugerty, 2010). Similarly, in Ethiopia, the current policy environment and in its Growth and Transformation Plan (GTP) launched for the period 2010 and 2011 up to 2014 to 2015, the Ethiopian Government attempts to promote production and marketing of high value agricultural products with a view to increase competitiveness in domestic, regional, and international markets.

In the period of globalization, smallholders need to produce for the market as they are competing with farmers around themselves and with those producing similar commodity at a regional and global level. However, the reality shows that commercialization of smallholder farmers is not yet high enough to enable farmers to benefit from the agriculture because the farmers are not yet out of the subsistence-oriented agriculture (Mahelet, 2007). Thus, the smallholder farmers can't integrate with the market and enjoy the benefits of commercialization unless the already existing hurdles are removed and a better environment is created. At the local level commercialization is affected by the market, institutional and resource factors that influence production and marketing (Pender *et al.*, 2006).

Dairy production, among the sector of livestock production systems, is a critical issue in Ethiopia where livestock and its products are important sources of food and income, and dairying has not been fully exploited and promoted in the country (Sintayehu *et al.*, 2008). The efforts to improve the productivity of smallholder dairy production and improve its market orientation needs to be supported and informed by a detailed understanding of the current and dynamic condition of production, marketing, processing and consumption of milk and dairy products (Asfaw, 2009).

Dairy products are an important source of income for Ethiopian rural women who are responsible for dairy marketing (Lenjiso *et al.*, 2016). Identification of formal markets that demand standard and high quality products will help to determine market price based on the quality and thereby enhance commercialization of the smallholder dairy sector (Zelalem *et al.*, 2010).

Among the Borena pastoralists, milk is mainly used for household consumption, and selling where the money generated in turn is used to purchase grains, clothes, salt, sugar, tea, etc. Pastoralists also give milk to relatives and neighbors who do not have or/ less milking animals. A small amount of milk is also given to guests and travelers who asked the pastoralists water to drink (CARE, 2009). Moreover, milk has social (customary and ritual obligatory) values to the pastoral communities of Borana. Thus, it has various socio-cultural and economic uses to the pastoral societies in general.

In pastoral areas especially in Yabello district, milk has an important contribution as a food item and as an income source. Especially for poor households, transforming the subsistence-oriented production system into a market-oriented production system serves as a way to increase the smallholder farmer's income and reduce rural poverty. This needs a deliberate improvement in smallholder commercialization decision as well as the level of commercialization to facilitate stable incomes and sustainable livelihoods.

However, the study conducted by CARE (2009) focused on the production system, marketing system and value chain of dairy products in Borana Zone. But, the determinants and level of cow milk commercialization are not addressed. Particularly, no study focuses on the determinants of smallholder commercialization in dairy. This study was proposed to identify household-level determinants of the output side commercialization decision and level of commercialization of cow milk in Yabello district, Borana Zone, Oromia National Regional State of Ethiopia.

1.3. Research Questions

In this regard, the studies were attempted to answer the following research questions:

1. What is the level of cow milk commercialization in the study area?
2. What factors are affecting cow milk market participation in study area?
3. What are the determinants of cow milk commercialization in the study area?

1.4. Objectives of the Study

The major objective of this study is to identify the determinants of cow milk commercialization in Yabello District of Borana Zone, Ethiopia.

The specific objectives of the study are:

1. To identify the factors that determine cow milk market participation in the study
2. To identify the determinants of cow milk commercialization in the study area

1.5. Scope and Limitations of the Study

This study focuses on identifying the determining the level of cow milk commercialization in Yabello district. Specifically, it focuses on identifying the factors that determine the commercialization of cow milk in the study area. The study was limited to only cow milk even though camel milk is also important. The study addressed only one district in terms of locations selected because of limitations of time and financial resources.

1.6. Significance of the Study

The study provides essential information about the determinant of cow milk commercialization and the level of commercialization of milk in the study area. Therefore, the study was benefit pastoralists, researchers, a governmental and nongovernmental organization for policy formulation, planning of appropriate production packages and development of market integration.

1.7. Organization of the Thesis

This thesis has been organized under five chapters. The remaining part of the thesis is organized as follows. Chapter two presents a review of literature on theoretical and empirical pieces of evidence that support and guide this study. Chapter three discusses the research methodology of the study. Chapter four presents' results and discussions (descriptive and econometric results) Chapter five summarizes the main findings of the study and draws conclusion and recommendations.

2. LITERATURE REVIEW

This chapter deals with the theoretical and empirical literature on commercialization

2.1. Definition and Basic Concepts

Pastoralist: pastoralists defined as people who are primarily rearing and depending on livestock and their products as their source of food and income (Elliot, 2005).

Pastoralism: is a mode of production and way of life for many people who derive most of their income or nutrition from keeping domestic livestock. This livestock are reared in conditions where most of the feed is natural rather than cultivated or closely managed (Sanford, 1983). The arid and semiarid areas of the earth constitute 50-million km or about 35% of the land surface (Mundlak and Singer, 1975). These areas support 500-600 million people. About 40 million have animal-based economic, with the majority of these being referred to as pastoralists (Sandford, 1983).

Pastoralism is a viable, vibrant, and sustainable economic system that underpins the rural economy in East Africa. It accounts for a significant share of the informal and rural economy and contributes inputs critical to the formal economy, particularly milk and meat protein. in East Africa and accounts for a significant share of the formal and informal economy at national, regional, and global levels (Davies et al., 2015). Indeed, past research estimated the total annual economic value of pastoralism in Ethiopia at 15 billion ETB (around 1.6 billion USD) (SOS Sahel, 2006). In the formal economy, products from pastoralist systems are significant too, with domestic and export sales of livestock and livestock products accounting for 12–16 percent of national Gross Domestic Product (GDP) and 30–35 percent of national agricultural GDP (REGLAP, 2012)

Smallholder producers: As the basis of land and livestock holdings, cultivate less than two hectares of land and own only a few herds of livestock (Salami *et al.*, 2010). According to, Dixon *et al.*, (2003) smallholders in areas with high population densities usually cultivate less than one hectare of land, which may increase up to ten hectares or more in semi-sparsely populated arid areas, in combination up to ten animals. (Hazell *et al.*, 2007) also define

smallholders by assigning numerical values as those with less than two hectares of cropland and with few numbers of livestock.

Smallholder producers account for the majority of the rural population and more than 85% of the rural population in Ethiopia relies on agricultural production for its livelihood. However, in agriculture-based economies the smallholder agricultural production is characterized by low output, poor access to land, and poor access to inputs, poor irrigation system, little access to know-how (risk management, technology, and skill), low level of market orientation, poor infrastructure and institutional factors (Moti, 2007; Tilaye, 2010).

The majority of producers in Ethiopia are subsistence smallholders, with little separation between production and consumption decisions (Muller, 2014). Smallholders in Ethiopia are known for their resource constraints such as capital, inputs and technology; their heavy dependence on household labor; their subsistence-orientation; and their exposure to risks such as reduced yields, crop failure and low prices Diao *et al.*, (2010).

According to Nyangaga *et al.* (2001) definition, smallholder dairying is a form of small-scale farming systems where dairy animals (cattle, buffalo, camel, and goats) play a central role as a source of milk, income and critical inputs for agricultural production (such as draught power and fertilizing manure). Smallholding dairy producers are farmers who depend greatly up on milk and other dairy products for their livelihoods.

Smallholder Dairy Producers: Smallholder dairy producers dominate the dairy industry at the production and are the users of the extension services provided by various development partners. Different players are linked and interact with smallholder dairy producers at various levels based on the type of ongoing joint venture activities. The actors are extension agents, various non-governmental and international development partners mainly Food and Agricultural Organization (FAO), Netherlands Development Organization (SNV), Land O'Lakes, Self Help, Hunde (in the central highlands), cooperatives and research and higher education institutions (Yilma *et al.*, 2011).

Smallholder producers, however, lack the required technological, organizational as well as institutional capacities. Lemma *et al.* (2008) reported smallholders to be less organized and

distant from market outlets, lack economies of scale and institutions for risk management and face higher transaction costs.

The driving force for small-scale milk processing units in Borana pastoralists is not business viability rather social in nature. lack of an appropriate business plan, management, and support services, absence of continuous mentoring from development actors, lack of organizational development skills based on appropriate diagnosis, supply seasonality and low-quality raw milk, lack of market for skimmed milk are among other shaded the financial viability of the ventures (CARE, 2009).

Commercialization: It is a process involving a slow action on the part of the producers to use their land, labor, implements, and inputs in such a way that profit is exploited from the crops produced or animals reared for exchange or sale (Hinderink and Sterkinberg, 1987).

Commercialization of production systems: It is a process through which a household production goal changes from subsistence to profit maximization and a production system in which households produce market-oriented products based on the preference of consumers. Hence, in the era of globalization, smallholder farmers need to produce for the market as they are competing with farmers around themselves and with those producing the same commodity at regional as well as the global level (Birhanu *et al.*, 2006).

Agricultural commercialization: It is defined as a shift from household production for home consumption to production for sale in the market. This shift entails that production and input use decisions are based on profit maximization, reinforcing vertical linkages between input and output markets (Olwande *et al.*, 2015). It is a process involving the transformation of subsistence agriculture to market-oriented production that tends to impact income, consumption and nutritional setup of the farm households (Von Braun, 1995).

Commercialization of agricultural production is conceived as the process of agricultural modernization, specialization, and structural transformation of the economy toward more rapid and sustainable growth. The welfare gain of agricultural commercialization can be achieved through specialization, comparative advantage, economies of scale and flow of ideas due to regular interaction (Barrett, 2008).

According to Pingali and Rosegrant (1995), agricultural commercialization is more than producing surplus output to the market and thus includes household's decision behavior on product choice and input use based on the principle of profit maximization. They explain that agricultural commercialization normally takes three important stages, firstly subsistence agriculture, secondly semi-commercialized agriculture and thirdly a fully commercialized agricultural stage.

In subsistence level, the farmer's main goal is the provision of his/her family food by using household and non-tradable inputs. In the semi-commercial level, the farmer's objective changes to generating a surplus output which could be traded in the market. He/she uses both tradable and non-tradable farm inputs. In a fully commercialized agricultural level, the farmers' objective is profit maximization and farmers' farm inputs are obtained from the market. However, there is also the prevalence of commercialization in subsistence agriculture where farm households supply a certain proportion of their output to the market from their subsistence level (Gebre-ab, 2006). Therefore, it is argued that the process of commercialization is determined by a number of factors linked with internal or external to farming activity (Jaleta et al., 2009). Internally, households' resource endowments including land, labor and capital; and whereas, change in technology, infrastructure, demography and market institutions around the farm are among the external factors.

2.2. Measurement of Agricultural Commercialization

The relevance of measuring the level of smallholders' commercialization is to measure to what extent a given farm household is commercialized in its overall production, marketing, and consumption decisions, and to analyze the determinants of commercialization (Moti *et al.*, 2009). Commercialization can be measured along a continuum from zero (total subsistence-oriented production) to unity (100% production is sold) (Govereh *et al.*, 1999). Commercialization is measured at the household level as either in terms of gross or net sales measured as the ratio of percentage gross value of marketed output to total farm production (Mather *et al.*, 2013).

Commercialization is calculated as a percentage of the total product sold from a household or as a percentage of cash crops as compared to all crops cultivated by the household (Von Braun *et al.*, 1994).

2.4. Empirical Reviews of Agricultural Commercialization

Smallholder dairy producers are just one, among many key clients for commercial dairy development. Small-scale processors and distributors of dairy products need to acquire the needed technological, entrepreneurial and institutional capacities to succeed in a competitive market. Private support services need knowledge of a different kind to provide efficient support for the commercialization of dairy systems. Development of vertically integrated and coordinated milk value chain is an important option to reduce operational and transaction costs, to meet consumers demand and to encourage partnerships along the chain (Costales *et al.*, 2006). There is a serious concern, however, that smallholder agricultural producers are often excluded from participation in value chain since they usually lack access to credit, make a limited investment in their human capital (including skills and entrepreneurship training), and are isolated by physical distance from the market (Mendoza and Thelen, 2008).

Determinant of smallholder commercialization can be considered as development of input and output markets, institutions like property rights and land tenure, market regulations, cultural and social factors affecting consumer preferences, production and marketing opportunities and constraints, agro-climatic conditions, and production and marketing related risks are other external factors that could affect the commercialization process (Pender *et al.*, 2006). On the other hand, factors like smallholders' resource endowments including land, labor, physical capital, and human capital are household specific and considered as internal determinants (Moti *et al.*, 2009).

In Ethiopia as indicated by Pender and Dawit (2007) commercialization is affected by agro-climatic conditions and risks, access to market and infrastructure, community and household resource endowments, development of local commodity, input and factor markets, laws and institutions, cultural and social factors affecting consumption preference, production, and market opportunities and constraints. Mahelet (2007) found several factors that can either

facilitate or constrain the commercialization of smallholders farming are distance to the market, transport access and road access, availability of credit, extension services and market information; output, input and factor prices; land size, access to modern inputs and storage facilities; and integration into the output market.

A study conducted by Martey *et al.* (2012) in their study of commercialization of smallholder agriculture in Ghana indicated that output price, Age of household head, education status of household head, land status of household head, farm size, access to extension service, distance to market, market information, off farm income affected level of commercialization significantly at different level with different sign.

Multinomial logit regressions were used to study factors influencing urban dairy farmers' choice milk marketing channels in Kenya Berem *et al.* (2015). The result shows that; age, education, dairying experience, household size and frequency of milk purchases had significant influences on the type of channel chosen by the actors. Berhanu *et al.* (2014) the probit model results indicated that age of household head, dairy farming experience, milk yield per day, milking cow ownership and landholding size plays a significant size played a significant role in milk participation

Kembe and Charles. (2016) employed OLS to assess the influence of market access factors on the commercialization of smallholder dairy value chain development in Uasingishu County, Kenya the result show that market access factors have significant influence.

Tobit regression model employed to identify the major determinants of livestock commercialization in Oromia (Girum, 2016). The result shows that sex of the household, household family size, access to market information, size of grazed land, distance from the market, an alternative resource of income, tropical livestock unit, price of livestock, state of road and access to educational level of the household were statically significant.

Godfrey. (2010) used the Tobit model to estimate factors affecting the level of commercialization among cattle keepers in the pastoral areas of Uganda. Cattle keepers' sales rate were positively influenced by the sex of the household head, access to market information, distance to the nearest livestock market, the value of the milk sold, and cattle

prices while road condition and access to an alternative sources of income negatively affected the cattle keepers' sales rate.

Aman *et al.* (2013) used a double hurdle model to analyze the determinants of the commercialization decision and level of commercialization in West Hararghe zone in the first hurdle, the result of Probit Regression Model revealed that gender, distance to the nearest market, and cultivated land played a significant role in smallholder commercialization decision. In the second hurdle, the result of Truncated Regression Model revealed that, household education, household size, access to irrigation, cultivated land, livestock, and distance to the nearest market were the key determinants of the level of commercialization.

Tekalign (2014) employed Tobit model to identify determinants and welfare outcomes of commercialization of smallholders' farming in Anchar Woreda, West Hararghe of Ethiopia. The result of Tobit regression model revealed that, being male household head, land size, LU owned, use of irrigation and frequency of extension contact are found to significantly and positively influencing smallholder commercialization; while age, distance from market, income from non-crop sources and participation in off/non-farm activities are disclosed as significant cross-cutting determinants of smallholders intensity of commercialization to the market and family size affect commercialization of wheat producers negatively.

2.3. Agricultural Commercialization in Ethiopia

Over the previous decade, Ethiopia committed an average of 14% of its national budget to the agriculture sector and achieved an average of 7% agricultural growth per annum. Agriculture will continue to play a crucial role in the coming years as Ethiopia consolidates its food security gains and expands its footprint on the global economy with value-added exports (ATA, 2017). Thus, this requires transforming the sector from its traditional subsistence orientation to one that is market-focused and commercialized.

The government of Ethiopia formed and implemented Agricultural Commercialization Clusters (ACC) through the Agricultural Transformation Agency (ATA). The primary goal of the agricultural commercialization clusters is the commercialization of smallholders' agriculture and agro-industrial development, offering a strategic entry point for private sector engagement (Pauw, 2017).

Agricultural Commercialization Clusters were designed to strengthen and provide a strategic platform for commercializing agriculture. The ACCs aim to drive specialization, diversification, and commercialization of smallholders' agriculture in priority value chains; enhance production and productivity, quality outputs, aggregation, value addition and market linkages.

2.5. Milk Production and Marketing in Ethiopia

2.5.1. Milk production in Ethiopia

According to FAO (2010), in terms of total number of ruminants Ethiopia ranks 9th in the world. Though Sintayehu *et al.*, (2010) argue that comparable statistics for Sudan and Nigeria are inflated, which would give Ethiopia the largest livestock herd in Africa, with seventh place globally. Besides, the livestock population census (CSA, 2017) shows that Ethiopia has about 59.5 million heads of cattle, 30.70 million sheep, 30.20 million goats, 2.16 million horses, 8.44 million donkeys, 410 thousand mules, 1.21 million camels, and 56.53 million poultry. Livestock are kept in all of the farming systems of thus by pastoralists, agro-pastoralists, and crop-livestock farmers.

Ethiopia holds large potential for dairy development due to its large livestock population, the favorable climate for improved, high-yielding animal breeds, emerging market opportunity, improved policy environment for involvement of private sectors, and the relatively disease-free environment for livestock (Matawork, 2010). Given the considerable potential for smallholder income and employment generation from high-value dairy products, development of the dairy sector in Ethiopia can contribute significantly to poverty alleviation and nutrition in the country.

Ethiopia holds a large potential for dairy development. According to the Central Statistics Authority (CSA, 2017), cattle are the main source of milk production, although small quantities of milk are also obtained from goat and camel in pastoral areas. The total cattle population is estimated at 59.5 million out of which 964,698 thousand (1.62%) and 108,397 (0.18%) are cross and pure exotic breeds, respectively. Dairy-cows are estimated to be around 7.16 million and milking-cows are about 11.83 million heads. Total cow milk production for the rural sedentary areas of the country, accounts about 3.1 billion liters. And also about 179.66 million quantities of milk are obtained from goat and camel in the country and this corresponds to an average milk yield per cow per day is about 1.37 liters.

Despite its potential for dairy development, the productivity of indigenous livestock genetic resources in general, is low and the direct contribution it makes to the national economy is limited. For example, in 2009 average cow milk production was estimated at only 1.54 liters/cow per day (CSA, 2009), and the per capita milk consumption was only about 16 kg/year, which is much lower than African and world per capita averages of 27 kg/year and 100 kg/year, respectively (FAOSTAT, 2009).

CSA (2010/11) indicated that the total production of cow milk is about 4.06 billion liters, and this translates to an average daily milk production/cow of 1.86 liters/day. The MoA (2012) also stated that some improvement in per capital consumption of milk and estimated it at 19.2 kg. The performance of Ethiopian dairy sub-sector has been lagging far behind that of the neighboring countries with comparable agro-ecological conditions.

Different authors classified milk farming system based on different criterion. According to Getachew *et al.* (2009) milk production system has been characterized under five categories of

production system while Land O'Lakes (2010) turns it under four types. However, Gatwech (2012) seen it under two main category namely rural milk production system and pre-urban and urban production system. These two categories of production system have its figure characteristics.

Rural milk production

Rural dairy system represents the rural milk production system and accounts for about 97 percent of the total national milk production and 75 percent of the commercialized milk. This sector is largely dependent on the indigenous zebu breeds of low productivity, which produce about 400–680liters of milk/cow per lactation period (Zelalem *et al.*, 2011). The traditional smallholder system is part of the subsistence farming system that contribute up to 98% of the total milk production of in Ethiopia, and includes pastoralists, agro-pastoralists, and mixed crop–livestock producers (Land O'Lakes, 2010).

Pastoral/agro-pastoral production is the major system of milk production practiced in the lowland regions of Ethiopia where livelihoods are heavily dependent on livestock. Cattle dominate the livestock population followed by camel, goats, and sheep. Cows constitute about 40 percent of the herd (FAO, 2018) and cattle kept by pastoral and agro-pastorals households are approximated to be 3.1 million (Approximated from the total number of livestock keeping rural households and the proportion of rural population residing in lowland areas (approximately 13 million and 0.24, respectively) with of 10–20; large herds of >200 heads are common too (MoA, 2006). Dairy cattle constitute approximately about 36 percent of the herd and indigenous breeds were kept.

The average milk production from indigenous cows was 1.85 liters/head per day and ranged from 1.24 in the rural lowland agro-pastoral system of Mieso to 2.31 in the rural highland system of Fogera (Azage.*et al.*, 2013). Small-holder producers sell their milk and milk products to urban areas (primarily through informal market) when transport is available and affordable .At some distances, the cost to transport raw milk prohibits selling to distant markets or any market for more rural producers (Land O'Lakes, 2010)

There is extensive milk production potential in Borana pastoral area. The zone has a total of 129,029 tons of cattle, camel, and shoats' milk production potential in the area. From this total, the cow's milk constitutes about 55% or about 70,000 tons (YONAD, 2009). Within pastoral areas, the existence of well experienced and developed indigenous livestock management system, marketing business, the milk processing culture that the pastoralists have, the unmet demand for milk and milk products at the local and export market is conducive environments for milk production.

However, because of the rainfall pattern and related reasons shortage of feed availability milk production is highly seasonally dependent. In this system indigenous stock grazing in pastures in extended rangeland throughout the year and milked twice a day. No supplementary feeding is provided.

In the highland areas, agricultural production system is predominantly substance smallholder mixed farming, with crop and livestock husbandry. In this system feed for livestock consists of forages, crop residues and stub grazing and hay native pastures.

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 yield is 524 litre for 239 days, of which 238 litre is off-take for human use while 286 litre 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).

Urban and peri-urban milk production

These are number of smallholder and commercial dairy farms are emerging in capital cities of the country (Azage, 2003) and most regional towns and districts (Nigussie, 2006). Peri-urban milk production is developed in areas where the population density is high and agricultural land is shrinking due to urbanization around big cities like Addis Ababa and other regional towns (Getwach, 2012). It possesses animal types ranging from 50% crosses to high-grade

Friesian in small to large-sized farms and contributed only 2% of the total milk production of Ethiopia.

This production system owns most of the country's improved dairy stock (Tsehay, 2001). The main source of feed is both homes produced and purchased hay and the primary objective is to get additional cash income from milk sale. This production system is now expanding in the highlands among mixed crop–livestock farmers, such as those found in North Shoa and Holetta, and serves as the major milk supplier to the urban market (Gebrewold *et al.*, 2000).

This system developed based on the high market demand in and around major cities and towns for milk and milk products. The main feeds sources are agro-industrial by-products (Oil Seed Cakes, Bran, etc.) and purchased roughage. The system comprises small and medium-size dairy farms located mainly in the highlands of Ethiopia. Farmers use all or part of their land for homegrown feeds.

Generally, the primary objective of the production system is to sell milk as a means of additional cash income. The system characterized by small scale intensive husbandry with crossbreeds not more than 10 heads and managed under zero grazing.

2.5.2. Milk marketing in Ethiopia

Markets, not only production, increasingly drive agricultural development (Rajalahti *et al.* 2008), The empirical evidence confirms Ethiopian dairy subsector development has primarily been conditioned by demand-side factors, more than the availability of technological options to overcome the supply-side constraints such as feeding, breeding, and animal health (Staal *et al.*, 2008).

In Ethiopia, the national per capita consumption of milk and milk products is about 17 kg, which is one of the lowest in sub-Saharan Africa (Ahmed *et al.* 2004) and milk consumption is only 19 liters per person 10% of Sudan's and 20% of Kenya's. But urbanization is driving up consumption per capita consumption in Addis Ababa is 52 liters per person (ATA, 2016). The average expenditure on milk and products by Ethiopian household's accounts for only 4% of the total household food budget (Staal *et al.*, 2008).

The habit of consuming milk and milk products is yet to be developed, even among middle-income urban households with a better purchasing power. The small quantity of milk produced coupled with high transaction cost results in lower prices for smallholder unorganized producers, and high product price for poor urban consumers leading to low effective demand. according to CSA (2016) reported, from the total annual milk production, 42.380% used for household consumption, 6.12% sold, only 0.33% used for wages in kind and the rest 51.17% used for other purposes (could be to produce butter, cheese, and the likes).

Like other African countries (e.g., Kenya and Uganda), dairy products in Ethiopia are channeled to consumers through both formal and informal marketing systems. Until 1991, the formal market of cold chain, pasteurized milk was exclusively dominated by the DDE (Dairy development Enterprises) which supplied 12 percent of the total fresh milk in the Addis Ababa area (DDE 2000). 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 (Muriuk *et al.*, 2001). Formal milk markets are particularly limited to peri-urban areas and Addis Ababa.

The survey result conducted by Mohammed *et al.* (2004) revealed that in addition to DDE, several private milk-processing plants have been established in Addis Ababa, two of which Sebeta Agro-Industry and Dinsho dairy industries have already started marketing their products. Although their share of the market is still small compared to DDE.s, the entry of private firms in the formal milk market is a significant development indicating the profitability and potential of private investment in dairy in Ethiopia and that the policy environment is facilitating such entry.

The informal market involves direct delivery of fresh milk by producers to consumer in the immediate neighborhood and sale to collectors or traders nearby towns. In the informal market, milk may pass from producers to the consumers directly or it may pass through two or more market agents. The informal system is characterized by no licensing requirement to operate, low cost of operations, high producer price compared to formal market and no regulation of operations. The informal (traditional) market has remained dominant in Ethiopia.

In recent years, promotional efforts have focused on dairy marketing. Milk marketing cooperatives have been established by the SDDP (Smallholders Dairy Development Program) with the support of the Finnish International Development Association. These groups buy milk from both members and non-members, process it and sell products to traders and local consumers. The units also process milk into cream, skim milk, sour milk, butter, and cottage cheese. The number of these milk cooperatives reached to 32 in total, 2 established by FAO/TCP (Technical Cooperation Programme) and the World Food Programme (WFP) while by SDDP (Redda, 2001). Setting up a new dairy cooperative would reduce the travel time to the group, and the actual number of households that would benefit depends on local population densities. It is also important to keep newly emerging milk groups small and geographically limited to ensure proximity and avoid large groups that would tend to increase average travel times (Holloway *et al.*, 2002).

The study conduct in Ada'a district, East Shawa zone, in the rural area of dairy farmers sold raw milk through informal and formal milk marketing channels 59% and 41% respectively (Girma and Verschuur, 2014). But According to ValkVO and Tessama (2010), 98% of milk produced in the rural area sold is through informal chain whereas only 2% of the milk produced reached the final consumers through a formal chain.

2.6. Analytical Framework of the Study

Double hurdle model was first introduced as a class of models by Cragg (1971). The modeling approach assumes a two-step decision process. This is based on the assumption that household makes two separate decisions; the first step involves the decision whether to participate in the market or not participate and secondly the extent of participation. The model estimation involves a probity regression to identify factors affecting the decision to participate in the market by using all sample households in the first stage, and a truncated regression model on the participating households to analyze the extent of participation, in the second stage. The limitation of the model is it does not capture sample selection bias when error of the selection and outcome equation are dependent or correlated.

Heckman two-stage model was developed by Heckman (1979) and has been used extensively to correct for bias arising from sample selection. This model assumes that the missing value of

dependent variable implies that the dependent variable is unobserved (not selected). In Heckman two-stage model the decision to participate can alternatively be modeled as two separate processes. The model first uses a probity regression with all variables to estimate the probability of participation. Then the inverse mills ratio is computed from the probity regression and is used as a repressor with other explanatory variables to explain the outcome of dependent variable.

Tobit model is a statistical model proposed by James Tobin (Tobin, 1958). Tobit model is a special case of censored regression models that arise when the dependent variable is limited (or censored) from above and/or below. In many cases a Probit or Logit model is specified to explain whether or not farmers commercialize without considering the intensity of commercialization. the Probit or Logit models cannot handle the case of commercialization that have a continuous value range. One approach of addressing the problem is use of Tobit model which interprets the zero observation as corner solution and addresses the intensity of commercialization.

Likelihood ratio test (LR test) is a statistical test used for comparing the goodness of fit of Tobit model and Double-hurdle model. A test of the Tobit model against the double hurdle model comes from the fact that the hurdle model log likelihood can always be written as the sum of the log likelihoods of the two separate models: probity and a truncated model (Greene, 2000). Therefore, whether a Tobit or a double hurdle model is more appropriate can be determined by estimating the Tobit and the double hurdle models (the truncated regression model and the probity model) separately and then conducting a likelihood ratio test that compares the Tobit with the sum of the log likelihood functions of the probity and truncated regression models (Genanew and Alemu, 2010).

The likelihood ratio test statistics Γ can be computed (Greene 2000) as:

$$\Gamma = -2 [\ln L_{\text{Tobit}} - (\ln L_{\text{probit}} + \ln L_{\text{Truncated}})] \sim \chi^2_k \quad (1)$$

Where,

Γ = likelihood ratio statistic;

$\ln$ = natural logarithm;

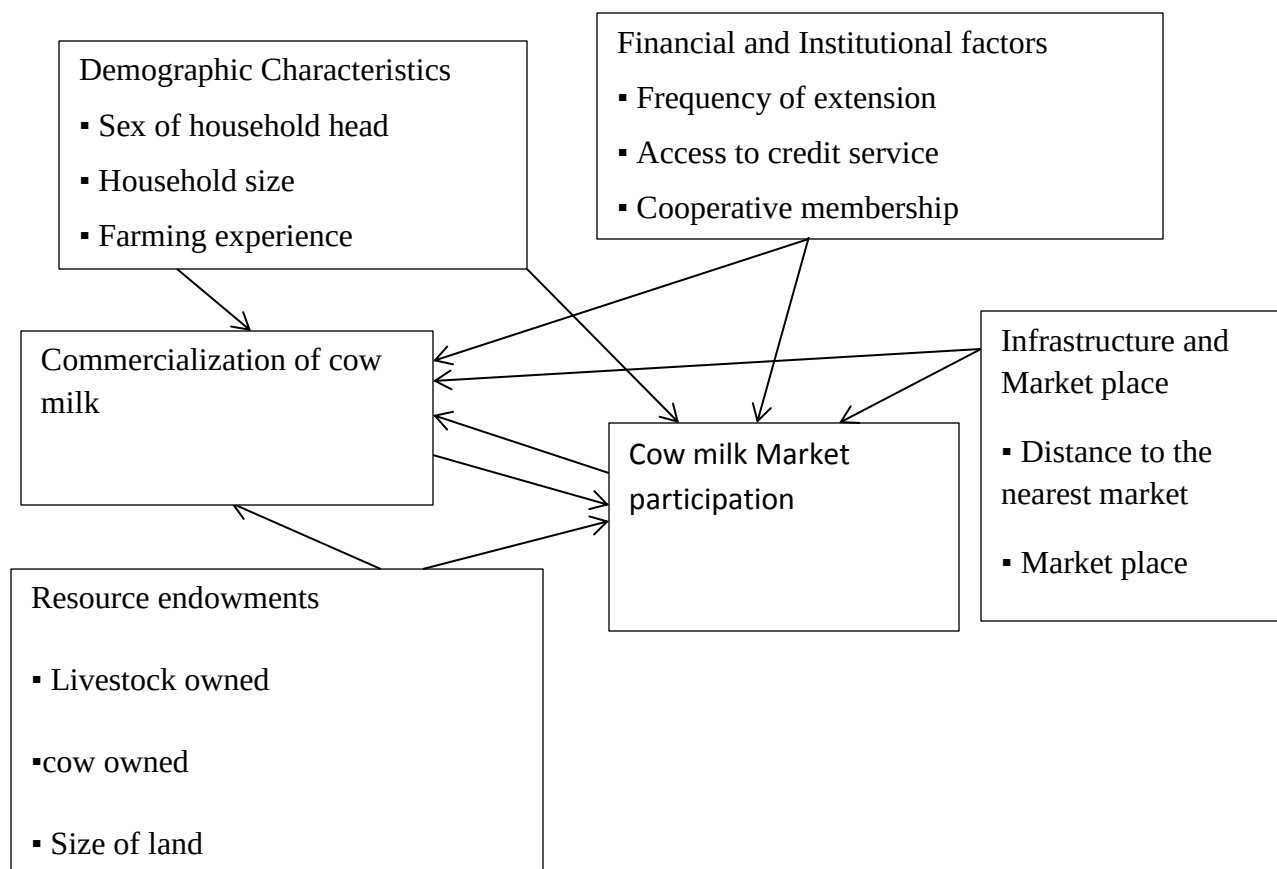
LTobit, LProbit and LTruncated = likelihood of Tobit, Probit and Truncated regression models,

χ^2 = chi-square statistic and k are the number of independent variables in the equations.

The hypothesis test for accepting and rejecting the null is written as $H_0: \lambda = \beta/\sigma$ and $\lambda \neq \beta/\sigma$. Thus, Tobit model arises as we accept the null hypothesis $\lambda = \beta/\sigma$. Decision rules to accept the null hypothesis is when the likelihood ratio statistic (Γ) is less than the value of the chi-square statistic (χ^2_k). The chi-square statistic is obtained from the chisquare table for a pre-defined level of statistical significance and degrees of freedom (where, degrees of freedom = number of parameters involved in the analysis) (Hailemariam *et al.*, 2006). the Tobit estimation assumes that both the decision to commercialize and the intensity of commercialization are jointly determined by the same explanatory variables. Thus, in this study, since the value of dependent variable commercialization index ranges between 0 and 100 inclusive, Tobit regression model was used to identify factors determining commercialization of milk producers

2.7. Conceptual Framework of the Study

The conceptual framework is an essential guideline in identifying important variables in the study and for effective and efficient data collection. This factor can be categorized into demographic characteristics; resource endowment; infrastructure and market; financial and institutional factors.



Source: Own sketch from empirical review

Figure 1: Conceptual framework of the study

3. RESEARCH METHODOLOGY

3.1. Description of the Study Area

The study was conducted in Yabello district of the Borana zone of the Oromia Regional State. The Yabello districts is one of the 13th districts of Borena zone located at Central of the Zone and also Zonal capital which is located at 570 km from Addis Ababa to Southern at main road of Addis Abeba to Moyale . The name Yabelo comes from Ya,a Bal'a which means Wide meeting of Borena Oromo's. The district is geographically situated within latitude 4°30'55.81"and 5° 24'36.39"N and longitude 7° 44'14.70"and 38° 36'05.35"E. The district has common boundaries with Elwaya district in the West, Gomole district in the North East and Dubluk district in the South. On the other hand, the district is sub-divided into 13 rural peasants associations.

According to the information obtained from Woreda Administration and Communication Office the total population of the district were 63,648 out of which 36,382 were men and 27,266 were female. The total households of rural kebeles of the district were 10,048 out of which 7880 were male and 2168 were female. The estimated area of the district is 555,000 square kilometers with an estimated population density of 14.9 people per square kilometer, which is less than the zone average that is 21.1 people per square kilometer.

The annual temperature varies between 21 °C and 38 °C with prominent feature of the ecosystem is the erratic and variable nature of rainfall, with most areas receiving 238 mm and 989 mm annually, with a high coefficient of variability from 18 % to 69 %.

The four largest ethnic groups exist in Yabello districts were the Oromo (Borena, Guji and Gabra whose administered by their democratic characteristics Gada system traced back from many centuries), the Burji, the Amhara, the Konso and others nation and nationalities (CSA, 2015).

As information obtained from rural water desk, Yabello district depends on rainy seasons. There are manmade and natural ponds that can be used as a source of drinking water for livestock and human beings, particularly in rural areas of the district. The rainy season of the

district is normally characterized by two seasons. There are no both seasonal and perennial rivers as well as artificial and natural lakes in the district.

3.2. Data Type, Sources and Methods of Data Collection

Both quantitative and qualitative data were collected from of primary and secondary sources. The primary data were collected from cow milk producers and it was focusing on factor affecting market participation and determinants of cow milk commercialization, such as: demographic characteristics of the household, dairy production experience, livestock owned (TLU), cow owned (TLU), land owned, distance to the nearest market, access to credit service access extension service, non/off-farm income, market place and cooperative membership. Producer's survey and focused group discussions were used to generate data on socio-economic, institutional and demographic characteristics of milk producers. The questionnaire covered different topics to capture relevant information related to the study objectives. Also, the checklist was used to generate data through group discussion. Personal observation and informal discussions were made to elicit information to support the data obtained from the producers.

Besides, secondary data were reviewed from various sources such as documents from the district office of livestock and pastoral development and empirical findings related to the topic of interest. Structured and semi-structured interview schedules and checklists were developed and pre-tested to collect data from producers. Trained enumerators, who are familiar with the local culture and language, were used to conduct the survey.

3.3. Sampling Procedures and Sample Size Determination

The target populations for this study were smallholder cow milk producers, in Yabello district. Purposive and two stages random sampling procedure was used for the selection of sample household heads. Yabello district was selected purposively since it is the potential area of milk production Borana Zone, Southern Ethiopia. In the first stage, four cow milk-producing kebeles; namely; Harobake, Yubdo, Dadim, and Dikale were selected randomly from a total of 13 cow milk producing-kebeles of the district.

In the second stage, from the total of 2801 households in the selected four kebeles, 154 sample household heads were selected randomly, using probability proportionate to the size of cow milk producer's households in the kebeles.

There are several factors to determine the correct sample size that appropriately represents the population. These factors are homogeneity of the population, analytical methods to be employed, and available resource such as time, finance and management. Accordingly, to determine the required sample size, this study used a simplified formula developed by Yamane (1967) was used to minimize the availability of error and bias during sample determination. Therefore, the required sample size at 95% confidence level with a degree of variability of 5% was used to obtain a sample size required to represent the true population. The total sample size ($n=154$) was determined following a simplified formula provided by Yamane (1967).

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

Where: n = sample size, N = population size (sampling frame) and e = level of precision.

Table 1: Sample distribution of households of cow milk producer in selected kebeles

Name of kebele	Total number of Households (cow milk producers)	Number of sampled households
Yubdo	657	36
Haro bakes	413	23
Dikaale	1195	66
Daddim	536	29
Total	2801	154

Source: Yabello District Pastoral Office, (2019) and own computation result

3.4. Methods of Data Analysis

Both descriptive statistics and econometric model were employed for analyzing the data collected from smallholder cow milk producers.

3.4.1. Descriptive statistical analysis

Descriptive statistical analysis method such as mean, proportions, percentages, and standard deviations were used in the process of examining and describing farm households' demographic characteristics, resource ownership, institutional and infrastructural service, and production characteristics of milk producers.

3.5. Econometric Analysis

Participation models specification

In this study, the cow milk market participation and commercialization index are the dependent variables. Household's participation decision in cow milk market is dichotomous (binary), it takes a value of 1 if the household has participated in cow milk market and zero otherwise. If the scope of this study is only the participation decision of the farmers it is possible to use either binary logit or binary probit model. As indicated in Gujarati (1995), logit or probit models are widely applied to the analysis of determinant studies for a limited dependent variable and their result is similar. Contrary to this, Green (2003) suggests that although both models result with similar outputs, the logit model is easier in the estimation, even though this is not the problem nowadays since it is the work of the computer software within a couple of seconds. These two models are used only for the analysis of the probability of market participation. Both are only suited in determining the probability models but not for linear models. Tobit model, Heckman two-steps procedure and double hurdle model are the models suited to analyze the factors determining the probability of cow market participation and determinants of cow milk commercialization under different underlying assumptions.

Initially, it was proposed that the determinants of cow milk commercialization are dependent on the cow milk out. Based on this assumption, Tobit model following Tobin (1958) was initially proposed to be used to analyze the determinants cow milk commercialization, by

using commercialization index. After collecting the primary data, the estimation was undertaken by Heckman two-step procedures and Lamda (λ) which indicates the inverse mills ratio (IMR) was insignificant, which indicates that there was no significant sample selectivity bias

Furthermore, it was found that the two dependent variables were determined by different sets of explanatory variables from Double hurdle model result, which fulfill the assumption of Double hurdle model, not Tobit. In addition to the above condition, test on the best fit of the models among Tobit and Double hurdle model using the log-likelihood ratio test following Newman *et al.* (2003), was made and Double hurdle model was found to be the best fit than the Tobit model and the test can be referred from appendix part (Appendix table 3). The coefficients for the two dependent variables were different and their significant variables were not the same for the two dependent variables. Therefore, the double hurdle model was selected and used for the sake of analyzing cow milk market participation (first hurdle) and determinants of cow milk commercialization (the second hurdle) of cow milk producer.

The first hurdle model, which is probit is used in estimating the factors determining the probability of participation in cow milk market. Truncated regression as one part of Double hurdle model has been used in estimating the determinants of cow milk commercialization.

Participation decision equation is specified as follows:

$$Y_{i1}^* = X_{i1} \beta_1 + \varepsilon_{i1}, \varepsilon_{i1} \sim N(0, \delta_{12})$$

$$Y_{i1} = \begin{cases} 1, & \text{if } Y_{i1}^* > 0 \\ 0, & \text{if } Y_{i1}^* \leq 0 \end{cases}$$

Cow milk commercialization equation is specified as:

$$Y_{i2}^* = X_{i2} \beta_2 + \varepsilon_{i2}, \varepsilon_{i2} \sim N(0, \delta_{22}) \quad (3)$$

$$Y_{i2} = \begin{cases} X_{i2} \beta_2 + \varepsilon_{i2}, & \text{if } Y_{i1}=1 \text{ and } Y_{i2}^* > 0 \\ 0, & \text{if } Y_{i2}^* \leq 0 \end{cases}$$

Where Y_{i1}^* is unobserved (latent) variable for the participation decision in modern beekeeping practice,

Y_{i1} is the observed discrete decision of the farmer whether he/she has participated or not in cow milk market, the subscript i refers to the i^{th} household, the subscripts 1 and 2 refer to the variable and parameters related to the participation equation and the level of participation, respectively.

X_1 's are the index of explanatory variables determining the participation decision of the producer in cow milk market,

X_2 's are the index of explanatory variables determining the determinants of cow milk commercialization.

β_1 refers to the index of parameters related to explanatory variables determining participation decision of the producer,

β_2 refers to the index of parameters related to explanatory variables that determining the determinants of cow milk commercialization by producers,

ε_{i1} is the error term of the participation equation which is normally distributed ($\varepsilon_{i1} \sim N(0, \delta_1^2)$), with zero mean and constant variance,

ε_{i2} is the error term equation which is normally distributed ($\varepsilon_{i2} \sim N(0, \delta_2^2)$) with zero mean and constant variance,

Y_{i2}^* Unobserved (latent) variable for the intensity of participation in cow milk market,

Y_{i2} is the observed actual number of the cow milk market

Analysis of the Marginal Effects of Participation Decision

The marginal effects that are determined from the estimation of probit part of double hurdle model in this particular study interest could be determined by using the formula of partial derivations/ partial effects based on Burke (2009).

The marginal effect, the effect of a unit change or discrete change in explanatory variables on the probability of participating in modern beekeeping practice can be given as follows.

$$\frac{\partial P(Y_{i1=1}/X_i)}{\partial X_j} = \beta_j \phi(X\beta) \quad (4)$$

Where β_j is the coefficient on x_j and $\phi(x\beta)$ is the standard normal probability density function which would be evaluated at $(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots)$.

For the continuous explanatory variables, these marginal effects are used to calculate elasticity at the sample means because the slope of the dependent variable is not constant at different per unit change of the variables. For the discrete or categorical variables, the marginal effects are used to calculate percentage changes in the dependent variable when the variable shifts from zero to one, *ceteris paribus*.

3.6. Definition of Variables and Working Hypotheses

To identify the factors affecting cow milk market participation decision and the determinants of cow milk commercialization of producers, the definition and hypothesizing how these factors are related to the dependent variables are required. Accordingly, the dependent and independent variables are defined and hypothesized as follow.

Dependent variables

Milk market participation (SALE): It is a dummy dependent variable that represents the probability of milk market participation of households. The variable takes the value one for a household who participates in milk market whereas it takes the value of zero for the household who does not participate in the milk market. This is regressed in the probit model framework (The first hurdle).

Amount of milk sold (AMS): It is the continuous variable measured in terms of value of milk sales by the household. It is used in the second stage of double-hurdle estimation procedure.

Independent variables

Age of household head (AGE): It is a continuous independent variable that is measured in a year. Tshiunza *et al.* (2001) and Berhanu *et al.* (2014) identified age as a major household's characteristics that significantly affect market participation and commercialization. Thus it is

expected to positively influence cow milk market participation and cow milk Commercialization.

Sex of the household head (SEXHH): It is a dummy variable taking a value of 1 if the household head is male and 0 otherwise. Male headed households have better access to information which would provide them better able to manage their farms and produce more surpluses for the market as compared to female-headed households (Leykun and Jemma, 2014). Getaneh (2005) indicated a negative relationship between sale volume of milk and male-headed household. Therefore, sex of the household head was expected to affect cow milk market participation and cow milk commercialization negatively.

Household family size (HHSIZE): It is a continuous variable measured in terms of adult equivalent. Having more household members reduces the proportion of output that is going to the market because of households with large members tend to consume more of what they have produced and less is available for sales (Efa *et al.*, 2016). As the proportion of output consumed at home increased, the quantity of output sold decreased. Gebremedhin and Jaleta (2010) indicated the negative relationship between household size and market participation. Thus, household size is expected to affect cow milk market participation and cow milk Commercialization negatively.

Milk production experience (EXP): It is a continuous variable measured by the number of years of experience the households have in milk production at the time of interview. Farmers with longer production experience are expected to be more knowledgeable and have good weather forecasting ability, this improves the productivity and quantity of output sold (Edward *et al.*, 2012). The dairy production experience is expected to influence cow milk market participation and cow milk Commercialization positively.

Cow ownership (COTLU): It is a continuous variable measured in the number of milking cows owned by a household in Tropical Livestock Unit (TLU). As the number of dairy cows increases, milk production also increases and the percentage share of consumption decline and milk sale increases (Holloway and Ehui, 2002). The previous study indicated that the variable show positive and significant relationship with market participation and marketable volume

(Getaneh, 2005). Therefore, it expected to influence cow milk market participation and cow milk Commercialization positively.

Landholding (LAND): It is a continuous variable that reflects the pasture used for grazing for the owned cattle by the producer Milk production from milking animals (Cattle, camels, sheep, and goats) is influenced by their population and distribution, and the availability of natural pasture and water. Milking animals are part of the Wera herds and herded separately from other for a herd, staying nearer to the community base where the family groups are found (CARE, 2009). The size of the household landholding is hypothesized to influence cow milk market participation and cow milk Commercialization positively.

Distance to the nearest market (MRKTDIS): It is a continuous variable and measured in walking which the time farmers travel to sell their produce to the market. Farmers located in a village or distant from the market is weakly accessible to the market, the closer to the market the lesser will be the transportation cost and time spent. Tadele *et al.* (2017) showed that the distance and remoteness of villages from the market area had the likelihood to influence the markets participation of producer (Berhanu and Moti, 2010). Kembe and Charles (2016), they indicated that there is a negative relationship between distance to market and the average household commercialization. Hence; distance from the nearest market is hypothesized to affect cow milk market participation and cow milk Commercialization negatively.

Market place (MKT): It is a dummy variable taking the value of one if the household head had an appropriate market place or milk shade at the market place and 0 otherwise. The development of improved marketing system is essential to increase production (Tsehay, 2002). It is expected to positively influence cow milk market participation and cow milk Commercialization.

Nonfarm and off-farm income (OFFRMIN): It is a continuous variable measured in monetary value (ETB) and shows the amount of income obtained from other activities undertaken by the household members in the past year. Godfrey (2010), found that off-farm income was negatively associated with the household's decision to participate in livestock market as a seller but was positively associated with the household's participation in the

market as a buyer. It is expected to negatively influence cow milk market participation and cow milk Commercialization.

Access to extension Services (EXTS): It is a dummy variable take one if the household had access to dairy extension services and zero otherwise. The agricultural extension services are expected to enhance the household skills and knowledge link with the modern technology and market (Lerman, 2004). The study conducted by Rehima (2006) show that extension visits had a direct relationship with market entry decision and marketable output. Therefore it is expected positively to influence cow milk market participation and cow milk Commercialization.

Cooperative membership (COOPMEM): This is a dummy variable that taking a value of 1 if a household head is a member of milk cooperatives and 0 otherwise. It is conceivable that, cooperatives have several contributions for smallholder rural farmers in developing countries (Geremew, 2012); indicated that Cooperative institutions provide necessary inputs, market information and buy their produce at better prices. Thus it is expected that those farmers who are members of local cooperative would be more likely to sell milk. It is expected to influence positively cow milk market participation and cow milk Commercialization.

Education (EDUC): It is a continuous variable that refers to the number of years of formal schooling that the household head attended. Educated household heads are expected to have a better skill, better access to information and make better use of their available resources. According to Rehima (2006), formal education has influenced household market participation and marketed volume positively. It is likely to positively influence cow milk market participation and cow milk Commercialization.

Table 2: Summary and hypothesis of independent variables for market participation and commercialization of cow milk

Variable	Type	Measurement	Expected sign
Age	Continuous	Age of household	+
Sex	Dummy	1 if the household head is male and 0 otherwise	-
Milk production experience	Continuous	Number of years of involving in milk production	+
Family size	Continuous	Number of family members in the household	-
Distance	Continuous	Distance from town/market in kilometers	-
Market place		1 if there is shade for milk in the market area or 0 other	+
Nonfarm/off farm income	Continuous	monetary value(ETB) and shows the amount of income obtained from other activities	-
Extension contact	Dummy	1 if the person is have extension contact or 0 otherwise	+
Cooperatives	Dummy	1 if the person is a member of cooperatives or 0 otherwise	+
Education	Continuous	the household head Access to education	+
Number of cows	Continuous	number of milking cows owned by a household in Tropical Livestock Unit (TLU)	+
Land	Continuous	The size of the household land holding for grazing	+

4. RESULTS AND DISCUSSION

This section presents the findings of the study. It reports the results of the descriptive statistics of the demographic characteristics, resource endowment, market and institutional characteristics of sample cow milk producers, the level of cow milk commercialization, and the econometric model results of market participation and determinants of commercialization of cow milk.

4.1. Demographic and Socio Economic Characteristics of the Sample Households

Among 154 sample respondents, 129 of them were cow milk market participants and the rest 25 respondents were non-participants. Group comparison of the market participants and non-participants was figured out using χ^2 -test for dummy variables and t-test for continuous variables, as it is presented in the following tables.

As indicated in Table 3, out of total sample respondents, 127 (82.5%) were male-headed and 27(17.5%) were female-headed households. Statistical analysis demonstrated that there was no significant mean difference between the market participants and non-participants in terms of the sex of a household head. The results show that being male or female had no effect on cow milk participations.

Concerning cooperative memberships out of total sample respondents, 27(17.5%) were cooperative members and the remaining 127(82.5%) were not organized under cooperatives. Statistical analysis shows that there was a significant mean difference between the market participants and non-participants in terms of cooperative membership at 10% (Table 3). This show that the households who are cooperative member had access to sell their milk at a cooperative place that minimizes the time they devote to sell milk at the market place and transportation costs and this motivates the households to participate in milk markets. Therefore being a cooperative member influenced cow milk market participation.

Table 3: Test statistics of market participant and non-participant (χ^2 /Fisher's exact test)

Variables	Participants		Non- participants		Total		χ^2 -value
	N	%	N	%	N	%	
Sex of household head							
Female	21	77.78	6	22.22	27	17.53	0.8634
Male	108	85.04	19	14.96	127	82.47	
Cooperative membership							
Involving	26	20.2	1	4.00	27	16.23	3.7801*
Excepted	103	79.8	24	96.0	127	83.77	
Availability of Milk Market Place							
Exist	8	38.10	13	61.9	21	13.64	37.2976***
Missed	121	90.98	12	9.02	133	86.36	
Access to Milk Market Information							
Access	111	84.09	21	15.91	132	85.71	0.0716
Not access	18	81.82	4	18.18	22	14.29	
Access to Milk Extension services							
Access	16	100.00	0	0.00	12	7.79	3.4603*
Not access	113	81.88	25	18.12	142	92.21	
Religion							
Muslim	10	66.67	5	33.33	15	9.74	9.9663**
Catholic	5	87.50	4	12.50	9	5.20	
Protestant	7	55.56	1	44.44	8	5.84	
Wakefeta	107	87.70	15	12.30	122	79.22	

Source: Own survey result, 2019

***, ** and * implies statistically significance at 1, 5, and 10% levels, respectively.

Concerning to milk market places, from total sample respondents, 21 (13.6%) households have appropriate milk market place whereas 133 (86.4%) have no milk market place among market participants. The χ^2 (Fisher's exact)-test result among market participants and nonparticipants indicated the existence of a significant difference between the groups in terms of the appropriate market place at 1% (Table 3). This indicated that the households who had

sold their milk and milk product at the farm gate or cooperative place motivated them to participate in cow milk participation. Therefore, the market place had a direct effect on cow milk market participation.

In terms of extension services, out of the total sample respondents, 14 (7.8%) have access to extension service while 142 (92.2%) have not. Statistical analyses show that there was a significant mean difference among the two groups in terms of access to extension service at 10%. The households who had access to extension service had to get advice on production and other issues related to dairy production and marketing. This favors them to participate in market. As a result, access to extension service had affected cow milk market participation.

The distribution of religion shows that out of the total sample respondents, 15(9.7%), 8(5.2%), 9(5.8%) and 122(79.2%) household heads were Muslim, protest, catholic, and Wakefeta, respectively. Wakefeta dominated sampled households followed by Muslim believers in both market participants and non-participants. As opposed to study conducted in Orthodox religion dominated area where the believers do not consume diet from animal origin for more than 208 days, religion in the study area had influence in affecting milk market participation of households. The χ^2 (Fisher's exact)-test result among market participants and nonparticipants indicates the existence of significant difference in terms of their religion at 5% (Table 3).

The t-test for continuous variables used in the study shows whether there was a significant mean difference between market participants and non-participants or not (Table 4).

The mean of dairy milk selling experience of milk market participants and nonparticipants were 4.9 and 0 respectively. The mean difference in milk market experience among market participant and nonparticipant is statistically significant at 1%. This shows that the households which have more milk selling experience had recognized the benefit gain from milk sold. Therefore, cow milk selling experience had direct impact on household's milk market participations (Table 4).

With regard to distance to the nearest market, the producers sold their milk products walking 6.5 hours on average. The mean difference in distance to the nearest market among market

participant and non-participant is statistically significant at 10%. Because of perishability nature of milk and milk product, the households who walk long distance to sell milk had discouraged to participate in milk markets. Therefore, distance nearest to market had direct influence on cow milk participation (Table 4).

Table 4: Summary statistics of variable by market participation status (continuous variable) mean and standard error

Variables	Participant (n=129)	Non- participant (n=25)	Total (n=154)	<i>t-value</i>
Education level (Years)	1.39±0.09	1.48±0.20	1.40±0.08	-0.42
Household size (Adult equivalent)	5.72±0.23	5.75±0.43	5.72±0.20	-0.07
Milk selling Experience (Years)	4.96±0.36	0	4.15±0.34	5.98***
Total No of Livestock (TLU)	11.43±7.29	6.47± 2.66	10.63±6.99	3.35***
No cow owned (TLU)	3.07±3.426	1.8±1.756	2.863±3.244	1.80*
Size of land owned (ha)	1.00±0.03	1.05±0.05	1.00±0.02	-0.93
Distance to the nearest market (Hr.)	6.95±0.70	4.20±1.57	6.50±0.64	1.64*
Non/off-farm income (ET Birr)	4226±6909	4810±7175	4320.8±6932.0	0.38

Source: Own survey result, 2019

***, ** and * implies statistically significance at 1, 5, and 10% levels, respectively.

In the study area, mixed crop and livestock farming system were practiced which is dominated by livestock productions. Livestock resources are useful in the livelihoods of smallholder's producers. The mean difference in livestock owned between market participants and non-participants is significant at 1% significance level. The average livestock holding per household for the Borena Zone pastoral areas is estimated at 5.5 TLU/ household and that of Yabello Distirict were 12.4 TLU/ household (CARE 2009). The average livestock owned by sample households excluding cows was 10.6 TLU (Table 4). This shows that the households that have other dairy livestock that substitute cow milk for house consumption, then the households have more cow milk market participants. Therefore livestock ownership had indirect effect on household's cow milk participations.

The mean difference in cow owned between market participant and non-participant is significant at 10% significance level. The average cow owned by sample households excluding cows was 2.9 TLU (Table 4). The results indicated that the households that have large number of milking cows had more milk production and more involvement in cow milk market participation.

4.2. Dairy Production Characteristics of Sample Households

According to focus group discussions the major farming activity in the study area was pastoral livestock production followed by agro pastoral production system. Cows provide the main source of milk for both home consumption and market whereas milk from small ruminants was consumed by households and camel milk was used for household consumption as well as income source. The production system in the study area is indigenous cow's milk productions. In the study area of dairy cattle barns were open barns. It is made of simple wooden materials.

Natural pasture, crop residues, hay and concentrated feed were the major feed resources for dry season, in their descending order. Communal grazing lands provide the major feed to cattle followed by crop residues and hay. Other important feed resources in the surveyed areas were mixing concentrated feed with hay/crop residues with salt. According to the respondents, hay and crop residue is frequently used supplement as compared to concentrated feed because of the high costs and problem of availability of concentrated feed. The results agree with (Tolera *et al.*, 2012).

In the study area, the availability of feed resources varies in seasons with respect to quality, quantity and type of feed. The principal dry season feed resources available to dairy cattle include crop-residue, stubble grazing, natural pasture and hay in their descending order of magnitude. Whereas, during the wet season, the principal feed resources were natural pasture. However, types of feed resources were not significantly different between kebeles of the district.

From the focus group discussion, feed and water problems are mentioned as the most important constraint by most of the cow owners. In addition, market problem, absences of commercialized livestock center, environmental problem such as drought and climate change,

and high density of livestock population (land shortage), genetic improvement of local cows, transportation and milk market place are critical problems. The interaction of these constraints affects the overall milk commercialization in the area.

Therefore, to reduce these problems and increase milk commercialization, integrated work between all actors (government and no government organization) aimed at commercialized dairy center, with solving water and feed problem, genetic improvement of local cows, working on to solve environmental problem and density of livestock population, development of organized market and milk market place improvements are essential. Collecting different plant leaves, feed preservation (crop residue) and purchasing feed can reduce the feed problem. Generally, creating the conducive environment for milk selling place, and providing suitable approach for the producers regarding with price especially during wet season (peak season), market place at different market outlet, and transportation and good linkage with market outlet with producer are suggested to be used as a solution.

To estimate the total milk production in the study areas, the following parameters were used: length of lactation period, number of lactating animals of cows and milk yield per day per cow. These parameters were multiplied to obtain the total milk produced in the study areas.

The average estimated daily lactation yield of local dairy cows was found to be 1.13 liters and the overall average lactation length of local cows was 7.9 months (Table 5). The results were higher than the national level in average lactation period per cow that is estimated to be about six months and lower than that of average milk yield per cow per day that is about 1.37 liters (CSA, 2017) and also lower than Somali and lower than Zone level that is 1.5 liters per day per cow and six month of lactation period (CARE, 2009) whereas the estimated mean of lactating cow were 2.4 in TLU.

Study conducted by (CARE 2009) the productivity of milk i.e. milk litre/ animal /day is ranges between 0.5 litters and 2.5 litters and an estimated average of 1.5 litters/cattle. The lactation length is also ranges between 120 to 270 days based on availability of feed and water as well as length of dry seasons and an average of 180 days is considered.

Table 5 Summary of statistics: cow milk production and income from cow milk.

Variable	Mean	Std.dev	Min	Max
Milk produced per day (lit)	1.13	0.39	0	2.33
Milk produced per year (lit)	660.5	878.8	0	9000
Milk sold per year (lit)	326.6	736.5	0	8440
Milk consumed per year (lit)	274.6	292.6	0	1680
Milk price per year (Br)	20.2	8.1	0	27
Income from milk per Year (Br).	4722.3	4610	0	20880
Commercialization level	41.05	25.69	0	93.8
Total lactation cow (TLU)	2.4	1.4	0	6
Lactation length (month)	7.9	3.3	0	18

Source: Own survey result, 2019

As indicated in Table 5 on average 660.5, 326.6, and 274.6 liters of cow milk were produced, sold and consumed in the year of study respectively. The mean income generated from cow milk was 4722.3 birr.

4.3. Econometric Analysis

Prior to the econometric analysis, essential tests that verify the model to employ for the analysis were undertaken on hypothesized variables. As to the survey results, out of total 154 sample households, 16.23% of them did not sell cow milk even if they produce in 2018/19 production year. Econometric models were used to assess the household characteristics, resource endowments, market access and institutional factors that are hypothesized to determine the producers decision to participate (or not) in output markets and the level of market participation. The double hurdle model was applied to analyze determinants of cow milk commercialization in terms of output market participation. This double hurdle model involves two-step estimation procedure. In first stage, probit model was used to explore factors governing market participation decision for a given reference period which is referred to as commercialization decision in this study.

4.3.1. Factors determining cow milk market participation

The result of probit model estimation that whether the household's decision to participate in cow milk market or not (Table 7). The probit model has been estimated by the maximum

likelihood method. Marginal effect was used as a useful measure to explain the result as coefficients of the probit model are difficult to interpret since they measure the change in the unobservable y^* associated with a change in one of the explanatory variables (that is, not partial effects). The overall model is significant at 0.000 levels as indicated by log likelihood value of -43.108. Moreover, based on pseudo R^2 of 0.369 the model appears to have good fit to the data (Table 7).

Cow ownership: As expected the variable has positive and significant effect at 1% on households' cow milk market participation. The positive and significant relationship between the two variables indicated that as the number of milking cows owned increased by a TLU, the milk production per household increases, turn increasing the percentage share of cow milk sold per day per households. The marginal effect of the variable confirm that a unit increase in milking cow by TLU leads the probability of participating in milk market to rise by 3.2 % (Table 7). The result is in line with Berhanu *et al.* (2014).

Cooperatives membership: As expected the variable has positive and significant effect at 5 % on households' cow milk market participation. The positive and significant relationship between the two variables show that the households who are cooperative member had access to sell their milk at a cooperative place that minimizes the time they devote to sell milk at the market place and transportation costs and this motivates the households to participate in milk markets. The marginal effect of the variable confirm that as the household member of cooperatives the probability of participating in milk market to rise by 7.1 %. The result is in line with Geremew, 2012.

Milk production experience: As hypothesized milk production experience of the household was found to have positive and significant effect on cow milk market participation at 1%. This indicates that household heads who have more milk production experience are expected to be more knowledgeable, this improves the productivity and quantity of milk sold turn leading to an increase in the probability of cow milk market participation The marginal effect of the variable confirm that as the year of milk production of the household increased, market participation of cow milk increases by 1.3 % (Table 7). The result is contrary with Berhanu *et al.* (2014).

Table 6: Estimated cow milk market participation model part of double hurdle (probit part)

Independent Variables	Coefficients	Robust Std. Err.	P> z	Marginal Effects (dy/dx)
Education level of the household	-0.484	0.388	0.212	-0.065
Cow ownership(TLU)	0.308	0.113	0.007 ***	0.032
Cooperatives membership	1.150	0.559	0.040 **	0.071
Milk production experience	0.126	0.051	0.013 ***	0.013
Extensions service	0.694	0.489	0.156	0.047
Land holding size	0.016	0.071	0.820	0.002
Market distance	-0.002	0.002	0.237	0.000
Access to market information	-0.711	0.450	0.114	-0.049
Market place	1.979	0.401	0.000***	0.489
Household size (Adult Equivalent)	-0.117	0.067	0.081*	-0.012
Age of the head	-0.151	0.055	0.006 ***	-0.016
Sex of household	-0.640	0.415	0.123	-0.048
Access to credit service	-0.640	0.402	0.442	-0.037
Income from off farm (ETB)	0.000	0.000	0.374	0.000
Constant	6.202	1.414	0.000***	
Number of Obs. = 154 Wald chi2(14) = 55.82 Prob > chi ² = 0.00 Pseudo R ² = 0.369 Log likelihood = - 43.108				y=Pr(SALE) (predict) =0.95

Source: Own computation result, 2019

Note: Symbols ***, ** and * indicates significant at 1%, 5% and 10% levels, respectively.

Market place (MKTPC): Market place was found to positively and significantly contribute at 1% on the cow milk market participation. This indicated that appropriate and permanent market place to sell their milk product helps households to participate in the market that could increase the probability of cow milk market participation. The marginal effect showed that

getting access to suitable market place by milk sellers will increase the probability of cow milk market participation by 48.9% (Table 7). The result coincides with (CARE, 2009).

Household family size: As contrary to hypothesize the variable is found to negatively and significantly affect participation in cow milk market at 10%. This indicates that the household with small family size had higher marketable milk surplus than households with larger family size and it indirectly affect the cow milk market participation. The negative impact of household size indicated that the higher the number of household members, the more they will consume their production. In other way, an increase in family size may also increase the number of dependent family members which would in turn increase the number of mouths to be fed and disproportionate volume of production and hence contribute to a decrease in the level of market participation. The marginal effect of the variable confirms that as member of household added to the family, the market participation of cow milk decreases by 1.2 % (Table 7). The results inconsistent with the findings of Aman Tufa *et al.* (2014) and Berhanu *et al.* (2009) and agree with (Koskei *et al.*, 2013)

Age of the house head: The result is contrary to prior expectation. The variable had negatively and significantly influenced households' participation in cow milk market at 10%. This indicate that old aged household heads are more probable to minimize their livestock number due to their inability to feed them by cut and carry system as well as taking them to far remote grazing areas. Also they traditionally perceive milk to be used only for house consumption. The marginal effect indicated that as the age of the household head increases by one year, the probability of cow milk participation decreases by 1.6 % (Table 7). This result agreed with the results of Woldemichael (2008) and Berhanu *et al* (2014), Cunningham *et al.* (2008) and Mahelet (2007) shows that age of the head negatively and significantly affects the degree of market participation.

4.3.2. Determinants of commercialization of cow milk producer

The factors that determine commercialization of cow milk producers was analyzed using truncated regression model.

The Truncated regression model estimated results showed that the likelihood function of commercialization index was significant at 1% level indicating a strong explanatory power of

independent variables to explain level commercialization of cow milk producers. The model result indicated that, out of explanatory variables used in the model; cow owned (TLU), cow milk production experience (year), market distance and age of household were found to significantly influencing the commercialization of milk producers in the study areas (Table 8).

Cow owned: Number of cows owned measured in TLU was found positively and significantly contribute to the level of cow milk commercialization at 1% significance level. This indicated that, as the number of milking cows owned increased by a TLU, the milk production per household increases. As a result the percentage share of milk sold per day per household's increase in turn increasing the probability of cow milk commercialization. The positive coefficient of livestock possession implies that an increase in cow possession by one TLU would increase the value of cow milk outputs of the household sold by about ETB 393.2. The result is in line with the finding of Holloway and Ehui (2002) and Getaneh (2005).

Milk production experience: As hypothesized milk production experience of the household head was found to have positive and significant effect on the level of cow milk commercialization at 1% significance level. The positive and significant relationship between two variable indicate that, the household heads who have longer milk production experience are expected to be more knowledgeable, this improves the productivity and quantity of milk sold this in turn could be increases the probability of cow milk commercialization. On average, more experience household earn about ETB 421.36 more as compared to less experience household head from sales of cow milk. This result in line with: (Edward *et al.*, 2012) and (Staal *et al.*, 2006)

Market distance: as expected distance to the nearest market was found negatively and statistically significant influence on level of cow milk commercialization at 5% level. The shorter the time taken to reach the nearest market would result to a greater degree of commercialization of cow milk. Distance to market was negatively affecting the value of milk sold possibly because of the increased transaction costs associated with marketing of the products. This implies that the location of producer in respect of potential markets is an important factor in encouraging producers to increase their sales. The shorter the time taken to reach the nearest market would result to a greater degree of commercialization of cow milk.

This result is in conformity with the findings of Berhanu and Moti (2010), Abebe *et al.* (2011), And Solomon *et al.* (2010), which found that being closer to market, enhance commercialization of cow milk

Age of the head: As opposite to expectation, age of the household head had negative and significant impacts on the level of cow milk commercialization at 1% significance level. This indicates that the young aged household heads use more input for dairy cows and have more milk participation that could increase the probability of cow milk commercialization. This finding was in agreement with the work of scholars such Tshiunza *et al.*, (2001) and Berhanu *et al.*, (2014) and dis agrees with Wang *et al.* (2015) and Pokhrel *et al.* (2016).

Table 7: Estimation of truncated part of double hurdle

Independent Variables	Coefficients	Robust Std. Err.	P> z
Education level of the household	-134.942	2244.97	0.821
Cow ownership(TLU)	393.216***	182.066	0.006
Cooperatives membership	-2132.069	2254.118	0.295
Milk Production Experience	421.36***	154.29	0.000
Extensions service	1421.82	2263.06	0.371
Land holding size	-872.0337	505.9314	0.125
Market distance	-9.210989**	7.700695	0.036
Access to market information	-3552.424	1964.394	0.322
Market place	2268.289	2770.278	0.207
Household size (Adult Equivalent)	187.2218	122.4358	0.928
Age of the head	-346.7945***	147.2641	0.000
Sex of household	4406.946	2355.002	0.402
Access to credit service	254.833	1789.523	0.295
Income from off farm (ETB)	0.1509219	0.10249	0.759
Constant	6055.507***	4702.395	0.000
Sigma	5465.386	701.0462	0.000

Source: Own computation result, 2019

Note: Symbols ***, ** and * indicates significant at 1%, 5% and 10% levels, respectively.

5. CONCLUSION AND RECOMMENDATIONS

5.1. Summary and Conclusion

The study aimed at analyzing cow milk commercialization in Yabello district of Oromia National Regional, State Ethiopia. The specific objectives of this study were to analyze the level of cow milk commercialization and the determinants of cow milk commercialization.

Primary data were collected from randomly selected 154 milk producer households in four kebeles. Descriptive statistics and econometric models were used to analyze the collected data. Double hurdle model was employed to identify the factors determining commercialization.

The double hurdle model was applied to analyze determinants of cow milk commercialization in terms of output market participation. This double hurdle model involves two-step estimation procedure. In first stage, probit model was used to explore factors governing market participation decision and the truncated regression for commercialization level of cow milk.

The result of probit estimation shows that the likelihood of household participation in cow milk market were influenced by owned (TLU), Cooperatives membership, production experience, market place, availability of labor force (Adult equivalent) and age of the household head. The Truncated regression model results shows that, out of explanatory variables used in the model; cow owned (TLU), cow milk production experience (year), market distance and age of household were found to significantly influencing the commercialization of milk producers in the study areas

5.2. Recommendations

From the findings of this study the following relevant recommendations are forwarded in order to help design appropriate intervention strategies to improve the smallholder milk producers in cow milk market participation and cow milk commercialization. The recommendations are the following:

Number of cows owned has positive and significant impact on cow milk market participation and commercialization. So, increasing the herd size with good milk producing cows should be emphasized to benefit smallholder producers. Thus to increase cow milk commercialization; there needs to be a crucial intervention by concerned development actors and partners for feed and water problem; in order to enable a stable feed and water supply throughout the year.

Cooperative member has positive and significant impact on cow milk market participation. The variables show that the households who are cooperative member had access to sell their milk at a cooperative place that minimizes the time they devote to sell milk at the market place and transportation costs and this motivates the households to participate in milk market. Therefore, the concerned body supports cooperative members through financing and training in order to increase the commercialization of cow milk producer.

More experienced households are better in cow milk market participation and commercialization. Provision of training to the pastoral communities is imperative so as to improve their knowledge and skills on the management of dairy animals. Thus, should be able to increase the awareness of households through experience sharing events in order to increase cow milk commercialization.

Market place is a significant contributor to cow milk participation. Therefore, providing proper market place for household producers and consumer by developmental workers and other stakeholders to enhance cow milk market participation.

An increase in household size was found to have negative and significant influence on cow milk market participation. This is because households with large household member consume more proportion of cow milk produce and reduce the amount that is going to be sold. Since

production resources are limited intervention on family planning based on interest of pastoral, by showing its negative impact is important in the study areas.

Market distance the shorter the time taken to reach the nearest market would result to a greater degree of commercialization of cow milk. as a result, improving rural infrastructure in developing market infrastructure in the form of establishing produce collection points across rural areas would assist poor producer for faster delivery

The results of the study showed that age of household head is negatively affecting cow milk participation and the level cow milk commercialization. This means old aged household heads are more probable to minimize their livestock number due to different reasons. Hence, supporting older aged households through training to participate in cow milk marketing is important for cow milk commercialization.

Therefore there is a need for investment in areas such as transport systems, improvement of market place and setting up modern market infrastructure.

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7. Appendix Tables

Appendix Table 1 Conversion factor of Tropical Livestock Unit (TLU)

Livestock Category	TLU	Livestock Category	TLU
Camel	1.25	Donkey (young)	0.35
Ox	1.00	Horse	1.10
Cow	1.00	Sheep (adult)	0.13
Bull	0.34	Sheep (young)	0.06
Heifer	0.75	Goat (adult)	0.13
Calf	0.25	Goat (young)	0.06
Donkey (adult)	0.7	Poultry	0.013

Source: Storck, *et al.*, 1991

Appendix of the Table. 2. Conversion factor used to compute man equivalent (Labour Force)

Age group	Male	Female
< 10	0.60	0.60
10-13	0.90	0.70
14-16	1.00	0.75
17-50	1.00	0.75
>50	1.00	0.75

Source: Samuel and Sharp, 2008

Appendix of Table 3 Likelihood ratio test of Tobit model specification

Loglikelihood ratio	Tobit = -613.157 Probit = -43.108 Truncated = -544.002
Hypothesis	H0= Tobit Specification H1= Double Hurdle Specification
Test statistic	52.14
Critical Value	$\chi = 30$
Decision	Reject H0

Source: Own computation from survey data, (2019)

Appendix. 4. Guiding questions for focus group discussion

1. What are the most commonly used livestock for dairy production in your districts?
2. What are the major opportunities in milk production in your area?
3. What are the major challenges of dairy production in your district?
4. What solutions do you recommend?
5. What is the most common other socio-economic or challenges of dairy products common in your area?
6. What are the major interventions undertaken and who make these interventions?
7. What are the challenges and drawback of past interventions undertaken in your district?
8. What types of research recommends and development interventions in your area or district? Why?
9. What are the major responsibilities of different organization do you suggest? Why?
10. What are the cultural and religious factors that affect the household's for involving milk market participation?
11. Discuss the following issues in your group; access to Education, Cooperatives, Extensions service, market information, Market place, off farm Income generating activities, health facilities, drinking water (for humans & animals), road infrastructure, credit facilities and access to farm inputs (improved breed, improved forage, veterinary drugs).

Thank you!

Appendix in table 5. Questionnaire

Instruction for enumerator

Thank the respondent & ask his/her willingness to complete the questionnaire

Describe objectives of the survey: To identify the determinant of cow milk commercialization

Thank the respondent at the END

Questionnaire ID _____

Name of the enumerator: _____ Phone number _____ Date _____

General information

1. Location: (1) Zone: Borana Zone (2) District: Yabello Weroda (3) PA _____

2. Respondent household character

2.1. Name of the respondent _____

2.2. Sex of the respondent 1) Male ☐ 2) Female ☐

2.3. Age of the respondent _____ years old

2.4. Religion 1) Muslim ☐ 2) Orthodox ☐ 3) Catholic ☐ 4) Protestant ☐ 5) Waqeffata ☐

2.5. Education status 1) Literate 2) Illiterate 3) Youth/elder education

2.6. If literate, what is education status respondent? 1) Elementary school ☐ 2) Secondary school ☐ 3) Preparatory/diploma ☐ 4) Higher institution ☐

2.7. Distance from the nearest services and facilities

No	Nearest service	Hour	Km
	Elementary school (1-8)		
	High school (9-12)		
	Market place/town		
	Livestock market place		
	Dairy product market place		
	Water source		
	FTC		
	Hospital		
	Health post		
	Transportation facility		
	Veterinary service place		

2.8. Social position of the Household

2.9. Community leader 2) Gada leader group ☐ 3) Security ☐ 4) None ☐

3. What are the major income sources of house hold in past 12 month?

No	Description	For consumption	Source of cash	Amount per year
	Cattle			
	Shoat			
	Camel			
	Milk			
	Trade			
	Aid			
	Labour			
	Dairy product sell			
	Livestock sell			
	Charcoal and firewood sell			

4. Family size

4.1. Household size 1) Male _____ 2) Female _____ 3) Total _____

Description of household characteristics (Exclude respondent)

No	*Relationship	Sex	Age	Education**
1				
2				
3				
4				
5				
6				
7				
8				

* Relationship 1) Husband 2) Wife 3) Son 4) Daughter 5) Relative 6) worker

** Education 1) Elementary school 2) Secondary school

3) Preparatory/diploma 4) Higher institution

5. What are your major sources of livelihood activities in last 12 months?

Sources of livelihood	Yes/No	Rank
-----------------------	--------	------

1) Crop farming		
2) Livestock rearing		
3) Beekeeping		
4) Petty trade		
5) Crop trading		
6) Livestock trading		
8) others (specify)		

5.1. Who is engaged in this activity? 1) Husband ☐ 2) Wife ☐ 3) Boys ☐ 4) Girls ☐ 5) others (mention)_____

5.2. When they engaged in this activity? 1) Year round ☐ 2) During slack time ☐ 3) During vacation ☐

6. What are the household resources/assets in past 12 month?

6.1. Do have land? 1) Yes ☐ 2) No ☐

6.2. If yes land allocation

Land allocation	Land size	
	Timad	Hectare
Crop Rain fed		
Crop Irrigated		
Private grazing land		
Private forage land		
Common land		
Common forage land		

7. Do have Livestock in past 12 month? 1) Yes ☐ 2) No ☐

7.1. If yes how many livestock's do you have?

Category	Numbers of livestock		Total
	Local	Crossbreed	
Cows			
Oxen			
Heifers			

Calves			
Bulls			
Goats			
Sheep			
Poultry			
Donkey			
Horse			
Camel			
Others(specify)			
Grand total			

8. Non and off farm source of income

8.1. Did you receive any income from non/off-farm activities in past 12 month? 1) Yes ☐
2) No ☐

8.2. What amount of income you received from non/off-farm activities in past 12 month?

No	Non-farm /off farm Source of income	Amount of income in Birr per year
1	Trade	
2	Brokers	
3	Aid	
4	Laborer	
5	Charcoal and fire wood sell	
6	Petty trade	
7	Others	
8	Total	

Note: Non/off-farm incomes are incomes generated by excluding income from own farming.

8.3. What is the reason to be engaged in non/off-farm activities?

1) Attractive income from non/off-farm activities ☐ 2) Shortage of land ☐

3) Excess family labor. ☐ 4) other (specify) _____

8.4. If you did not participate in non/off-farm income activities last year what is the reason?

1. Self-sufficient ☐ 2. No non/off farm income activity ☐ 3. Not interested to participate ☐ 4. Other (specify)_____

9. Dairy cattle production

9.1. Do you have dairy cow in past 12 month? (1) Yes ☐ (2) No ☐

9.2. What is your source of dairy cows?

No	Source of cow milk	Number of cow
	Born in own herd	
	Gift	
	Bought from market	
	Exchange	
	Others	

9.3. Breeding strategies

9.4. Do you practice breed selection for milking purpose in past 12 months? 1. Yes ☐ 2. No ☐

9.5. If yes what kinds of traits do you follow to select breeding cow from your herds? 1) body size ☐ 2) Colour ☐ 3) Calf survival ☐ 4) Calf growth ☐ 5) Age at first sexual maturity ☐ 6) Calving interval ☐ 7) Milk yield ☐ 8) other (specify)_____

9.6. Reproductive characteristics

No	Characteristics	Heifer /Cow
	Average age at sexual maturity (years)	
	Calving interval (years)	
	Average reproductive lifetime (years)	
	Number of calves produced per productive lifetime	

9.7. Dairy housing

9.8 Do you separate milking cow barn from other livestock? 1. Yes ☐ .2 No ☐

9.9. If yes, for what purpose you separate your milking cattle barn from other cattle?

9.10. How often do you clean your milking cattle house? _____

9.11. How often do you change your milking house? _____

9.12. Feeding and water resources

9.13. What are the major milking cattle feed types/supplementary and sources utilized in your area during the year? At what time and rank them

Feed types	Season	Sources*	Rank
Natural pasture			
Hay/standing hay			
Crop residues			
Mineral /sogida			
Pods			
Green fodder			
Purchased feed resources/furushka			
Others(specify)			

*1) own holding 2) Purchased 3) Communal holding

9.14. Do you give specific priority on feeding milking cow than other category? 1) Yes ☐ 2) No ☐

9.15. Do you have sufficient grazing pasture/feed resources for milking cow? 1. Yes ☐ 2. No

9.16. If no, which season feed shortage is critical? _____

9.17. How did you overcome the feed shortage during this season? _____

9.18. What are the major dairy cattle productions related problems?

9.19. Are you access to Veterinary service? 1. Yes ☐ 2. No ☐

9.20. What kind of veterinary service existed in your area? 1. Public ☐ 2. Private ☐ 3. Both

10. Labor division in cow rearing/management (Tick one or more boxes in each column and row; (F=Family, H= Hired

No	Activities	Male		Female	
		<15years old	>15years old	<15years old	>15 year old
1	Selling and Purchasing cow				
2	Herding				
3	Feeding				
4	Watering				
5	Milking				
6	Making dairy products				
7	Selling milk products				
8	Barn clearing				
9	Barn construction				

11. Credit services

11.1. Do you get credit services related to your dairy cattle production in past 12 months? 1) Yes ☐ 2) No ☐

11.2. If yes from which organization do get? 1) Relatives/Friends ☐ 2) Bank ☐ 3) Micro finance institution ☐ 4) Traders ☐ 5) Cooperatives ☐ 6) Others (specify) _____

11.3. For what purpose you need credit services? 1) Feed purchase ☐ 2) Salt purchase ☐ 3) for buying cow ☐ 3) other (specify) _____

11.4. If no what is the reason behind it? 1) There is no credit services ☐ 2) Difficult to payback ☐ 3) am not interested ☐ 4) other (specify) _____

Milk production and marketing

12. Do you have milking cow in past 12 month? 1) Yes ☐ 2) No ☐

12.1. If yes for how many years do you involved in milk production? _____

No	Category	Numbers of lactating cow	Lactation lengths/duration (month)	Average milk per day (lit/day)		Amount of milk sold per day	
				Wet	Dry	Wet	Dry

1	Local cow						
2	Crossbred cow						

12.2. What is the average cow milk produced per year? _____

12.3. For what purposes do you use the produced milk 12 month?

Purpose types	Koki/year/house hold in Dry season	Koki/year/house hold in Wet season
Consumption		
Processing		
Sell		
Gift		

12.4. What are the major constraints of milk production in past 12 month?

12.5. Do you sell milk? 1) Yes ☐ 2) No ☐

12.6. If yes for how many years do you involved in selling of milk? _____

12.7. At what price per unit (Birr per liter/koki) you sold milk in past 12 month? _____

12.8. What is the average cow milk sold per year per liters? _____

Market place

13. How far the dairy/ milk market place from your home (Km)? _____

13.1. Do you have appropriate market place for your dairy product? 1) Yes ☐ 2) No ☐

13.2. If yes where do you sell milk? 1. There is shed for milk ☐ 2. Collection center ☐
3. union/cooperative ☐ 4) other (specify) _____

13.4. If no where do you sold milk? 1) in open market ☐ 2) a road side ☐ 3) other (specify)

13.5. To whom do you prefer to sell milk?

Middle men ☐ 2) traders ☐ 3) consumers ☐ 4) retailers ☐ 5) processors ☐ 6) Cooperatives ☐

13.6. What the reason behind the preference among the above? 1) Pay more prices ☐ 2) Reliable ☐ 3) Trust ☐ 4) others (specify) _____ -

13.7. For what Reason do you sell milk? 1) surplus ☐ 2) not surplus but to cover family expenses ☐ 3) others, (specify) _____

14. Cooperative membership

14.1. Are you member of milk cooperative in past 12 month? 1) Yes ☐ 2) No ☐

14.2. .If yes, who is a member of cooperative? 1. Husband ☐ 2. Wife ☐ 3. Both ☐

14.3. If yes what is the advantage of being membership of milk cooperatives? 1) Fair price ☐ 2) Profit delivery ☐ 3) Provide Training ☐ 4) for marketing information ☐ 5) Credit ☐ 6) Others (specify) _____

14.4. If no why? 1. No cooperative in village ☐ 2. Bureaucrat ☐ 3. Not interested ☐ 4. Other (specify) _____

15. Marketing information

15.1. Do you get information related to milk market price? 1) Yes ☐ 2) No ☐

15.2. If yes, who are your sources of market information? 1) DA ☐ 2) Traders ☐ 3) Neighbor farmers ☐ 4) Cooperative society ☐ 5) Others (Specify) _____

15.3. How often do you get, market information? 1) Occasionally ☐ 2) Quarterly ☐ 3) Monthly ☐ 4) Weekly ☐

15.4. What are the major problems of marketing of milk in past 12 month?

16. Extension services

16.1 Do you access to extension services regarding on the milk? 1. Yes ☐ 2) No ☐

16.2. if yes the service providers and their main focuses

No	Services	Main service providers agent*	Rank	Frequency of service delivery**
1	hygienic milk handling			
2	milk processing practices			

3	milk marketing practices			
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*1) Aid organization 2) Agricultural extension agent 3) Research extension agent 4) Milk cooperative.

**1) Weekly 2) Twice a month 3) Monthly 4) Twice a year 5) Yearly

Thank you for your patience and time allocation to respond!