



Together for a Sustainable Development

MEKELLE UNIVERSITY

College of Dryland Agriculture and Natural Resources

Department of Animal, Rangeland and Wildlife Sciences

**Value Chain Analysis of Dairy in Laelay Maychew and Adwa Districts in
Central Zone of Tigray, Ethiopia**

By

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A thesis

**Submitted in Partial Fulfillment of the Requirements for the Master of
Science Degree in Livestock Production and Pastoral Development**

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DECLARATION

This is to certify that this thesis entitled “*Analysis of dairy value chain in Laelay Maychew and Adwa Districts in Central Zone of Tigray, Ethiopia,*” submitted in partial fulfillment of the requirements for the award of the degree of MSc in Livestock Production and Pastoral Development in Department of Animal, Rangeland and Wildlife Sciences Mekelle University done by Haregeweyni Tekelyesus **Id No. CDA/PR/005/06** and is an authentic work carried out by her under my guidance. The matter embodied in this thesis work has not been submitted earlier for award of any degree or diploma to the best of my knowledge and belief.

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BIOGRAPHICAL SKETCH

The researcher was born on December 1985 GC in Ahferom woreda Central zone of Tigray region. She attended her elementary school at Fersmay Hahayle primary school and secondary school at Wori secondary School during the period between 1993 and 2004/2005 GC. She joined Jimma University in 2004/2005 and graduated with a B.Sc degree in Animal Production and Health on June, 2007. Then after, she was employed in Agriculture and rural development office of woreda Laelay Maychew in 2008 as expert of animal production for one year. After one year of service there, she has been employed as expert of animal and animal production quality control for five years. Finally, after six years of working experience she joined to Mekelle University in November 2013/2014 to follow her graduate MSc Program in Livestock Production and Pastoral Development.

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List of abbreviations and symbols

AGP	Agricultural Growth Project
AI	Artificial Insemination
ARC	Agricultural Research Center
ATEVT	Agricultural Technical Educational and Vocational Training
AWARDO	Adwa Woreda Agricultural Development Office
CSA	Central Statistical Agency
DA	Development Agent
DCSI	Dedbit Credit and Saving Instituion
ETB	Ethiopian Birr
ECX	Ethiopian Commodity Exchange
FMD	Foot and Mouth Disease
FTC	Farmer Training Center
GDP	Gross Domestic Product
ICT	Information Communication Technology
ILRI	International Livestock Research Institute
Kg	Killogram
LIVES	Livestock Irrigation Value Chain for Ethiopian Smallholder
LMWARDO	Laelay Maychew Woreda Agricultural and Rural development Office
Masl	Metter above sea level
mm	Mili meter
NGO	None Gevrnmental Organizations
MoA	Ministry of Agriculature
%	Percent
OoARD	Office of Agriculture and Rural Development
Ql	Quintal
REST	Relief Society of Tigray
SD	Standred Devation
SPSS	Statistical Package for Social Scientists
TAMPA	Tigray Agricultural Marketing Promotion Agency

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Abstract

This study was aimed at analyzing dairy value chain in Laelay Maychew and Adwa districts of Tigray Region. The main focus was to describe and characterize different value chain actors, functions and services providers along the dairy value chain, to quantify the economic contribution of dairy value chain to actors and to investigate factors of small holder farmer's participation in dairy value chain. To accomplish these tasks formal and informal data collection tools for both primary and secondary data. A total of eighty smallholder dairy farmers from Laelay Maychew and eighty smallholder dairy farmers from Adwa district were selected at random and were interviewed using structured questionnaire. Milk and butter were the most important dairy products marketed in the areas. Dairy producers and retailers (café and restaurants) are found to be important milk market chain actors in the study area. From the milk value chain actors, 66.5% of retailers (café and restaurants) and 33.5% of milk producers added a value to the milk. In milk market, milk retailers enjoyed the highest net profit. The econometric estimation procedure was employed to identify factors that determine milk market participation decision and milk sale volume of the farm household in the area. The logistic regression results showed that educational level, cross breed type, access to credit and access to extension service are significantly affecting milk market participation decision. Similarly estimation results of second stage Heckman selection model showed that breed type and total milk product were significantly affecting volume of milk supply. The major constraints of dairy production and marketing in the studied areas were inadequate availability and supply of feed, low volume of milk, lack of training access, low house hold income/low purchasing power, unavailability of cooling facilities for milk storing, distance to market, low market demand of the product, low breed performance, access to transport, land access, access to water. Dairy product value chain in the study area seemed to be ineffective and underdeveloped. Thus, dairy development interventions should be aimed at addressing both dairy production technological gaps and marketing problems. The study further suggested strengthening of dairy cooperatives and milk processing industries establishment, improving access to services and consolidating the linkage among dairy value chain actors should receive due attention in order to improve dairy production and marketing.

Key words: *dairy, milk, butter, value chain*

CHAPTER ONE: INTRODUCTION

1.1 Backgrounds and justifications

Agriculture is the basis of Ethiopian economy, accounting for about 45% gross domestic product (GDP), employs 80% of the labour force and generates 80% of the export earnings (CSA, 2007). Livestock perform multiple functions in the Ethiopian household economy by providing food, input for crop production and soil fertility management, cash income as well as in promoting savings, fuel, social functions, and employments. With these multiple functions, livestock serve as a vehicle for improving food security and better livelihood of the rural population of Ethiopia (Land O'Lakes, 2010).

Ethiopia holds the largest cattle population in Africa estimated about 53,382,194. The cattle are mostly maintained by smallholder farmers and 98.9% are indigenous breeds while the cross breed and pure exotic breeds are represented by 0.94 and 0.11%, respectively (CSA, 2012). From the total cattle population, 44.8% are males and 55.2% are females; out of this 20% are milking cows. In Ethiopia the average daily milk yield per cow is estimated to be 1.5 liters with average lactation period of 6 months and the total annual national milk production in Ethiopia comes from about 10 million milking cows and is estimated about 3.2 billion liters (CSA, 2012). The large and diverse livestock genetic resources, existence of different agro-ecologies suitable for dairy production, increasing domestic demand for milk and milk products, better market opportunity, and proximity to international markets indicate the potential and opportunities for dairy development in the country. Dairy production in Ethiopia is expected to increase rapidly in response to the fast growing demand for livestock products resulting from increasing human population, especially in urban areas, and rising consumer income, provided that appropriate interventions are made along the dairy value chain and 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 reduction and nutrition ((Tegegne *et al.*, 2013). Dairy production among the sectors of livestock production system is

a crucial component in Ethiopia where dairy farming and its products are important source of food and income, job creation (Mohamed *et al.*, 2004).

The shift towards market economy is creating large opportunity for private investment in urban and peri-urban dairying (Mohamed *et al.*, 2004). Ethiopia has a complex dairy value chain, with both formal and informal channels. The dairy value chain comprise about 500000 smallholder rural farmers who produce about 1130 million liters of milk of which 370 million liters of raw milk, 280 million liters of butter and cheese and 165 million liters is consumed by the calves (Mohammed *et al.*, 2004). The remaining 315 million liters was marketed through both informal and formal retailers through farmers 'organizations. This dairy value chain has a variety of entrepreneurial actor's small holder and commercial producers, small and large processors, service and inputs providers, farmers' organizations and cooperatives (AGP, 2013).

In Tigray regional state, agriculture remains to be the dominant economic sector. The region has a total of 3,539,395 cattle and 18% (654,948) are milking cows (CSA, 2012). Milk is an important cash income sources for household consumption expenses. There are huge opportunities for improving the productivity and marketing of dairy product. The opportunities for the development of value chain based dairy product are the presence of appropriate agro-ecology for undertaking of potential livestock production and huge market potential for dairy products (Gebremedhin and Dawit, 2013). According to Tegegne *et al.* (2013), the value chain approach starts from an understanding of the consumer demand and works its way back through distribution channels to the different stages of production, processing and marketing. The study will help to identify possible entry points for intervention across the dairy product value chain and thereby contribute to the development of the dairy industry in the study area.

1.2 Statements of the problem

Dairying constitutes an important part of the Ethiopian smallholder crop/livestock mixed farming system. The country is known to have the highest number of cattle in Africa making it one of the biggest potential producers of milk and milk products in the continent. Despite this advantage, the industry is plagued with a number of constraints and the country remains a net importer of dairy products and farmers are poorly organized into cooperatives and unions, while their products are sold at sub optimal prices (Yilma *et al.*, 2011).

In many instance, policy decision on livestock and livestock product marketing are taken in the absence of vital information on how they affect dairy producers, traders, exporters, and consumers. Consequently, current knowledge, on dairy product market chain, performance and prices is poor for designing policies and institutions to overcome the perceived problems in the marketing system. Value chain of dairy products also insights the performance of all business activities involved in the flow of goods and services from the point of initial production until they are in the hands of ultimate consumers (Ayele *et al.*, 2003).

Dairy products are an important cash income source for household consumption expenses in central zone of Tigray. There are many opportunities for the development of dairy value chain based milk products including the presence of suitable agro-ecology for realization of potential dairy production, huge market potential for dairy products. But there is a problem of linkages among value chain actors and lack of support services such as extension services, insufficient data with which to plan improved services, and inadequate information on how to improve animal breeding, marketing, and processing critically affect the production of dairy value chain. To date, there is no information regarding the dairy value chain in Laelay Maychew and Adwa districts. However this study will help to identify possible entry points for intervention across the milk value chain and there by contribute to the development of the dairy industry.

1.3 Objectives of the study

1.3.1 General objective

The general objective of this study is to investigate the dairy value chain and identify the way of for developing the sector in Laelay Maychew and Adwa districts of central zone of Tigray.

1.3.2 Specific objectives

1. To identify and characterize different value chain actors, functions and services providers along dairy value chain.
2. To quantify the economic contribution of dairy value chain to actors
3. To determine factors that affect small holder farmers participation in dairy value chain
4. To identify the opportunities and constraints in the dairy value chain development

1.4 Research questions

1. Who are the actors and service providers involved in the dairy value chain?
2. What does the dairy value chain looks like?
3. What is the role and functions of each actor and service providers in the dairy value chain?
4. What are the factors that affect small holder farmer's participation in dairy value chain?
5. What is the economic contribution of dairy value chain to actors?
6. What are the opportunities and constraints to development of the dairy value chain?

1.5 Significance of the study

This study has a significant importance to various stakeholders that are directly or indirectly dealing with dairy research and development. Therefore, interested dairy farm owners (small, medium and large scale), investors, government and NGO's, experts and researchers can use the output of this study as baseline information for their intervention and further related crucial studies. In addition, the information generated from this study can be an input for local and

regional policy makers in the policy formulations focusing on dairy value chain analysis and other related issues. Moreover, the research outcome will identify the major constraints at different dairy value chain steps and suggests the possible options to be considered for its improvement.

1.6 Scope and limitations of the study

Due to time and financial limitations, the study was limited to only two districts of the central zone of Tigray region. The study was narrowed down to focus on dairy value chain and may not represent the wide scale management variation in dairy development in the study area. They focused on the major proportion of dairy production and passed through a number of value chains up to the end consumers. Nevertheless, the study is of value in terms of suggesting areas where the attention of practitioners and policy makers is needed and can serve as baseline for further research into the dairy value chain.

CHAPTER TWO: LITERATURE REVIEW

2.1 Concepts and definitions of value chain

A value chain is made up of a series of actors (or stakeholders) ranging from input suppliers, producers and processors to exporters and buyers engaged in activities required to bring agricultural product from its conception to its end use (Kaplinsky and Morris, 2001). A value chain, therefore, incorporates productive transformation and value addition at each stage of the value chain. At each stage in the value chain, the product changes hands through chain actors, transaction costs are incurred, and generally, some form of value is added. Value addition results from diverse activities including bulking, cleaning, grading, and packaging, transporting, storing and processing (Anadaja and Berhanu, 2009).

According to Bammann (2007, cited in Dawit 2010), there are three important levels of value chains (1) Value chain actors: The chain of actors who directly deal with the products, i.e. producer, processor, trader (2) Value chain supporters: The services provided by various actors who never directly deal with the product, but whose services add value to the product. (3) Value chain influencers: The regulatory framework, policies and infrastructures. Value chain describes the full range of activities which are required to bring a product or service from conception, through the different phases of production (it included three or more of the following: producers, processors, distributors, brokers, wholesalers, retailers and consumers (Kaplinsky and Morris, 2001).

2.1.1 Value chain mapping

According to Gebremedhin *et al.*(2012) mapping the value chain helps to identify value chain actors, service providers, their roles and functions; the various channels of product flows the stages involved in the value chain identify the location and position of particular chain actors of interest and visualize networks to get a better understanding of connections and interdependencies between actors and processes in a value chain, identify constraints and opportunities at different stages of the chain. The mapping process is also important in

demonstrating interdependency between actors and processes in the value chain. The mapping process further helps to create awareness of stakeholders to look beyond own involvement in the value chain.

2.1.2 Dairy value chain analysis

Value chain analysis is a method for accounting and presenting the value that is created in a product as it is transformed from raw inputs to a final product consumed by end users. Value chain analysis is synonymously referred to as production chain, ‘market chain’, ‘processing chain’ or ‘supply chain’. Value Chain analysis aims to assess both goods and services along the chain and the relative strengths and weaknesses in the links among various actors involved in the chain. So, the efficiency of a market chain is a result of how well the actors in the chain are organized and also how well the chain is supported by a range of business development services (SNV, 2008)

2.1.3 Actors in dairy value chain

There are various actors (from individuals to institutions) in the dairy sector that play various roles at different levels. These include: farm input suppliers, producers of different scales, cooperatives and unions, extension service providers, traders, processors, distributors, industry facilitators, development partners and consumers as end users (Yilma *et al.*, 2011).

The formal milk chain involves seven distinct value adding activities from production of the milk through reaching to the final consumer in the market, these activities include input supply, milk production, raw milk transportation, bulking and cooling, processing and packing, transporting processed milk and milk products and retailing gathering (bulking) (Land O’Lakes, 2010).

Input suppliers

Feed supplier: Animal feeds and feedings are the major inputs in any dairy activity. The feed resources of smallholder dairy producers are green fodder or hay from private or communally owned bottomlands, enclosures pasture, enriched grazing lands, rehabilitated gullies and forest areas other feed resources include crop residues, agro industrial by products, by-product of locally made beverage (‘*Atella*’) and aftermath (Sintayehu *et al.*, 2008).

A study done by Dawit (2010), in Tigray region showed that about 91% of the dairy producers are producing their own livestock feed from the bottomland enclosures, area closures, rehabilitated gullies and forest areas. The remained 9% dairy producers purchase additional feed from other farmers who have land in the bottomlands.

Credit supplier: Financial institutions in Ethiopia include public and private commercial banks, public development bank, microfinance institutions, saving and credit cooperatives and others. The goal of public support for microcredit is to improve the benefit of poor households through better access to small loans (Gebremedhin *et al.*, 2012)

Heifer suppliers: can be carried out by purchasing dairy cows from different suppliers. Crossbred dairy cows are often supplied from dairy producers in the nearby areas. Heifers can be also gained via other means from neighbor, gift, own herd. Under the small holder farmers the cross breed or Begait heifers are bought from local or distant markets (Dawit, 2010).

Processing equipment suppliers: Processing is essential for the dairy sector as milk has a very short shelf life. The type and quality of milking utensils used as well as methods and frequency of cleaning milking utensils affect the quality of milk and its products. Various equipment supply and utensils are utilized in milk collection, transportation, processing and marketing (Dawit, 2010). According to the report of Sintayehu *et al.* (2008) the majority 92% of urban producers used plastic milk utensils and about 43.3% of the rural producers used clay pot and plastics, while few 12.5% farmers used locally made grass utensils.

Drug suppliers: According SNV (2008), Poor animal health and management are major constraints of dairy development in Ethiopia which cause poor performance across all dairy production systems. Many of these problems result from the interaction among constraints themselves e.g. poorly fed animals develop low disease resistance, fertility problem, partly because the animal health care system relies heavily on veterinary measures. Poor grazing management systems continue to cause high mortality and morbidity (e.g, internal parasites). Supply of drug was carried out by governmental institutions. Private drug supply increased by nearly all the veterinary services and vet drugs supply channeled through institutions (Embaye, 2010).

2.1.4 Services provided and providers to smallholder farmers

The Offices of Agriculture and Rural Development (OoARD), dairy cooperatives, different governmental and non-governmental dairy development projects, dairy traders, higher educational and research institutions, private input suppliers, and dairy producers, both commercial and non-commercial farms are the important stakeholders/institutions that contribute to the development of dairy production and/or marketing (Sintayehu *et al.*, 2008).

Extension service: Dairy development in the country is undertaken by the government represented by the Ministry of Agriculture (MoA). MoA is the government's main arm for agricultural policy formulation and technical supervision including designing strategies, preparation of programs, capacity-building, providing trainings and coordinating national agricultural development projects). The national strategy for agricultural extension has changed to farmers training centers (FTCs) approach. The establishment of FTCs and the deployment of three ATVETs graduates as Da's per FTC are widely perceived as having a positive contribution to dairy development. One of the three development agents being assigned to an FTC has specialized in livestock production and she/he is supposed to focus on livestock and dairy extension (Yilma, 2011).

Artificial insemination service (AI): The first is the public sector AI service provider operated by the OoARD. The second is a private AI service delivery enterprise operated by former district AI technicians. The third service provider is dairy cooperative and the fourth is the farmer AI technician employed/trained (Alemayehu *et al.*, 2012). This technology is important to improve the genetic potential of indigenous animals and prevent transmission of diseases, which otherwise would be the case during natural mating. Currently AI service has been expanding to highland agro-ecological set-up close to urban and secondary towns where consumption of dairy products is high although the level of adoption and efficiency of the operation is low (Tegegne *et al.*, 2013).

Animal health services: Provision of veterinary service is the major and the day to day activity and encompasses basic animal health education treatment and vaccination; laboratory diagnosis and sample collection for regional laboratory. In addition to clinical based service, technicians

involve in mobile clinical service on call basis and vaccination campaigns. The vet service providers are very much preferred by producers for their timeliness and availability for home services (SNV, 2008).

Dairy cooperatives: Dairy Cooperatives play a significant role in ensuring sustainable supply of raw milk to the dairy industry by coordinating the flow of milk from their members and assisting them by supplying the required dairy farm inputs (Yilma, 2011). Farmers' milk marketing groups and dairy cooperatives play a key role for milk marketing outlets, which as a result encourages farmers to produce more milk (Zegeye, 2003). The role of cooperatives should also be extended to supply inputs and services to producers at reasonable price, and value adding scheme of commercial milk processing (Tegegne *et al.*, 2013).

Market information service: Market information refers to all the information about the buying and selling of agricultural products and inputs, and services and it must be noted that market information is much more than just information about prices and quantities (Gebremedhin *et al.*, 2012). The primary objective of a market information service is to increase the degree of knowledge of market participants (farmers, traders and consumers) about the market (Embaye, 2010). In Ethiopia, there exist both national, example the Ethiopian Commodity Exchange (ECX), and regional market information systems, example Tigray Agricultural Market Promotion Agency (TAMPA). Market information systems distribute market information electronically through internet, radios and televisions, pamphlets, magazines and newspapers. The extension agents need to make use of these sources to the extent they are accessible (Gebremedhin *et al.*, 2012).

Dedebit credit and saving institution (DCSI): Dedebit Credit and Saving Institution can support agricultural production in general and dairy production in particular and thereby contributes to commercialization of smallholder agriculture (Gebremedhin *et al.*, 2012). The service of the financial institution for the development of dairy sector in Ethiopia is of dominant importance for milk producing smallholders (Land O'Lakes, 2010).

2.2 Dairy marketing system in Ethiopia

2.2.1 Dairy marketing channel

In Ethiopia, dairy and dairy products are channeled to consumers through both formal and informal marketing systems (YONAD, 2009).

Informal market: involves direct delivery of fresh milk by producers to consumer in the immediate neighborhood or sale to itinerant traders or individuals in nearby towns (Land O'Lakes, 2010). In the informal market, milk may pass from producers to consumers directly or 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. In Ethiopia, 95% of the national milk is marketed through informal channels and is unprocessed. According (SNV, 2008) the traditional processing and marketing of dairy products, especially traditional soured butter, dominate the Ethiopian dairy sector, only 5% of the milk produced is marketed as liquid milk due to underdevelopment of infrastructures in rural areas and production is non-market oriented and most of the milk produced is retained for home consumption.

Formal milk markets: are particularly limited to peri-urban areas and Addis Ababa. The formal market appears to be expanding during the last decade with the private sector entering the dairy processing industry in Addis Ababa, DireDawa and Dessie towns (SNV, 2008).

2.2.2 Dairy marketing agents

Marketing agents achieve both personal and social goals. They add value to production and by so doing help satisfy consumer needs.

Producers: Rural traditional small holder producers and improved market oriented (urban, peri-urban and commercial) dairy farmers. The first link in dairy supply chain, the producers produces the products and supplies to the second agent. From the moment he/she decides what to produce, how much to produce and when to produce and sale (Gebremedhin *et al.*, 2012).

Rural assembler: Sometimes also known as transporter or trader, he/she is the first link between producer and middle men. These are markets where smallholder farmers or local traders sell their produce to collectors, who would later take to wholesale or retail markets (Gebremedhin *et al.*, 2012).

Whole seller: Concentrates the various, intermediate sized loads and puts the product into large, uniform units. These are markets where retailers and businesses buy their supplies. They are generally found in larger towns and cities. Farmers can also deliver produce to wholesalers in these markets. However, the main suppliers are usually traders who have bought from farmers or other small traders. In most cases, a wholesaler in the market will buy agricultural product for sale to retailers, or wholesalers operating in other markets (Gebremedhin *et al.*, 2012).

Retailers: The main role of retailers is the distribution of products to consumers. Their function is to obtain supplies and display them in forms and at times convenient to Cafés, hotels and restaurants; institutional consumers. In between these two extremes of retailers are a large array of village and small town or city shops that sell various goods but which generally do not keep sizeable stocks (Gebremedhin *et al.*, 2012)

Consumers: are the last links in the supply chain of the product. The participants and their respective functions often overlap. The most widespread combinations are traders-whole sellers that collect the commodity and supply it to retailers to consumer (Gebremedhin *et al.*, 2012).

2.2.3 Dairy product processing

Dairy products require processing to meet consumers' needs and tastes and it can prolong the shelf life of a product, especially for perishable products. For example, processing fluid milk into milk products such as butter, cheese and other products enables the producer to store the product longer (Gebremedhin *et al.*, 2012). Most milk is processed by the producer's on-farm into butter and soft cheese (*ayib*) for home consumption and sale. Rural producers who are located far from urban markets usually process surplus milk into butter because of difficulties in selling fresh milk locally and strong demand for butter in markets in towns and cities (Mohamed *et al.*, 2004).

For processing the milk should be fermented either in a plastic container or other local materials made from clay. Butter is the major value added product produced at the units it is used for cash generation, cooking Ethiopian dishes, and medicinal and cosmetic purposes (e.g. application to the braided hair of women). In almost all societies of Ethiopia, women are responsible for butter (Tsehay, 2001).

2.3 Economic contribution of dairy to actors

Nutrition: Dairy is also an important tool to address poverty, enhance agricultural development, and create employment opportunities beyond an immediate household or smallholder dairy operation. Livestock is a development tool because it “extends and sustains three major pathways out of poverty: (1) securing assets of the poor (2) improving smallholder productivity and (3) increasing market participation by the poor” (ILRI, 2007). Development of the dairy sector can contribute extensively to poverty alleviation and nutrition in the country (Ulfinia *et al.*, 2013). The contribution of dairy to household nutrition may not only come through a direct consumption of milk but through replacement effects due to the impact of improved dairy production on market integration (Staal *et al.*, 2008). This has helped them to raise healthy children through increased consumption of dairy products.

Income generation: The income obtained from sales of dairy product from the individual farmer's point of view, from the farmers' milk marketing unit point of view, income varies greatly depending on factors including location, unit's management and amount of milk received. In general, all farmers' milk marketing units are profitably run and the total revenue collected comes from sales of butter, fresh skim milk, and skim milk *ergo* and *ayib*. Most revenue is collected from the sales of butter as it has a high market value. Over half of the revenue is used to pay suppliers for raw milk purchased (Tsehay, 2001).

Employment creation: Smallholder dairy farms depend heavily on family labour to perform various tasks. Dairy production is therefore an important source of self-employment, especially for rural households. A significant proportion of dairy operators also hire long-term or casual labour, which creates employment among some of the poorest segments of society, including landless households in rural areas (Staal *et al.*, 2008). Even in Kenya on the smallest farms, in

total at farm level some 7.8 people are employed full-time for every 100 liters of milk produced on a daily basis (Staal *et al.*, 2008). Other is a cleaner and a protector (guard). Their salaries are paid monthly from the profit of the respective milk-marketing group. As the volume of milk handled increases, the units call for more employees (Tsehay, 2001).

2.4 Determinants of market participation

Agricultural output supply to markets is a clear indicator of market orientation agricultural productivity and therefore market participation by farmers is one way of poverty break through strategy in developing countries (Gebremedhin *et al.*, 2012). This happens when farmers take right decision while proportioning the agricultural products to markets that generate more economic benefits. The amount of agricultural produce that farmers decide to supply to a certain market is influenced by factors such as household characteristics, farming characteristics, institutional and market related factors (Ouma *et al.*, 2010).

Mamo and Degnet (2012) identified that gender and educational status of the household head together with household access to free aid, agricultural extension services, market information, non-farm income, adoption of modern livestock inputs, volume of sales, and time spent to reach the market have statistically significant effect on whether or not a farmer participates in the livestock market and his/her choice of a market channel. The study uses binary logit and multinomial logit to explore the patterns and determinants of smallholder livestock farmer's market participation and market channel choice using a micro-level survey data from Ethiopia.

Sex of household head: Female contribute more labor in the area of feeding, cleaning of barns, milking, butter and cottage cheese making and sale of dairy products. However, such constraints as lack of capital and poor access to institutional credit and extension service, may affect female participation in dairy production and markets (Tanga *et al.*, 2000). According to Berhanu *et al.* (2013), due to their potential dairy production advantages over female headed households, male headed households are expected to be more market oriented. Therefore, being male headed household is hypothesized to affect accessing hotel/restaurant milk market outlet choice positively as compared with accessing other milk market outlets.

Size of milk output (yield): past studies revealed that milk yield per day significantly and positively affected marketed surplus of milk (Woldemichael, 2008). Therefore, the variable is hypothesized to affect accessing hotel/restaurant milk market outlet positively than others because of hotel/restaurant capacity to purchase large volume of milk (Berhanu *et al.*, 2013).

Access to dairy extension services: The number of extension agent visits improves household's intellectual capitals and helps in improving dairy production and impacts milk market outlet choices (Berhanu *et al.*, 2013). Past studies revealed that extension agent visits had direct relationship with market outlet choices (Holloway and Ehui, 2002). Thus access to dairy extension service is hypothesized to affect accessing hotel/restaurant milk market outlet choice positively as compared with accessing other milk market outlets.

Market distance: According to Berhanu *et al.*(2013) distance to the market translate into market accessibility and ease of output transfer by market actors (time taken to reach the nearest urban market). This has a direct impact on volume of agricultural produce farmers avail to the market. Negative relationship between the quantity supplied and distance to the market, implying that as the distance increases away from the farm, there is a decline in the transacted quantities by farmers and closer a household to the nearest urban center, the lesser would be transportation costs, loss due to spoilage and better access to market information and facilities.

2.5 Reproductive performance of dairy breed

Age at first calving: Age at first calving is the age at which heifers calve for the first time (Gidey, 2001). It is closely related to the rearing intensity, and in a breeding program has impact on generation interval and response to selection. According to Adebabay (2009), the average age at first calving of local and cross breed heifers were, 53.52 months and 34.68 months, respectively in Oromia region of Bure district.

Calving interval: Calving interval is the period between two consecutive parturitions, and ideally should be in the range of 12 to 13 months in zebu cattle in Ethiopia (Mukasa-Mugerwa, 1989 Cited in Kedija, 2007).

Lactation length and average milk yield: The lactation length of animals mostly depends on the management objective of the herder; the herder may prolong the lactation length for the sake of continuing milk production or dry off the dam at early stage for the purpose of breeding the cows. As indicated the average lactation length for dairy cows was 7.29 months (Kedija, 2007). The overall mean daily milk yield at the beginning, middle and end of lactation in North-eastern Amhara region were 3.6, 3.1 and 1.5 liters, respectively and the overall average lactation length was 232 days (Solomon *et al.*, 2009). According to Woldemichael (2008), it was also reported that the average milking days/lactation period in Shashemene, Hawassa and Dale district's was found to be 240 days for local zebu breed dairy cows and 232 days for cross breed dairy cows. This was because of the fact that some of the local dairy farm owners have milked their cow even during the whole pregnancy period which is not economical (prolongs the next heat period).

2.6 Constraints and opportunities of dairy production and marketing in Ethiopia

2.6.1 Constraints of dairy production and marketing in Ethiopia

In smallholder dairy farmers there are different factors affecting dairy value chain. Among these factors reduction in volume of milk production, high cost of different inputs (animal feeds, improved breeds), high bargaining power of trader, weak relationship of dairy cooperative with its members, long fasting period of Ethiopia Orthodox Church are identified as the major factors affecting milk value chain in smallholder dairy farmer (Girma and Marco, 2014)

Dairy production is constrained by multifaceted factors, though the nature and magnitude of the problems. Challenges and problems for dairying vary from one production system to another and/or from one location to another (Tegegne *et al.*, 2013). The major constraints are explained below.

Feed shortage: In terms of quality, quantity and seasonality of feed and water supply which leads to reduction of volume of milk produced by small holder dairy farmers is one of the major factors which affect milk value chain in Ethiopia. Roughage and concentrate feeds are either too expensive or unavailable in sufficient quantity and quality to improve dairy production (Tegegne *et al.*, 2013 and Girma and Marco, 2014).

Shortage of land: For dairy farming and feed production is a major problem in urban, per urban dairy farming system and the rural highlands of dairy production system of Ethiopia. Dairy farms under this system have great pressure to expand dairying mainly due to rapid urbanization and population growth. Dairy producers are interested to expand their farm; the land size cannot allow most of them to do so. As land size increases more and more facilities become inevitable that take-up space other than the animal barn (Sintayehu *et al.*, 2008).

Constraints of reproductive and genetic breed: In Ethiopia, local breeds are the main source of milk and milk products. The number of crossbred cows is very low and is mainly concentrated in and around major urban and peri-urban centers. Indigenous cattle breeds are generally characterized as multi-purpose animals and managed in low input production system and they are inherently low milk producers (Sintayehu *et al.*, 2008).

Diseases and parasites: Diseases in dairy animals affect reproduction, milk production, milk quality and cause mortality and morbidity in rural lowland dairy production system. Mastitis is the one, which causes high economic loss, as a system is market oriented dairy system (Ulfina *et al.*, 2013). The prevalence of diseases such as Blackleg, FMD, Anthrax, Bovine tuberculosis, Lump skin disease, Tick-borne disease and Lice infestation are which hinders the realization of increased milk Production. Those problems related to access to veterinary service, medication supply, and cost of medication aggravated milk productivity in particular and dairy farm production in general (Ulfina *et al.*, 2013).

Seasonality of milk supply: Marketing constraints include fluctuation in demand and supply of dairy products (as a result of feed shortage and different socio cultural reasons), poor infrastructure (Lack of cooling facilities, simple processing equipments and quality testing skills and equipments) and the long time fasting of the members of the Ethiopian Orthodox church (Ulfina *et al.*, 2013). Many people of Ethiopia are Orthodox Church believers and they have a great role in milk marketing during the long fasting period. There is also mismatching in the supply and demand price difference of milk products during long fasting and after fasting period (Girma and Marco, 2014). Van der Valk and Tessema (2010), indicate that the calendar of Orthodox Christian church involves three prolong fasting period per year (before Easter, in

August, in December) and two fasting period every two weeks (Wednesday and Friday) for a total of more than 200 days per year. During the fasting days most of Orthodox Christian abstains from consuming products of animal origin then it is a big challenge in demand marketing of milk and milk product.

2.6.2 Opportunities of dairy production and marketing in Ethiopia

The dairy production is essential for rural Ethiopia and it is potentially the largest rural employer in the Ethiopian highlands and pastoral/ agro-pastoral areas. With continued urbanization, growing population size, demand for milk by the children and younger generation, it is expected that the dairy production will become a major player in agricultural development and has further potential to contribute extensively towards increased income and employment. The ultimate goal of the intervention in the dairy production in general and dairy Value chain in particular is to increase rural incomes by increasing the number of rural households deriving their livelihood from dairy industry through managing high productivity enterprises, while delivering quality and affordable dairy products to the market (SNV, 2008).

CHAPTER THREE: MATERIALS AND METHODS

4.1 Site designation

The study was conducted in two districts (Laelay Maychew and Adwa) in the central zone of Tigray regional state.



Figure 1. Map location of Laelay Maychew and Adwa in central zone of Tigray

Source; www.tigraionline.com

Location of Laelay Maychew district - The study area is located in central zone of the Tigray region located at a distance of 1024 km far away from Addis Ababa capital city of Ethiopia, and 250 kilometers from the regional state capital city of Mekelle. It lies between 14°07'00" and 14°09'20" north latitudes and between 38°38'00" and 38°49'09" East longitude and the elevation ranges from 1650 - 2480 masl. The district is bounded in the north by Merebleke woreda and in the east by Geter-Adwa woreda and Weri-Leke woredas, west by Tahitay maychew woreda and southern by Naidier-Adiet woreda. The total area coverage of the woreda is 556 sq km (LMWARDO, 2011). The study district is found in dry Weinadega agro-climatic zone. From the prevailing weather conditions, rainfall occurs during June to August. September is a transition

month between rainy and dry season and it represents the autumn. The period between December and February is characterized by cold and dry weather conditions and the warmer period extends between March to July. The annual rainfall of the district is 650 up to 700 mm. It is observed that the three months from June to August on average contribute more than 90% of the total rainfall. April to June is the hottest months in the district with average minimum and maximum temperature 12.4⁰C to 29.6⁰C, respectively. The coldest month is December where the average minimum and maximum temperature are 8.6⁰C and 26.8⁰C (LMWARDO, 2011).

Socio-economic features: the study area is characterized by small-scale subsistence mixed farming-system, with livestock production as an integral part. Crop production is mainly practiced in rain-fed conditions with little irrigation. Almost all of the cropland is planted to annual food crops, including cereals (maize, sorghum, barley, wheat and teff), pulses (beans, soybeans, chick pea and lentil), and root crop (potatoes). A very small fraction of farmers produce vegetables or fruits. These crops are grown mainly in homestead gardens or where irrigation exists.

Location of Adwa district: The study area is located in central zone of Tigray Region, Northern Ethiopia. Adwa is located at a distance of 1006 km far away from Addis Ababa capital city of Ethiopia, and 225 kilometers from Mekelle capital city of the regional state. Geographically the area lies between 38⁰ 53'55"E to 38⁰ 57'30"E longitude and 14⁰08'43"N to 14⁰11'47"N latitude with 1650 to 2258 masl altitude. Undulating surface, flatlands and mountains are the main characteristics of the study area. The surrounding mountains are characterized by gentle to steep slopes covered with scattered bushes. The boundaries of the district are Merebleke woreda from North, Ahferom and Wori-leke woreda from East, Wori- leke and Laelay Maychew woreda from South, and West (AWARDO, 2011). The district has two agro-climatic zones, namely Kolla (lowland) and Weinadega (midland) which is 32.2 and 67.8%, respectively. The annual mean rain fall ranges between 600 to 850 mm, rainy season occurs between June and August followed by a dry period beginning in September and lasting till February. Annual average temperature of the Woreda ranges from 12 ⁰C to 27⁰C, and with erratic rainfall (AWARDO, 2011)

Socio- economic features; the main economic activities of the study area are mixed farming practiced by the smallholder farmers (crop cultivation and livestock rearing) with the dominant

crops produced in the area are cereals (Teff, wheat, barley, mixture of barley and wheat ‘*Hanfets*’, finger millet, sorghum and maize), pulses (soya bean, chick pea, and lentil) vegetables (onion, tomato, hot pepper, shallot, garlic, cabbage, carrot, Swiss chard and lettuce) and oil crops (flux/linseed and nug/Niger seed). Livestock include cattle, goats, sheep, equines, bee colony, poultry and little irrigation and forestry activities are the sources of livelihood next to crops. There are also some supportive activities like food/cash for work in governmental and non-governmental organizations and other off-farm activities (AWARDO, 2011).

3.2 Sample size and sampling techniques

The study was carried out in two districts of central zone of Tigray. The study sites namely Laelay Maychew and Adwa districts were selected based on their potential for dairy production. Prior to dairy household sampling, an initial complete listing of all the dairy cattle in each district was obtained from respective woreda office of agriculture and rural development. Breed type (local and cross) owning was recorded for all households.

A two-stage sampling technique was used to draw sample units. According LMWARDO (2014), and AWARDO (2014), there were 16 and 18 *Tabias* located in rural areas of the two districts (Laelay Maychew and Adwa districts) respectively. From each district 2 *Tabias* were sampled. Accordingly, Medego and Dura *Tabias* from Laelay Maychew, Seloda and Beteyehanse *Tabias* from Adwa district were selected based on their potential for dairy production. The dairy producers were stratified into local and cross breed dairy cow owners.

A total of 160 dairy producers (75 cross breed and 85 local breed owners) were selected for the study from 4 *Tabias* (Table 1) through random sampling methods. Representative samples were taken from the dairy value chain actors that can contribute value addition to the commodity under study and services providers that contribute services provided to producers. The sample size dairy value chain actors involved in the study were input suppliers 24 including: private feed supplier (7), drug suppliers (4) and 13 retailers (Restaurants, snack, café and hotels, 9 service providers including: OoARD(2), Dedebit credit and saving institution (2), AI service provider (2), Vet service provider (2) and 1 from Relief Society of Tigray (Table 2).

Table 1. Sample size distribution of dairy farmers in the study sites

Location	Tabias	Dairy house- hold Population	Sample size of dairy farmers N (%)
Laelay Maychew	Medoge	1218	44(25)
	Dura	979	36(20)
Adwa	Beteyehanse	1457	45(30)
	Soloda	1156	35(25)
	Total	4810	160(100)

Source: own computation from OoARD data

N= number of respondents

Table 2. Sample distribution of dairy production actors and service providers

Location	Private input suppliers	Retailers	Private and public service providers	Total
Aksum	6	7	4	17
Adwa	5	6	5	18
Total	11	13	9	35

Source: own computation

The data were collected using primary data collection method. During the survey data were collected from the selected respondents (N=160) of the districts using semi-structured questionnaire (Annex1). The questionnaire consisted of characteristics of household head, land holding, source of income, farm size and breed type, reproductive performance of local and cross breed cow, input uses and input suppliers, service providers, dairy marketing systems and the major constraints of dairy value chain. In addition to this, focus group discussion was held with 6 knowledgeable persons on dairy production to gather additional information on the status of dairy production, marketing system, service provision and constraints of dairy production. In addition to this, formal and informal discussion was held with key informants (district experts (8), Development agents (DA's) (4) and *Kebele* administrators (2)).

The secondary source of data such as total livestock population, human population, farming system, dairy cattle population (both cross and local breed), house hold head (both male and female house hold head) and location and physical characteristics of the districts were collected from the district office of agriculture and rural development.

3.3 Data analysis methods

The data collected from the identified dairy producers and value chain actors were encoded into SPSS version 16. Descriptive statistics such as mean, frequency, percentages and standard deviations were used in the process of comparing socioeconomic, demographic and institutional characteristics of households. Ranking method was used to rank the variables that prioritize by the smallholder farmers like purpose of keeping dairy cattle and major constraints of dairy value chain in the study areas.

An econometric analysis was conducted to assess factors affecting dairy value chain. The binary logistic regression model was employed to estimate the effect of the hypothesized independent variables on the participation of milk market decision using STATA software Version 10. The logistic distribution has an advantage over others in the analysis of dichotomous variables in that it is exceptionally flexible and easily used functions from mathematical point of view and subjects itself to meaningful interpretation (Hosmer and Lemshow, 1989).

Determination of the logit Model

The logit model was employed for each practice, since it was believed to propose better explanation on the decision of milk market participation in the study area and its determinants independently. The output of probit and logit models is usually similar (Aldrich and Nelson 1984). The logit model is easier to estimate and the interpretation of parameter estimates is straight forward. A binary logistic model was used to see the determinants of milk market participation decision in this study.

$$Y^* = Z' \alpha + \epsilon_1$$
$$Y = 1 \text{ if } Y^* > 0$$
$$Y = 0 \text{ if } Y^* \leq 0 \tag{1}$$

Where, Y^* is a latent (unobservable) variable representing household's discrete decision whether to participate in milk market or not. Z' is a vector of independent variables hypothesized to affect household's decision to participate in milk market. α is a vector of parameters to be estimated

which measures the effects of explanatory variables on household's decision. ϵ_1 is normally distributed disturbance with mean (0) and standard deviation of δ_1 and captures all unmeasured variables. Y is a dependent variable which takes on the value 1 if a household participates in milk market and 0 otherwise. Since the probit regression parameter estimate does not show by how much a particular variable increases or decreases the likelihood of participating in milk market, marginal effects of independent variables on probability of a household to participate in milk market was considered. For continuous independent variables, the marginal effect was calculated by multiplying the coefficient estimate α by standard probability density function by holding other independent variables at their mean values. The marginal effect of dummy independent variables was analyzed by comparing probabilities of that result when dummy variables take their two different values (1 if participate in milk market and 0 otherwise) while holding all other independent variables at their sample mean values (Wooldridge, 2002 cited in Berhanu *et al.*,2013).

Variables affecting volume of milk supply were modeled using second-stage Heckman selection model (Heckman, 1979). The Heckman selection equation is specified as second stage Heckman selection

$$\begin{aligned}
 Z_i^* &= W_i \alpha + \epsilon_2 \\
 Z_i &= Z_i^* \text{ if } Z_i^* > 0 \\
 Z_i &= 0 \text{ If } Z_i^* \leq 0
 \end{aligned}
 \tag{2}$$

Where:

Z_i^* = Latent variable representing optimal volume of milk sold to market outlets which is observed if $Z_i^* > 0$ and unobserved otherwise

Z_i = Observed volume of milk sold to markets

W_i = Vector of covariates for unit i for selection equation which is a subset of Z'

α = Vector of coefficients for selection equation

ϵ = Random disturbance for unit i for selection equation

The selection equations that are determinants or independent variables whether particular observation was in the sample used to estimate equation are as follows

X₁ = Distance to nearest dairy product market

X₂ = Education of the household head

X₃ = Sex of the household head

X₄ = Breed type (Local and cross)

X₅ = Land holding size

X₆ = Access to credit

X₇ = Access to extension services

X₈ = Experience on dairy production

X₉ = Market information

X₁₀ = Access to training

X₁₁ = Total milk product

Variable Definitions

In order to explain producer's fluid milk market participation, continuous and different variables were identified based on economic theories and the findings of different empirical studies. Accordingly, in order to investigate the research questions of this study, the following variables were constructed.

Dependent variables

1. **Volume of milk supplied to market:** It is continuous variable that represents volume of milk supplied to market.
2. **Milk market participation decision:** It is the dummy variable that represents whether a level of household milk market participation decision.

Independent (explanatory) variables (Xi)

The following eleven variables were assumed to influence the dairy product supply chain and market participation decision of the households in the two study districts.

1. **Distance to nearest dairy product market :** The closer the market, the lesser would be the transportation charges, reduced trekking time, reduced loss due to spoilage, and reduced other marketing costs, better access to market information and facilities. This improves return to labour and capital and increase farm gate price and the incentives to participate in economic transaction. Therefore, it is hypothesized that this variable is negatively related to market participation and marketable surplus. A study conducted by Holloway and Ehui (2002)) on expanding market participation among smallholder livestock producers in the Ethiopia high lands revealed that distance to milk market was negatively related to milk market participation decision of dairy household.
2. **Breed type (local and cross);** Production in turn varies directly with crossbred and local bred lactating dairy cows in the study area. The positive and significant difference between breed type and milk market participation decision may be cross breed dairy cows could produce more milk than local breed dairy cows to participate in milk market participation decision. Moreover, integration of crossbred cow, upgrading milk production potential of local cows, among others should be used to increase milk yield per day per household and hence milk market participation and volume of milk supplied (Woldemichael, 2008).
3. **Land holding size:** It is a continuous independent variable measured in hectare. As input for dairy production, land is very important for forage and pasture development to feed dairy cows. It is expected that as size of land increases, proportion of land allocated for feed development and improvement increases. It is hypothesized to affect milk market participation and volume of supply positively.
4. **Education of the household head:** It is continuous variable and is measured in years of formal schooling of the household head. Education plays an important role in the adoption of new technologies. Further, education is believed to improve the readiness of the households to accept new idea and innovations, and get updated demand and supply price information which in turn increase producers' readiness to produce more and

increase milk market entry decision and volume of sale. It is assumed to have positive effect on the dairy product chain participation decision and volume of milk sale (Kedija, 2007).

5. **Sex of the household head:** is dummy variable it was expected to have positive effect on milk market participation decision and milk sale volume. In mixed farming system, both men and women take part in livestock management. Generally, women contribute more labour input in dairy farming activities including, feeding, cleaning of barns, milking, processing and sale of milk and other dairy product. However, such constraints as lack of capital and poor access to institutional credit and extension service, may affect female participation in dairy production and markets (Tanga *et al.*, 2000). Due to their potential dairy production advantages over female headed households, male headed households are expected to be more market oriented. Therefore, being male headed household is hypothesized to affect accessing hotel/restaurant milk market outlet choice positively as compared with accessing other milk market outlets.
6. **Access to credit:** Debt can be interpreted in two ways: the first way pertains to the fact that increased debt in other activities may lead to lack of free collateral in order to secure loans for dairy activities. Access to credit is hypothesized to have a positive effect on introducing dairy heifer as it improves the financial capability of the farmer to participate in volume of milk supply chain (Embaye, 2010).
7. **Access to extension service:** The number of visits made by extension agent in the year measures the variable. Number (frequency) of extension visits improves the household's intellectual capitals, which improves dairy production and processing of milk into various dairy products. Therefore, number of extension visits has direct influence on dairy product market participation and product supply to market. According to Holloway and Ehui (2002), identified that extension visit was directly related to dairy household milk market entry decision and marketed milk volume.
8. **Experience on dairy production:** It is a continuous variable, it refers to the number of years the farmer engaged in dairy production activity and is expected to influence to milk market participation decision and supply of milk to the market positively. As farmers got more experience in dairy, the probability of increasing production and hence supply would be higher. Staal *et al.* (2006 cited in Berhanu *et al* 2013) included the variable in

probit model and found out that the variable revealed positive relation to milk market participation and market outlet choice. Therefore, the variable is hypothesized to affect accessing cooperative milk market outlet choice positively as compared with accessing other milk market outlets.

9. **Total milk product:** It is continuous variable measured in liters. The variable is expected to have a positive contribution in smallholder dairy value chain participation and volume of milk supplied to market. A marginal increase in dairy production has obvious and significant effect in motivating the income level. The processed part of the product may be used for home consumption or sales. Production in turn varies directly with the number of crossbred and local bred lactating dairy cows (Woldemichael, 2008).
10. **Access to market information:** Farmers marketing decisions are based on market price information, and poorly integrated markets may convey inaccurate price information, leading to inefficient product movement. Therefore, it is hypothesized that market information is positively related to market participation and marketable surplus (Holloway and Ehui, 2002).
11. **Access to training:** Is dummy variable that is expected to have attending dairy product training is a positive contribution in smallholder dairy chain participation and on volume of milk supplied to market.

CHAPTER FOUR: RESULTS AND DISCUSSION

This chapter presents the results of descriptive and econometric analysis of the study. The descriptive statistics is used to describe the general characteristics of sampled dairy household respondents. The econometric analysis is used to identify factors that affect dairy value chain.

4.1. Characteristics of respondents

Age: The pooled average age of the respondent household head of the two study area is 48 years. The mean age of the household head of Laelay Maychew was 47 years and the mean age of the household head of Adwa district is 49 years (Table 3). Most of the household heads were between the ages of 41 to 60 (70 %). This is one of the household characteristics that are important to describe the households working age (productive age). This is supported by review report of Tegegne *et al.* (2013), who reported the average age of the household heads in the in Ethiopian smallholder farmers are ranged from 39.7 to 51.9 years, and it is within the range of the productive age. Also the majority of respondents are adult, though a great deal of the youth is still engaged in the dairy farming business.

Family size: The mean family size of the household head in Laelay Maychew and Adwa districts is 6.46 and 5.65 persons, respectively. The pooled average household family size of respondents was 6 persons (Table 3). The average household family size observed in this study is comparable with the findings of Embaye (2010) and Adebabay (2009), reported the values of 6.5 in Atsbiwenberta and Alemata woredas of Tigray, 6.22 persons per family in Bure district, respectively. This indicates that dairy producers with large family size adopt for improved technologies to improve productivity and incomes. Dairy farming also demands high labour and therefore, households with larger family size are able to meet the required labor demands. The family size may influence the availability of labour in the households for herding and cropping activities. This is in agreement with the report of Yitaye (2008), in case of North western Ethiopian and Tegegne *et al.* (2013), stated that large family size recorded in Ethiopian smallholder farmers is an advantage for the dairy producers to engage the labour force in different activities of dairying.

Dairy farming experience: The average experience of respondents in dairy farming in Laelay Maychew and Adwa districts are 12.5 and 13 years, respectively. Almost similar result was reported by Woldemichael (2008), who reported the average experience in dairy production were 13.4, 13.8 and 20.4 years in Hawassa ,Shashemene and Yergalem, respectively. This experience in dairy production influences on increasing knowledge and management of dairy inputs and adoption of new technologies.

Land holdings: The average land holding size (rent, own and your family land) of Laelay Maychew and Adwa districts of sampled household heads are 1.2 ha and 1.1 ha, respectively this is including the (Table 3). Similarly, Kedija (2007) reported that the land holding size of household heads engaged in dairy farming in Mieso district ranged between 1- 1.5 ha. Land holding size influences dairy production to expand the dairy farm in the districts.

Market place distance: Average distance of market from home in Laelay Maychew and Adwa district are 7.7 and 6 km, respectively (Table 3). Distance to market influences dairy value chain due to perishability nature of the product. The closer to the market the lesser would be the transportation cost and time spent. According Berhanu *et al.* (2013) the marginal effect of the likelihood of accessing hotel/restaurant milk market outlet in Wolayta zone decreases by 5.7% as compared with accessing individual consumer milk market outlet for a distance away from the nearest urban center.

Table 3. Household characteristics in Laelay Maychew and Adwa districts

Variables	Laelay Maychew			Adwa		Total		
	N	Mean	SD	N	Mean	N	Mean	SD
Age (Years)	80	47.4	8.5	80	49	160	48	8
Total family size (Number)	80	6.46	1.7	80	5.65	160	6.5	1.8
Total land (ha)	77	1.2	0.6	73	1.14	150	1.2	0.5
Experience in dairy farming (years)	80	12.5	4.7	80	13	160	13	5
Distance from market (km)	80	7.7	3	80	6	160	7	3
Total number of cows holding/household	80	1.4	0.7	80	1.6	160	1.5	0.7

Source: Survey result; 2015

N=Number of respondents, Min=Minimum, Max=Maximum= SD= Standard Deviation

Educational level: The percentage of illiterate household heads, church education and grade1-4 in Laelay Maychew district is greater than the corresponding educational groups in Adwa districts (Table 4) while the percentage of above grade 5 in Laelay Maychew district was less than the same educational category in Adwa districts. This difference is due to the culture of the households and their awareness regarding the importance of education. This shows the growing of educational coverage which provides better opportunity to implement improved agricultural practices and wise use of scarce agricultural resources in the study area. The role of education is clear in affecting household income, adopting technologies demography, health and as well as a whole socio-economic status of the family (Kerealem, 2005 cited in Adebabay, 2008).

Table 4. Education level of sample respondents in the district

Educational level	Laelay Maychew		Adwa		Overall Average	
	N	%	N	%	N	%
Illiterate	18	23	12	15	30	19
Church education	16	20	8	10	24	15
Grade 1-4	22	28	20	25	42	26
Grade 5-8	17	21	29	36	46	29
Grade 9-12	5	6	6	8	11	7
Grade >12	2	2	5	6	7	4
Total	80	100	80	100	160	100

Source; Survey result; 2015

N; number of respondents

Sex of the respondent: Out of the total interviewed dairy producer farm households in the district area of Laelay Maychew and Adwa (N=160) 79.4% are male-headed households and the remaining 20.6 % were female headed households (Table 5). This is due to most of house hold heads in the study area are dominated by male headed households and the female headed house hold were not engaged in dairy production due to lack of capital and low access to extension and credit service. Similarly Tegegne *et al.* (2013) reported that most of the households sampled in rural highlands of dairy production system of Fogera and Bure were male headed households (77.5–97.4%).

Almost all of the total sampled dairy producer households (99.4%) were Orthodox Christians. The large percentage of Orthodox Christians in the study area has great influence on milk market chain during the fasting periods. In the Orthodox Christians religion more than 200 days of the year are fasting days and most of the followers abstained from consuming dairy products during this period consequently it resulted in lower market demand. Studies conducted by Girma and Marco (2014) in Ada'a District, East Shawa Zone of Oromia regional State revealed that, Orthodox Christians is the most dominant type of religion and has a great influence on milk marketing system during fasting period.

Land access: Accessibility of land for local and cross breed cow owners who had land access are 99 and 89%, respectively. These finding was in line with the report of Dawit (2010) in Atsebi womberta district where he reported that about 94 and 86% of local breed and cross breed cow owners had land. On the other hand 6 and 14% local breed cow and crossbreed cow owners have no lands. This indicated that landless emerges to be in favor of managing crossbred than local breed dairy cows. This is due to the reason that youngsters are mainly engaged in improved cross breed dairy cows in order to obtain income because those youngsters were landless peoples. Whereas local breed dairy cow owners were mainly owned by aged farmers in that case they are not engaged in improved dairy and they have lands to obtain the income.

Availability of market information: Availability of market information for local and cross breed cow owners were 36 and 81%, respectively (Table 5). The economic importance of rearing cross breed cows under smallholder farmers have been advocated for several years by bureau of agriculture and NGO's through mass media and extension information. Thus, this might help the crossbreed owners to have better market information in comparison with local breed owners.

Availability of credit access: Availability of credit access in the study area for local and cross breed cow owners were 87 and 93%, respectively (Table 5). These days, private, government and credit providing institutes encourage introduction of cross breed cows for improved milk production under smallholder farmers and such interventions might favor cross breed owners to have better credit access for the purchase of the necessary inputs for dairy farming business.

Market participation: The cross breed cow owners to see produced large amount of milk to participate in market; however, local breed cow owners produce small amount of milk for home consumption and processing into butter and cottage cheese. Most of the local breed owners participated in butter marketing, whereas cross breed owners are majorly participated in fresh milk marketing. Out of the total respondents interviewed both local and cross breed owners, 46% are milk market participants as they sell milk to market outlets available in the study area while the remaining households do not participate in selling milk due to distances to market center (5%), cultural taboo (11%), household consumption (21%), low product yield (17%), low demand of the product during long fasting period (39%) and low market price (1%).

Table 5. Access to land, market information and credit between local and cross breed owners

Household variables		Local bred owner N=(85)		Crossbred owner (N=75)		Over all total (N=160)	
		N	%	N	%	N	%
Sex of the household head	Male	65	76	62	83	127	80
	Female	20	24	13	17	33	20
Land access	Yes	84	99	67	89	151	94
	No	1	1	8	11	9	6
Market information	Yes	31	36	61	81	92	59
	No	54	64	14	19	68	41
Access to credit	Yes	74	87	70	93	144	90
	No	11	13	5	7	16	10
Access to extension service	Yes	63	74	59	79	122	77
	No	22	26	16	21	38	23
Market participation	Yes	36	42	69	92	105	67
	No	49	58	6	8	55	33

Source: Survey result; 2015

N= number of respondents

4.2 Description and characterization of value chain actors, functions and services providers

There are different actors and service providers in the dairy sector that play various roles at different levels in the study areas. These include input suppliers, producers, traders (retailers) extension service providers, Dedit Credit and Saving Institution, NGOs' and consumers as end users.

4.2.1 Dairy production inputs and input suppliers

This input supply system includes all input types used for dairy products in the study areas.

Credit suppliers: According to the survey result, Dedebit Credit and Saving Institution (DCSI) is the only credit supplier for dairy farmers. During the survey 9 and 22% dairy farmers got credit from Dedebit Credit and Saving Institution (DCSI) to purchase local breed and cross breed heifer, respectively. The average amount of money in ETB to purchase one local breed cow was 6288 birr and it was 9817 birr for crossbreed cows. According to the information gathered from Dedebit Credit and Saving Institution (DCSI) the amount of credit allowed for one local breed cow was 8000 ETB proceeding by crossbreed dairy cow 25000 ETB by the interest rate of 15% per annum for 4 years long. The average amount of credit taken by dairy farmer during the survey period to purchase local and cross bred dairy cow was less than that of allowed by the Dedebit Credit and Saving Institution (DCSI). Due to high interest rate of the credit the farmers use their own money to purchase those cows. Crossbred dairy cows are mainly supplied from dairy producers in the towns such as Aksum and Adwa whereas local breed dairy cows are supplied from dairy farmers in the district and outside of their district from western part of Tigray sheraro. Credit supply is important for financing investment and farm operations crucial to the commercialization of smallholder agriculture.

Feed suppliers: The main feed resources available for smallholder dairy producers are grass and hay. The average amounts of grass hay produced in the sampled household from own bottomlands were 184.75/ql/year/. Whereas the average amounts of grass hay purchased from other farmers were 276.50/ql/year/. Concentrate feeds were supplied to dairy producers by the private feed traders in Aksum and Adwa. Those private feed traders purchased the concentrate feed from Adwa, Aksum and Shere flour mill factories. During the survey period the private feed traders purchase on average a total of 117.86 quintals wheat bran/year. The average price of wheat bran is 260 ETB/ql and this price fluctuate among the season based on the availability of the raw material input (wheat) and the availability of other roughage materials like green grass and hay influence its demand and price. During dry season (October up to May) the price of wheat bran was 290 ETB/ql whereas during wet season (June, July, August and September) the price of wheat bran was 215 ETB/ql. The variations in price of wheat bran are associated with

low demand in wet season (Table 6) because of the availability of green grass and farmers substitute most parts of the wheat bran with green feed. Private feed traders purchased large amount of wheat bran from wheat milling factories and then sell to the smallholder farmers according to the demanded quantity by farmers. The average annual quantity of wheat bran purchased by the dairy farmers for the local and crossbred cow was 8.03 and 11.72 ql, respectively. This indicated that the dairy farmer give more emphasis on the feeding of crossbred cows because of their high genetic potential as compared to the local breed.

Table 6. Traders concentrate feed supply and its price during the survey period

Concentrate feeds	N	Min	Max	Mean	SD
Annual quantity of wheat bran/ql/supplied by trader	7	50	320	117.86	95.00
Traders purchasing price of wheat bran from flour mill Factory/Birr/ql	5	250	280	260	0.12
Selling price of wheat bran to farmer /Birr/ql	7	280	400	328	0.41
Annual quantity of wheat middling/ql/ supplied by traders	3	10	150	57	80.5
Purchasing price of wheat middling/Birr/ql	1	280	280	280	
Selling price of white middling to farmers(Birr)/ql	3	280	350	310	0.36
Annual quantity of nug seed cake(ql) supplied by traders	1	400	400	400	
Purchasing price of nug seed cake(Birr)/ql	1	300	300	300	
Selling price of nug seed cake to farmers(Birr)/ql	1	400	400	400	

Source: Survey result; 2015

1 summer season = June to September, 2 winter season= October up to May N= Number of respondents, Min= Minimum, Max= maximum, SD = Standard Deviation, ql= Quintal

Veterinary/Drug suppliers: Veterinary or drug supply is provided by OoARD and private drug suppliers. Veterinary service is provided by the government extension, the majority of farmers in the study area get good service regularly or on demand basis. However, regular vaccination is mostly obtained from government extension. The woreda veterinary departments provide vaccination services for most common diseases. There is a free preventive vaccination every year for contagious diseases such as anthrax, black leg, bovine pasturolosis and Foot and Mouth Disease. Veterinary drugs are supplied by private drug suppliers. There are 2 private veterinary

drug suppliers in Aksum and 2 drug suppliers in Adwa town. The drugs suppliers procured from Addis Ababa. The type of drug supplied to farmer by drug suppliers in the two districts were mostly Tetrachloride, Albendazole and Diaznone. The average drug supplied to producers from four drug suppliers were 1590 Pocket/year/by average unit price of 100 birr/pocket for average 4106 customers /year.

Sources of major inputs used by dairy farmers: About 37 and 62% of local and cross breed heifers are purchased from markets, respectively. Also 55 and 38% of local and cross breed heifers are obtained from farmers own stock, respectively (Table 7). The major feed resources available in the study area include grass hay, crop residues and industrial by-products. Hay is one of the feed types used in most of the dairy producer farmers in the study area. About 40% of the respondents in the study produce own hay and 50% bought it from the other farmers. This finding is similar with Sintayehu *et al.* (2008) who reported that the majority (53.7%) of the households in the mixed crop – livestock system of Shashemene–Dilla use animal feeds from own crop.

Table 7. Availability of major input and sources

Access of input sources		Laelay Maychew district(N= 80)		Adwa district (N=80)		Total	
		N	%	N	%	N	%
Availability of local breed heifers	Yes	45	56	49	61	94	59
	No	35	44	31	39	66	41
Source of local breed heifers	Own stock	21	26	17	21	38	40
	Purchased from market	23	29	19	24	42	45
	Both from own and market	1	1.2	13	16	14	15
Availability of cross breed heifers	Yes	38	48	38	47.5	76	48
	No	42	53	42	52.5	84	52
Source of cross breed heifers	Own stock	5	13	6	16	11	23
	Purchased from market	25	66	22	58	47	56
	Both from own and market	8	21	10	26	18	21
Availability of grass hay	Yes	73	91	79	99	152	95
	No	7	9	1	1	8	5
Source of grass hay	Own production	51	64	3	4	54	35
	Purchased from market	10	14	67	84	77	51
	Both from own and market	12	17	9	11	21	14
Availability of straw	Yes	65	81	49	61	114	71
	No	15	19	31	39	46	29
Source of straw	Own production	55	69	18	40	73	64
	Purchased from market	4	5	19	44	23	20
	Both	6	7.5	12	28	18	16
Green fodder	Yes	36	45	2	3	38	24
	No	44	55	78	97	122	76
Source of Green fodder	Own production	34	94	2	100	36	95
	Both from own and market	2	6	0	0	2	5
Availability of Concentrate feed	Yes	36	45	37	46	73	46
	No	44	55	43	54	87	54
Source of concentrate feed	Purchased from market	36	100	37	100	73	100
Availability of AI	Yes	67	84	75	94	142	89
	NO	13	16	5	6	18	11
Source of AI	from OoARD	67	100	75	100	142	100
availability of vaccination	Yes	73	91	76	95	149	93
	NO	7	9	4	5	11	7
Source of vaccine	OoARD	62	85	64	84	126	85
	From private input supplier	1	1	1	1	2	1
	Both	10	14	11	15	21	14
Availability of milk processing equipment	Yes	48	60	43	54	91	54
	No	32	40	37	46	69	44
Source of milk processing equipment	Local market	47	100	43	100	91	100

N= Number of respondents

4.2.2 Dairy producers in Laelay Maychew and Adwa districts

The average number of dairy cows for the production of milk per household in Laelay Maychew and Adwa district is 1.4 and 1.6, respectively. Whole milk, *Irgo*, butter, buttermilk, traditional soft cheese, and whey were among the common milk products produced and consumed in the study area. The average annual total milk produced in the dairy farms of Laelay Maychew and

Adwa districts are 1264 and 1381 liter, respectively (Table 8). The amount of milk produced in Adwa district is higher by 9% in comparison with Laelay Maychew, and this is associated with higher number of dairy cows holding/household in Adwa district. Out of the total milk products from Laelay Maychew districts 23% used for home consumption, 50% used for processing into butter and cottage cheese, and 27% sold in local market for house hold consumers and for café and restaurants. In the case of Adwa district from the total produced milk, 16% used for home consumption, 33% used for processing into butter and cottage cheese, and 51% sold in local market for house hold consumers and for café and restaurants (Table 8). The total milk product marketed in the study area contrasts with Belete *et al.* (2009), who reported that the total milk product sold in rural small-scale mixed system in Fogera is 13.8%. Sintayehu, *et al.* (2008) reported that the majority of the households (61.7%) used whole milk primarily for home processing (traditional), 25% for household consumption and only 13.7% sold to market in Shashemene-Dilla areas. This variation might be due to the awareness creation on market oriented dairy product of the dairy producer farmers on milk marketed from time to time and improved infrastructural area in the study area. The average butter produced from sample respondents of Laelay Maychew and Adwa districts were 9 kg/year (Table 8). In both study areas from the total produced butter about 52% used for consumption and cosmetics for female hair bridge and 48% marketed in local market for direct consumers. The high percentage of butter marketed in the study area was due to low perishability of the product and especially during fasting period milk is frequently processed in to butter.

Table 8. Production and utilization of dairy products in Laelay Maychew and Adwa districts

Dairy products	Laelay Maychew			Adwa			Over all mean		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Total milk produced(liter/year)	80	1264	1402	80	1381	1488	160	1322	1442
Amount of milk used for house hold consumption(liter/year)	22	938	728	26	627	463	48	783	596
Amount of milk processed(liter/year)	60	811	716	52	693	671	112	752	694
Amount of sold milk(liter/year)	18	1503	1398	48	1285	1200	66	1394	1299
Produced amount of butter (kg/year)	56	9	8	52	9	8	108	9	8
Butter used for house hold consumption(kg/year)	49	5	4	43	6	6	92	6	5
Sold amount of butter (kg/year)r	29	9	7	28	8	7	57	9	7

Source: Survey result; 2015

N=number of respondents, Min= minimum, Max=maximum, SD=Standard deviation

4.2.2.1 Participation of household members in dairy related tasks: Participation of household members in matters of family life is an issue of empowerment that has come to be a very important concept in development discussion. The participation of household members in the dairy farming activities are presented in (Table 9). The results showed that men and women are moderately involved in feed collecting, feeding, health follow up, cleaning and herding in the area. About 72.5, 75 and 54% of women and female child are highly involved in milking, processing and selling of dairy products, respectively. This finding is in line with the report of Kedija (2007) in Mieso district who found that milking is primarily undertaken by women and sale of live animals and breeding decisions are undertaken mostly by men (95.4%). Whereas this finding is in contrast to the findings of Adebabay (2009) in Bure district which was 52.6%, and Belete *et al.* (2009) in Fogera district Amhara region who found milking is done mainly by men while processing and sale of milk products and barn cleaning are mainly the jobs of women followed by female children.

As indicated in (Table 9), about 45 and 65% of men were involved in breeding and purchasing of dairy farm input activities, respectively. Similarly, Sintayehu *et al.* (2008) reported that adult males are involved in purchasing, selling of cattle and breeding activities in Shashemene–Dilla.

Table 9. Participation of household members in dairy farming activities

Dairy farming activities	Men		Women		Female and male children		Wor ker		Men and women		Women and female child		Women and male child		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Feed collection	13	8	12	8	15	9	7	4	55	34	11	7	5	3	157	98
Feeding	4	3	21	13	7	4	7	4	52	32	14	9	5	3	160	100
Cleaning	7	4	21	13	14	9	6	4	44	27	19	12	5	3	160	100
Health follow up	22	13	19	12	5	3	6	4	58	36	8	5	4	3	160	100
Herding	8	5	16	10	28	18	7	4	37	23	12	8	4	3	160	100
Breeding	72	45	22	14	13	8	4	3	23	14	6	4	-	-	151	94
Milking	7	4	99	62	7	4	5	3	24	15	17	10	-	-	160	100
Processing	2	1	10	64	3	2	3	2	2	1	18	11	-	-	132	82
Selling dairy product	19	12	84	52	11	7	5	3	13	8	4	2	1	0.5	146	91
Purchasing of dairy input	10	65	31	19	1	0.6	3	2	17	11	-	-	-	-	159	99

N= Number of respondents

Source: Survey result; 2015

4.2.2.2 Productive and reproductive performance of local and cross breed cows

Milk offtake: The average milk yield per day throughout the lactation period of local and cross breed cow in Laelay Maychew district is 2.3 and 7.5 liter, respectively and the average daily milk yield throughout the lactation period of local and cross breed cow in Adwa district is 2 and 7.2 liter, respectively (Table 10). The reported average daily milk yields is similar to 1.82 and 8 liter/reported by Adebabay (2009) in Bure district for local and cross bred cows, respectively and Belete *et al.* (2009) found that the average daily milk yield of a local and crossbred cow in Fogera district was 2 and 8 liter, respectively.

Lactation length: The overall average lactation length of local and crossbred cows is 193 and 233 days, respectively (Table 10). In line with the present finding, CSA (2010/2011) reports indicated that the local breed cows had 180 days of lactation length. Solomon *et al.* (2009) reported an average lactation length of 222 days, for local breed cows and 241 days for crossbred cows in North-eastern Amhara region. But this result was less than the average lactation length of cross breed cows (294 days) at Bure district (Adebabay, 2009).

Age at first calving: Age at first calving of local and cross bred cow is 4.23 and 3 years, respectively (Table 10). The result of this study for local and crossbred cow was similar with what was reported by Kedija (2007) in Mieso district and Adebabay (2009) in Bure district 4.37, 4.46 years, respectively and for cross breed cow almost similar with what was reported by Adebabay (2009) in Bure district 2.89 years and Gidey (2001) 2.91 years.

Calving interval: Calving interval refers to the period between two consecutive calving and is a function of a day's open and gestation length. The calving interval of local and cross breed cows is 18.5 and 13 months, respectively (Table 10). The reported calving interval in this study was almost similar to Gidey (2001) for Fogera breed 18.6 months and Niraj *et al.* (2014) the overall means for calving interval in indigenous and crossbreed cows, in and around Mekelle town were estimated to be 17.1 months but less than with what was reported by Adebabay (2009) in Bure district who reported the calving intervals of local and cross cows are 26.04 months and 16.2 months, respectively. The difference in calving interval might be explained mainly due to environmental factors and nutritional managements.

Table 10. Reproductive and productive performance of local and cross breed cows

Reproductive and productive performance of a dairy cow	Breed type	Laelay Maychew			Adwa			Over all mean		
		N	Mean	SD	N	Mean	SD	N	Mean	SD
Daily milk yield(liter)	Local	43	2.3	1	42	2	1	85	2.1	1
	Cross	37	7.5	3.0	38	7	3	75	7.2	3
Lactation length (days)	Local	43	193	51	42	194	42	85	193.5	47
	Cross	37	225	40	38	241	43	75	233	42
Lactation yield (litter)	Local	43	440	226	42	385	234	85	413	230
	Cross	37	2220	1581	38	2481	1515	75	2351	1548
Dry period (months)	Local	43	6	3	40	8	3	83	7	3
	Cross	37	3	1	32	3	1	69	3	1
Age at first calving (years)	Local	43	4	1	42	4	1	85	4	1
	Cross	37	3	1	38	3	1	75	3	1
Calving interval/(months)	Local	43	18	3	40	19.5	3	83	19	3
	Cross	37	13	2	32	13	1	69	13	2

Source: Survey result; 2015

N= Number of respondents, Min=minimum, max= maximum, SD=Standard deviation

4.2.2.3 Dairy products processing

Milk is a perishable product and it is necessary to process into long-shelf life products to add value and achieving better economic return. From the surveyed respondents, about 62 local breed owners and 42 cross breed owners process the milk into fermented dairy products (yoghurt, butter and cottage cheese) using locally available processing equipments. The majorly used butter making equipment in the study area is clay pot (67%) and gourd (33%). The processed quantity of milk, from the produced fluid milk of local breed and crossbreed cows about 60 and 40% of the milk is allocated for processing purpose, respectively. The reason for allocation of high percentage of fluid milk from local breed dairy cow for processing of fermented dairy products is associated with the milk from local cows is relatively small in quantity and rich in fat content in which farmers tend to process it rather than sell it as fluid milk whereas the milk from cross breed dairy cows is high in quantity but low in fat content then farmers tend to sell it as

fluid milk rather than processing it. Butter is a common marketable form of dairy product in the study areas because of its long shelf life and its derivative products such as butter milk and cottage cheese are used for household consumption purpose. The average selling price of butter during non-fasting and fasting period was 188 and 171.5 ETB/kg, respectively. This variation in price might be explained due to long fasting period of Orthodox religion, most of the consumers in the study area do not consume butter or bridge the women hair during this time. This argument is supported by Girma and Marco (2014) who stated that due to long fasting period of Ethiopia Orthodox religion church, most of the consumers in Ada'a district do not consume animal origin.

4.2.3 Dairy products marketing

From this survey, different butter and milk market participants were identified in marketing functions between producer and the final consumer. Milk producers, retailers (café and restaurants) and consumers are the key participants in milk product marketing in the study area. Similarly, milk producers and consumers are the key participants in butter market. Milk marketing system in the study area is mainly streamed through informal marketing system. It consists of individuals involved in the process of making the products available for consumption.

Dairy producers: According to the respondents, 36% of dairy producers in Laelay Maychew sold 27100 liters/year of milk to direct consumer and to retailers at café and restaurant with an average price of 12 ETB/liter while 57% of the dairy producers in Adwa district have sold 61700 liters/year of milk to direct consumer and to retailers at café and restaurant with an average price of 12.50 ETB/liter. According to the respondents, 11% of farmers in Laelay Maychew sold their fresh milk to retailers (café and restaurant) and 7.5% of farmers in Adwa sold their fluid milk to retailers (café and restaurant). The marketing of fluid milk from producers to consumers are 13 and 37% in Laelay Maychew and Adwa district, respectively. About 50% of the respondents in Laelay Maychew sold 254 kg/year/ of butter to consumer with an average price of 156 ETB/kg while 47% of the respondents in Adwa districts sold 227kg/year of butter to consumers with an average price of 172 ETB /kg. Dairy producers took the lion share in milk and butter market value chain. Dairy producers are mainly smallholders and they supply milk and butter for consumption to neighbors and retailers. The majority of milk producers in Tigray region deliver their milk directly to end-consumers, while some also sell to retailers, hotels and cafes (AGP,

2013). This is because of milk is a short shelf life product they sell directly to retailers and consumers only.

Table 11. Marketing linkages of milk and butter in the study area.

Products	Type of linkage	Laelay Maychew		Adwa		Total	
		N	%	N	%	N	%
Milk market linkage	Producer-Retailers(café and restaurant)	9	11	6	7.5	15	18.5
	producer-House hold consumers	10	13	27	34	37	47
	Producer- Retailers and Household consumers	13	16	14	17.5	27	33.5
Butter market linkage	Producer-House hold consumer	29	100	28	100	53	100

Source: Survey result; 2015

N= Number of respondents

As indicated in Table 11, with respect to the milk market linkage, the highest percent of milk market linkage is observed between producers and household consumers and limited linkage is noted between producers and retailers. Whereas, the butter market channel is solely linked between producers and consumers in both study sites. The survey result described that milk and butter in the study area are marketed mainly through informal marketing systems. Milk price in the areas varied greatly depending upon fasting and non-fasting periods. Average volume of milk sold during fasting and non- fasting periods in the study area are 687 and 732 liter/day/ respectively (Table 12). Small scale dairy farmers sell their milk at local market to direct consumers and retailers at café and restaurants with an average price of 8 birr during fasting period and 12.8 birr during non-fasting period. Also the average volume of butter sold during fasting is 13kg and during non-fasting 17kg with an average price of 171.5 and 188 birr/kg, respectively, Table 12 indicated that higher amount of milk and butter is sold during non-fasting period and also during this period the average price of milk and butter was higher. This is due to the increasing demand of milk and butter during non-fasting period was high but the demand of milk during fasting period is low because during this period most of Orthodox Christians religion followers do not consume dairy products. This is supported by Girma and Marco (2014), who stated there is a mismatch in the supply and demand of dairy products during long fasting periods in Ada'a district East Showa zone of Oromia.

Table 12. Dairy products sold by producers during fasting and non-fasting periods

Dairy product	Fasting period			Non- fasting period		
	N	Mean	SD	N	Mean	SD
Total amount of sold milk (liter/day)	57	687	627	66	732	682
Price of milk (ETB/liter)	72	8.3	2	62	12.8	0.9
Total amount of sold butter(kg/day)	51	4.24	3.52	57	4.65	3.38
Price of butter (ETB/kg)	52	171.5	22	54	188	20

Source: Survey result; 2015

N=Number of respondents, SD= Standard deviation, ETB=Ethiopian birr

Retailers (café and restaurants)

According to the data collected from retailers in the study area, during non-fasting period average amount of milk purchased from producers are 8.9 liter/day with an average price of 13 ETB/liter whereas during fasting period the average amount of milk purchased from producers is 3.7 liter/day with an average price of 9.75 ETB/liter. During non-fasting period average retailers net profit from sold milk is 153 ETB/day whereas the average net profit from sold milk during non--fasting period was 70 ETB/day. Retailers are the last link between producers and consumers. The main role of retailers is the distribution of products to consumers. Their function is to obtain supplies and display them in forms and at times convenient to cafés, hotels and restaurants; institutional consumers. Café and restaurants with the value addition of the collected milk, it will be sold either in boiled and cooled milk or yoghurt form and its price selling price ranged between 21 to 35 ETB/liter at café and restaurant. Table 13 indicated that the amount of milk purchased and sold during fasting period was low These indicated that the demand of milk is high during non-fasting and low demand during fasting period but the supply of milk is the same during fasting and non-fasting period. This result is supported by Girma and Marco (2014), who stated that demand of milk is high during non-fasting period. Retailers are more benefited during non-fasting period than fasting periods (the net benefit was doubled during non-fasting

than fasting periods in the study area). This is due to dairy products are high demanded during non fasting period high amount of milk is sold per day.

Table 13. Retailers milk purchasing capacity and milk prices during fasting and non-fasting periods

Parameters	Aksum		Adwa		Total	
	Mean	SD	Mean	SD	Mean	SD
Non-fasting period						
Total amount of milk purchased(liter/day)	7.7	4.8	10.3	6.5	8.9	5.6
Milk purchase price (ETB/liter)	108	67	124	77	115	70
Total milk purchase cost(ETB/day	7	5	9	6	8	5
Total amount of sold milk (liter/day)	35	0	30	0	32	2
Selling price of value added milk (ETB/liter))	255	176	285	191	269	175
Benefit from sale of milk(ETB/day)	147	110	161	114	153	107
Fasting period						
	Mean	SD	Mean	SD	Mean	SD
Total amount of milk purchased (liter/day)	3	2	4.5	3	3.7	2.5
Milk purchase price (ETB/liter)	30	20	43	27	36	24
Total milk purchase cost (ETB/day	3	2	4	2	3	2
Total amount of sold milk (liter/day)	35	0	30	0	33	2
Selling price of value added milk (ETB/liter))	102	73	112	67	107	68
Benefit from sale of milk(ETB/day)	72	53	69	40	70	45

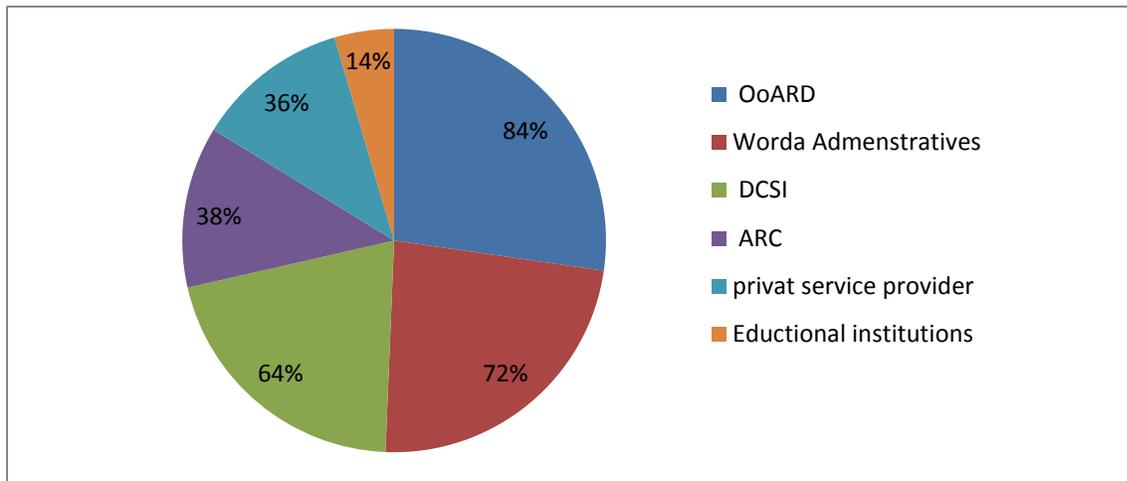
Source: Survey result: 2015

SD = Standard deviation, ETB= Ethiopian birr

4.2.4 Dairy value chain service providers and their roles in the study area

In the study area there are different public and private institutions which are operating in supporting of the dairy farming sector. These institutions play a vital role in terms of changing the livelihood of smallholder farmers through introduction of improved dairy cattle breeds to enhance the productivity and profitability of smallholder dairy farms. The public institutions office of agriculture and rural development that gives veterinary services, introducing of new and improved technologies like AI service to improve the performance of cow breed and experience sharing activities for model farmers whereas private such as Glimmer supports farmers in credit services for purchase of dairy cattle, LIVES involved in capacity building and introducing of improved livestock technologies and Relief Society of Tigray (REST) (found only in Adwa district) support

farmers with supply of local Begait dairy cattle breed in the form of credit and Dede-bit credit and saving enterprise involved in credit provision services.



Source; survey result, 2015

Figure 2. Dairy Product service providers in the study area

As shown in Figure 2, pertaining the services provided for the farmers engaged in dairy farming, the highest (84%) percentage of services is provided by the Woreda Office of Agriculture (OoARD) followed by environment enablers' (woreda administrative) 72%. Whereas the input (credit supply service given by Dede-bit credit and saving institutions (DCSI) 64%. The remaining service providers in the study area are Agricultural Research center (38%), private service providers (36%) and educational institutions (14%), respectively.

Extension services: The result of this study revealed that the contact of development agents (DA's) with dairy producers is not regular and frequent. The average contact with DA's is 4.5 days/month, in this regard about 55% of the respondents in Laelay Maychew and 67.5% respondents in Adwa districts have access to extension service (Table 14). Embaye (2010), reported that out of the total respondents, 31% of them get four times per month contact to DA's and 24, 29, and 16% of the sampled households had three times, twice and once contact per month with DA's in Atsbiwenberta and Alemata woredas, respectively. The number of

respondents who had access to extension service in the present study is higher than from the findings of Woldemichael (2008) in southern Ethiopia and Adebabay (2009) in Bure district which was reported as 40 and 45%, respectively. This variation might be due to the huge and extensive investment made in supporting of extension service on improved dairy production increases from time to time in the study areas.

Access to credit services: According to the respondents of the study area, 90% of the farmers have access to credit service for the purchase of dairy cows. About 20% credit access for dairy producer farmer is obtained from Dedit credit and saving institution, the remaining 80% have from owned due to high interest rate of the credit.

According to the respondents in the study area 56 and 59% of dairy farmers in Laelay Maychew and Adwa districts had access to a variety of market information sources that are access to dairy products/inputs price information, market place information and buyers information from different sources (media, extension agent's neighboring and friends) (Table 14). This result was lower than the result of Woldemichael (2008), who reported that 82% of the sampled dairy households were access to milk market price information. This variation is due to the dairy producers had get market information from their own experience.

In the study sites transmitting information from extension agents and experts to dairy producers are mainly streamed through training. Out of the sampled dairy producer households 39% of the respondents in Laelay Maychew and 44% in Adwa districts got trainings related to milk production for average 5 days' per one training period (Table14). About 35 and 29% of respondents in Laelay Maychew and Adwa districts respectively were trained mainly on dairy management and forage development. Training is important for sharing of experiences among milk producers that in turn build up indigenous knowledge to emerging in dairy value chain. According to Gebremedhin *et al.* (2012) producers who do not have access to training usually encounter problems of deciding the type and quantity of product to marketing

Table 14. Access to different services on dairy production

House hold variables		Laelay Maychew		Adwa		Total	
		N	%	N	%	N	%
Access to extension service	Yes	44	55	54	67.5	98	61.2
	No	36	45	26	32.5	62	38.8
Access to credit	Yes	74	92.5	70	87.5	144	90
	No	6	7.5	10	12.5	16	10
Access to market information	Yes	45	56	47	59	92	57.5
	No	35	44	33	41	68	42.5
Source of market information	Media	9	11	10	12	19	11.5
	Extension agent's	34	42	27	34	61	38
	Neighbors and friends	2	2	9	11	11	11.5
Type of information	Products/inputs price information	24	30	23	29	47	29.5
	Market place information	10	12	1	1.2	11	6.5
	Buyers' information	11	14	22	27	33	20
Access to training	Yes	31	39	35	44	66	41.5
	No	49	61	45	56	45	58.5
Type of training	Dairy management	2	2	2	2	4	2
	Dairy management, forage development and milk processing	6	8	3	4	9	6
	dairy management and forage development	28	35	19	24	47	29.5
Training organizer	OoARD	15	19	23	29	38	24
	Private organizations	10	13	1	1	11	7
	OoARD and private organizations	8	10			8	10
	Agricultural research institute and NGO's	2	2			2	2

Source: Survey result; 2015

N= Number of respondents

Artificial insemination services (AI): Among the respondents about 96 and 99% of respondents have access to AI services in Laelay Maychew and 99% Adwa district, respectively. The AI service in the study sites is given by Office of Agriculture and Rural Development Office. During the survey period in Adwa district, from the inseminated number of 2533 cows, about 2011(79%) of cows are effectively conceived. Also in Laelay Maychew district, from the inseminated number of 2522 cows, about 2331(92%) of cows are effectively conceived. This is one way of extension approaches to increase improved agricultural technologies among dairy producer in the study area. Similar argument is reported by Kinfе and Tewodros (2013) in Tigray region farmers' awareness on the benefits of technology adoption and other farm decisions is improving from time to time due to the expansion of schools and extension services. Dairy producers use AI services to improve the genetic performance of local breed dairy cow to get crossbreed instead of purchasing of improved breed cows and to prevent transmission of diseases.

Table 15. Availability of AI service

AI service		Laelay Maychew		Adwa		Total	
		N	%	N	%	N	%
Access to AI service	Yes	77	96	79	99	156	97.5
	No	3	4	1	1	4	2.5
Total dairy cow inseminated		2522		2533		5055	
Consumption rate		1853	73	1711	67.5	3564	70

Source: Survey result; 2015

N= Number of respondents

Access to veterinary services: According to respondents 99% of the dairy farmers in Laelay-Maychew and 97.5% of dairy farmers in Adwa district have gained access of veterinary service while only 1 and 2.5% of the dairy farmers in Laelay Maychew and Adwa do not have access to veterinary service. This result is greater than from the finding of Adebabay (2009) who found 86.2% of the respondents in Bure district have access to veterinary services. This variation could be due to the awareness of the dairy producers in vaccination of dairy cattle in the study districts

from the last five years. This is due to diseases incidence at dairy farmer affects the productivity and reproductive performance of dairy cows. The major dairy cattle diseases prevailing in the study area were mastitis; milk fever, metritis, blacklegs. Veterinary service is one of the input issues to be dealt with under the packages of improved dairy technologies especially in disease prevention. According to the survey results, 86% of the sampled dairy farmers in Laelay Maychew and 82% of dairy farmers in Adwa district have got veterinary service from Office of Agriculture and Rural Development Office, while 1% dairy farmers in Laelay Maychew and 4% of dairy farmers in Adwa have gained from private drug supplier and also 13 and 14% from both office of Agriculture and Rural Development Office and private drug supplier in Laelay Maychew and Adwa, respectively (Table16).

Table 16. Access to Veterinary service

Vet service		Laelay Maychew		Adwa		Total	
		N	%	N	%	N	%
Vet service	Yes	79	99	78	97.5	157	98.2
	No	1	1	2	2.5	3	1.7
Vet source	OoARD	69	86	66	82	135	84
	Private vet suppliers	1	1	3	4	4	2.5
	Both OoARD and Private vet suppliers	10	13	11	14	22	13.5

Source: survey result; 2015

N= Number of respondents

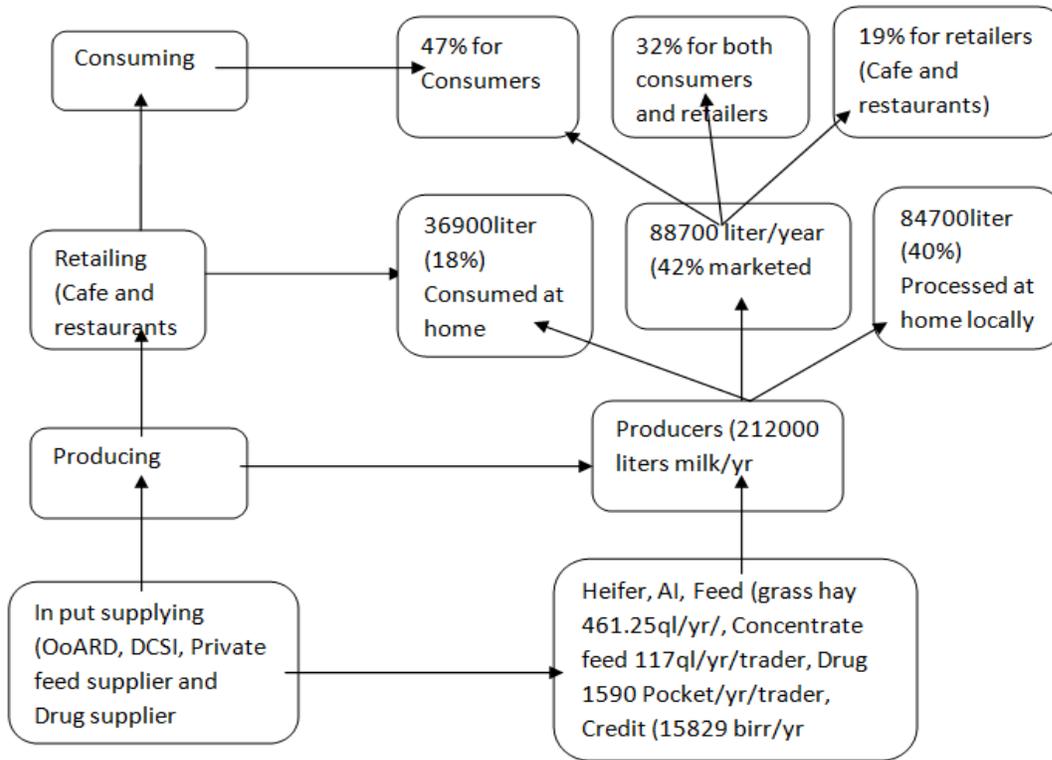


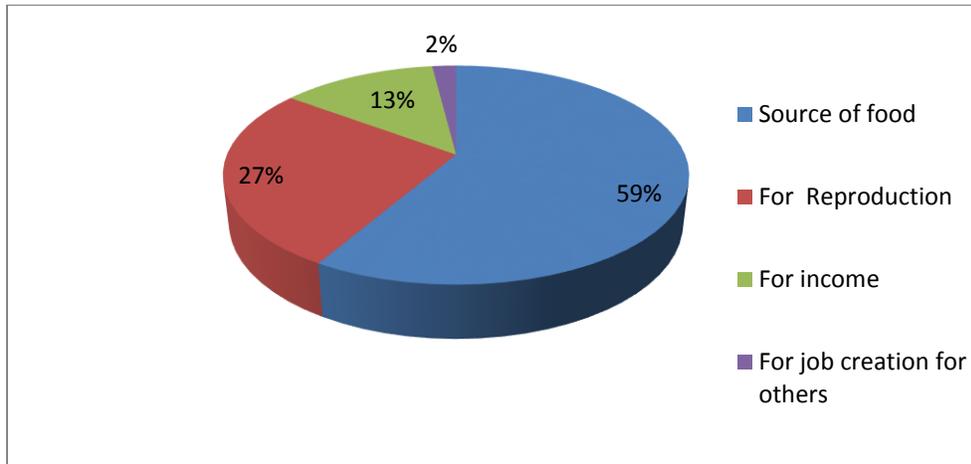
Figure 3. Dairy value chain maps in the study area

4.3 Economic contribution of dairy value chain and value addition to actors

4.3.1 Importance of dairy cattle in the study area

As an essential part of the mixed farming system, livestock production plays a significant role in the household food security in the study area. It meets critical financial need, dietary requirements, draft power, transport, loan repayment, dowry and gift, fuel, fertilizer, as a safeguard in the case of crop failure.

The importance of dairy cattle in rural smallholder farmers of the districts was dominantly producing milk for consumption 59%, for stock replacement 27%, for income source 13% and 2% for job creation for others (Fig 4). This is due to not well developed market oriented farming system of the area not surplus production is produced. It is largely produced only for meeting family food requirements.



Source; own formulation based on survey result, 2015

Figure 4. Importance of dairy cattle in the study area

Milk and milk products consumption and income generation: Dairy products are an essential component of the diet in the area. Fresh milk, yoghurt, butter, buttermilk, cheese and whey are among the common milk products produced and consumed in the study area. About 51% of respondents consume milk either after boiling or souring. Butter is used for various purposes like cooking, cosmetic, especially by the female members of the households (25%) and the remaining (75%) of butter is sold. Buttermilk and whey is used for human consumption. The whole milk produced and consumed in the study area is obtained only from both local and crossbred cows. Among family members, children and sick persons have the privilege to drink whole milk.

Dairy production is an important source of household income in the study areas (Table 17). The income generated from the sale of milk products is used to purchase farm inputs like feed (24%), purchase of food item (71%), non-food items like education materials for their children (7%) and saving (18%).

Table 17. Purpose of money obtained from sell of dairy products

Purpose of money obtained from sell of dairy products	N	Mean	SD
House hold consumption	123	71	26
School fees	62	7	5
Saving	50	18	17
For health service	29	6	3
Purchas of dairy inputs	62	25	18
To purchase furnisners	55	14	12
house constriction	17	20	16

Source: survey result 2015

N=Number of respondents SD= Standard deviation

The income from livestock production contributes only 3.1% in the study area but 77% of the household income is both from crop and livestock production. Off-farm activities contributed about 3.8%. The result of the study described that the average annual off-farm income of the respondents for local and cross breed cow owners is 9052 and 17615 ETB/year, respectively whereas the average annual income of local breed owner from crops is 19064 ETB/year and average annual income of crossbreed was 17645 Birr/year and also the average annual income from dairy source of local bred owners was 10992 Birr/year and cross breed owner 14452 Birr/year. The average total income of the respondents for local and cross breed cow owners were 69595 and 70092 Birr/year, respectively (Table 18). Out of this the average percentage share of the dairy product was 15 and 22% for local breed and cross breed cow owners, respectively.

Table 18. Income source of the house hold in the study area.

Income sources	Local bred owner			Cross bred owner		
	N	Mean	SD	N	Mean	SD
Income from off-farm (ETB)	14	9052	7724	19	17615	5719
Income from crop (ETB)	85	19064	10576	65	17645	13152
income from dairy (ETB)	85	10992	6968	75	14452	9290
Income from other livestock (ETB)	84	16114	6152	70	15506	7425
Income from non- dairy source	84	22387	6018	74	21703	7583
Total annual house hold income (ETB)	85	69595	17867	75	70092	19978
Percentage Share from dairy product (%)	85	15	8	75	22	17

N=Number of Respondents, SD= Standard deviation

As it can be seen in Table 18, the local breed cow owners get less money from off-farm activities than cross breed cow owners. This is due to most of the local breed cow owners are aged farmers and their involvement on off-farming activity is limited. Therefore, many of the youngsters are landless and they are engaged in rearing of cross breed cows and off-farming activities to obtain additional income. Local breed cow owners have land for crop production and they generate more income from sale of crops as compared with cross breed owners. The income from dairy products was higher in cross breed cow owners than local breed cow owners. This is because of cross breed cows were more productive than local breed cows. This is supported by Dayanandan (2011) who stated that cross breed farms were more profitable than local breed farms in the highland of Ethiopia. Whereas local breed cow owners get additional income from the sale of other livestock species including sheep, goat, cattle and poultry.

Overall, in the study sites the crossbred cow owners generate more total income as compared with local breed owners. This is due to cross breed dairy cow owners are more productive than local breed cows. This result is supported by Mohamed *et al* (2004) who reported that the average income of household per year for local and cross breed cow owners in Ethiopia is 168 and 1908 ETB, respectively.

Dairy as employment creation for others: Income and employment opportunity are common under market-oriented production systems. The type of labour that employed in dairy producer farmer in the study areas is herder milkier, cleaner and processor. According to the respondents in the study area the availability of employment creation for herding for local and cross breed cow owners was 5% and 11%, respectively, While 95 and 89% of the local and cross breed cow owners handled the dairy farming activities with their family members. The average amount of salary payment for one hired in the study area was 3733 Birr and 4080 Birr per year for local and cross breed cow owners respectively. Availability of hired labour on cross breed dairy cow owner was higher than that of local breed dairy cow owner. Similar result is reported by Dayanandan (2011) who stated cross breed dairy farm owners used more hired labors than local bred dairy farm owners in Highland of Ethiopia. Because cross breed dairy cows were more productive than local breed dairy cow in that case more productive dairy breed cows needs more labour to take care of them.

4.3.2 Economic analysis along milk value chain

The average input cost of retailers was 14 Birr/liter. The major part of retailers (café and restaurants) cost is composed of different costs, equipment cost, houses rent, labour cost and other costs. Milk producers added 35% value of milk in the area while retailers (cafe and restaurant) added 65 % (Table 19). The price change from producer's to consumer of processed product total 31.6 Birr/liter. The findings indicated that importance of milk processing in generating income and growth. Value addition is the difference in sales price and cost of inputs (raw materials) and marketing at each stage of the value chain. Milk price is determined by negotiation between producers and retailers (café and restaurants or between retailers and consumers.

Table 19. Cost, return and margin of milk value chain in the study area

Cost of materials/year	Producer	Retailer	Consumer	Total value added
Total material cost(Birr/cow)	6667			
Purchase cost	-	14	35	
Marketing cost				
Total cost/liter	2.40	14		
Sales price/liter	13	35		
Margin/value added	10.6	21		31.6
Percent value added	33.5%	66.5%		100%

Source; survey result, 2015

4.4. Factors affecting dairy value chain in the study area

4.4.1. Determinants of dairy product value chain

By using the binary logistic regression model eleven independent variables were tested to see this influence in participation decision on milk sale. Out of these variables four were found to have a significant effect on their participation decision at 1, 5 and 10 % probability levels. While seven of the variables out of the eleven variables did not show significant variation on participation decision of milk market sale in the study area (Table 20). The variables which showed significant variation on milk market participation decision were educational level of the household, cross breed type, access to credit and access to extension service. However, variables such as sex of the house hold head, land size, experience in dairy product, total milk product,

access to training, access to market information, market distance were not affecting milk market participation decision in the study areas.

Education level of the household head: Education has positive effect on probability of dairy household milk market participation decision and is significant at ($P < 0.1$). The marginal effect indicates that addition of one-year formal schooling leads the probability of dairy household milk market participation to rise by about 11%. The positive and significant relationship indicates that education improves the dairy household capacity to process production related and market related information.

Cross breed type: positive effect on milk market participation decision and found to be statistically significant ($P < 0.01$). Owning of crossbred cows had positive and significant contribution on milk market participation decision. Cross breed cow owners supply more milk to participate in milk market. Moreover, integration of cross breed cow, upgrading milk production potential of local cows, among others should be used to increase milk production per household and hence resulting in better milk market participation. The marginal effect also confirms that when the cross bred cow increases by one cow, the probability of participating in the milk market increases by 56%. Moreover, this result designates that increasing number of quality crossbreed dairy cows is an important policy intervention for stimulating the smallholder to market entry and benefit from economic transaction. This result agrees with the finding of Woldemichael (2008) on dairy marketing chains analysis in case of Shashemene, Hawassa and Dale districts.

Access to credit: The result of the model shows that this variable is positive and statistically significant ($P < 0.05$). Moreover, the positive sign of the variable indicates that milk market participants are get money from DCSI of the area to purchase dairy cows. The marginal effect further confirms that probability of milk market participation increased by 39% as credit increases.

Access to extension service: The model result describes that extension service has a positive and significant impact on market participation decision at ($P < 0.01$) probability level of the sampled

dairy households. The marginal effect of the variable confirms that contact with extension service increased the probability of milk market participation decision by 78%. This result is supported by Holloway and Ehu (2002) on expanding market participation among smallholder livestock producers on Ethiopian highlands.

Table 20. Logistic regression results of market participation decision

Milk market participation	Coef.	Std. Err.	Marginal effects(dy/dx	z	P>z
Sex	0.21	0.80	0.05	0.27	0.79
Educational level	0.47	0.26	0.11	1.83	0.07*
Land size	0.08	0.19	0.02	0.43	0.67
cross breed type	2.71	0.92	0.56	2.93	0.00***
experience	-0.03	0.05	-0.01	-0.72	0.47
Total milk product	0.00	0.00	0.00	0.79	0.43
Access to credit	2.48	1.13	0.39	2.19	0.03**
Access to training	-0.12	0.67	-0.03	-0.17	0.86
Access to extension service	4.22	0.80	0.78	5.27	0.00***
Access to market information	-0.19	0.71	-0.05	-0.27	0.78
Distance(km)	-0.10	0.11	-0.02	-0.88	0.38
_const	-2.49	2.10		-1.19	0.24

Number of observations = 160

LR chi2 (11) = 140.37 Prob > chi2 = 0.000 Log likelihood = -40.4069

Pseudo R² = 0.6346

*p<0.1;**p<0.05;***p<0.01

4.4.2. Estimation results of second stage Heckman selection model:

Out of eleven dependent variables, two variables were found to determine the probability of volume of milk marketed. These are cross breed type and total milk produced (Table 21).

Cross breed type: As hypothesized this variable is positive and significant (P<0.01). The positive sign of the output indicates that crossbreed milking cow causes the marketable milk surplus of the dairy households in the study area. The finding coincides with the findings of Woldemichael (2008) on dairy marketing chains analysis in case of Shashemene, Hawassa and Dale districts who stated that marketable milk surplus of the households were more responsive to number of cross breed milking cows.

Total milk produced: Similar to prior expectation the total milk produced in the household is positive and significant ($P < 0.05$) affected the amount of milk supplied to market. The positive and significant relationship between the two variables indicate that total milk product of household is a very important variable affecting household's volume of milk supply. This indicates that, an increase in total milk yield per household by a liter results in 0.25 liter increase in volume of milk supplies to market.

Lambda: According to the model output, the lambda (Inverse Mills Ratio) or selectivity bias correction factor has positive, but statistically insignificant impact on milk market participation decision. This result suggests that there appears to be no unobserved factors that might affect both probability of dairy household market entry decision and marketable milk volume. However, the positive sign of the inverse mill's ratio shows that there are unobserved factors that are positively affecting both participation decision and marketed milk volume.

Table 21. Heckman selection model - two-step estimates (regression model with sample selection)

Volume of milk marketed	Coef.	Std. Err.	z	P>z	[95% Con f.	Interval]
Sex	-19.92	210.99	-0.09	0.93	-433.46	393.62
Educational level	-8.64	69.70	-0.12	0.90	-145.24	127.96
Land size	4.49	5.24	0.86	0.39	-5.78	14.76
Cross bred type	972.23	373.99	2.60	0.01***	239.22	1705.24
experience	2.25	13.70	0.16	0.87	-24.60	29.10
Total milk product	0.25	0.13	1.95	0.05**	0.00	0.49
Access to credit	-89.91	349.01	-0.26	0.80	-773.95	594.13
Access to training	-66.00	170.17	-0.39	0.70	-399.53	267.54
Access to extension service	332.00	698.77	0.48	0.64	-1037.55	1701.56
Access to market information	-56.04	194.79	-0.29	0.77	-437.82	325.73
Distance	-19.06	31.34	-0.61	0.54	-80.48	42.36
_const	-376.70	1092.71	-0.34	0.73	-2518.38	1764.97
Lambda	745.36	617.23	1.21	0.23	464.39	1955.11

Number of observation = 160 Censored observation = 75 Uncensored observation = 85

Wald chi2 (11) = 23.50 Prob > chi2 = 0.0150 Rho = 1.00 Sigma = 745.36

*** $P < 0.01$ and ** $P < 0.05$

4.5. Major constraints and opportunities of dairy production and marketing

4.5.1 Major constraints of dairy production and marketing

According to the respondents and informal decision with key informants there were different challenges faced on dairy production and marketing in the study areas. As shown in (Table 22) the major constraints for milk production and marketing identified by the producers in the study area were feed shortage with high cost of feed ranked as first problem 92% respondents followed by low volume of milk (85 %) as second problem, lack of training access (80%), low house hold income /low purchasing power(78.8%),unavailability of cooling facilities for milk storing(75%),distance to market(73.8%), low market demand of the product (74%), low breed performance (72.5%),access to transport (62%), land access (59%), access to water (3.1%), access to credit (0.6%) and access veterinary services (0.6%).

Shortage of feed or high cost of feed: Inadequate supply of quality feed or high cost of feed is the major factors limiting dairy production in the study areas. About 28% of the households rank availability and quality of animal feed as first production constraint as its availability depends on the seasons of the year Roughage and concentrate feeds are either too expensive or unavailable in sufficient quantity and quality to improve dairy production. About 17% respondents of the studied area specify feed problem as second production constraint. Similar result was reported by Embaye (2010) in Tigray region Atsebi and Alemata woredas and Kedija (2007) in Oromia region Mieso district. The feeds are usually based on hay 95%, crop residue 70% and fodder 23%, concentrate feed 35% for local breed and 58% for cross breed cow and, were either not available in sufficient quantities in local market due to fluctuating weather conditions or when available are of high cost of the feed and poor in quality. These constraints result in low milk production, long calving interval and high mortality rate of young calves.

Low volume of milk: Low volume of milk production was the second most important factor 85% in the study area. Respondents in the rural area mentioned that there is low in feed availability in the study area. As a result of low feed availability farmers reduce their herd size due to the problem of animal feeds. This reduction in herd size in the study district lead to an overall reduction in volume of milk produced in the study areas.

Access to training: Is the third most important factors affecting dairy value chain in the study area 80%. Milk suppliers require having technical support on the process of production including feeding and nutrition, breeding, sanitation and milk hygiene, human and animal health, marketing and transportation of milk towards collection centers. Through appropriate technical support and capacity improvement, the core problem of milk value chain (shortage of raw milk supply, access to reach the raw milk and method and means of milk collection) could be tackled. Training access has not satisfied the needs of farmers in terms of providing need based service, hands on training and subject matter coverage tailored to different dairy production systems and market orientation.

Low household income: Scarcity of capital to expand the dairy farm is the fourth most important factor listed by the producers in the study area (78.8%) and to engage in dairy farming business and processing of dairy products demand high capital investment.

Unavailability of cooling facilities: About 75% respondents considered that milk is a perishable product and unavailability or lack of cooling facilities access is one of the major challenge for storing of dairy products for longer period of time.

Distance to market: It exhibited negative impact on dairy production system and marketing of milk in the areas next to the cooling facilities (73.8%). Due to absence of dairy co-operatives in the study area, the milk is delivered to urban centers by travelling on foot far distance.

Low market demand of the product: the major marketing problems faced by dairy producers in the area includes adulteration, seasonal variability of demand of milk, absence of permanent market place, perishability nature of milk the major challenges. According to the survey result, seasonality of dairy products due to long fasting period (The calendar of Orthodox Christian church involves four prolonged fasting period per year including: mid of February to mid of April (Easter), June first week to Mid of July, From August 7 to 23, November 26 to January 09 and two fasting days of Wednesday and Friday every week. The total number of fasting days in Orthodox Christian churches is more than 200 days. The survey result showed that about 99.7% of the interviewed farmers are Orthodox Christian followers and they do not consume animal origin during this time and the demand of dairy products will be lower and consequently affects

the marketing of dairy products. There is also mismatching in the supply and demand of dairy products during long fasting and after fasting period in the area

Low breed performance: In the study area local breed cows are the main source of milk and milk products. The number of crossbred cows is very low and is mainly concentrated in Aksum and Adwa towns. Those animals are low in managed input production, due to low management and genetic breed, delayed age at first calving, low calving rate and long calving interval, low milk productivity. Then low breed performance are important problem in the study area. SNV (2008) also indicated that the productivity of indigenous stock is a major constraint in dairy development and the indigenous herds' genetic potential for milk production is low.

Access to transport: About 62% of respondents explained that milk is a perishable product and access to transport is one of the major constraining factor which affects marketing of dairy products.

Land access: Dairy producers' ranked access to land related problems as the tenth important constraint that hindered dairy development in the area. The proportion of dairy producer households who identified this as a serious problem was 59%. Lack of access to land for expansion of the dairy enterprises and feed production is due to shortage of land. The land size cannot allow most of them due to rapid urbanization and population growth. It was almost similar with what was reported by Sintayehu *et al.* (2008) who reported that the land accessibility problem identified was 57.5 and 48% in the urban and in the mixed crop–livestock system, respectively.

Access to water: Access to water during the dry season is a major constraint in the study areas especially in Laelay Maychew districts. From the interviewed respondents 3.1% had problems related with water access as water resource development is crucial to dairy production.

Access to credit: is also the least constraint 2.5% next to access to water constraints. Financial supports to the smallholder farmers are used to intend into commercial dairy farming. These constraints of access to credit are affected by limited credit availability and high interest rate.

This finding was in agreement with Kinfе and Tewodros (2013) in the smallholder dairy producer of Tigray region.

Access to veterinary services: It is one of least constraints which influences dairy production in the study area and this is due to most of the dairy producers in both study sites have low access to veterinary services. Where as poor animal health and management are major constraints of dairy development in Ethiopia which cause poor performance across all dairy production system (SNV, 2008).

Table 22. Major Constraints of dairy production and marketing

Constraints	N	%	Rank
Shortage of feed /high cost of feed	148	92	1
Low volume of milk	137	85	2
Lack of training access	128	80	3
Low house hold income / low purchasing power	126	78.8	4
Unavailability of cooling facilities for milk storing	120	75	5
Distance to market	118	73.8	6
Low market demand of the product	119	74	7
Low breed performance	116	72.5	8
Access to transport	100	62	9
Land access	95	59	10
Access to water	5	3.1	11
Access to credit	2	2.5	12
Access veterinary services	1	0.6	13

Source; survey result 2015

N=number of respondents

4.5.2 Opportunities of dairy production and marketing

There are important dairy production opportunities in the two study districts. Among the different opportunities, the conducive policy frameworks in the agricultural sector development manifested by assigning three development agents in each *Tabias* and infrastructure development could facilitate dairy production and marketing. The majority of dairy producers of both districts are interested to expand and/or involve in dairying in the future due to potentiality of the area. As the informal survey indicated that production and marketing support services (dairy input supply, extension service, credit access, increasing access to AI service, increasing coverage of livestock health service and market information), which are agents of development for the dairy sector, are provided and improved from time to time. In addition, governmental organizations like OoARD and Private sectors like LIVES, Relief society of Tigray, credit and saving institution and others are supporting as well as actively participating for the development of the dairy enterprise in the study areas. The other opportunities of production and marketing in the studied areas are crossbreed cows are introduced and continuously disseminated until each individual farmer could own these breeds, all farmers have access to extension service related to dairying; regardless of the variation in frequency of DA contact, integrated modern forage production activities are initiated by OoARD.

Generally, increasing public investment in knowledge infrastructure and human capital development, rural roads, and information and communication technology (ICT) were perceived as gradually creating the necessary fundamentals for the dairy subsector in the study area.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

5.1. CONCLUSIONS

The main dairy value chain actors in the study areas are input suppliers, dairy producing farmers, retailers and consumers. Dairy producers, OoARD, private feed and drug suppliers are the main actors involved in the production and input supply activities. Retailers purchase milk from producers and sell by adding value to consumers at café and restaurant. There are also public and private supportive services that support dairy value chain directly or indirectly. Value chain supporters or enablers provide facilitation tasks like creating awareness, facilitating joint strategy building and action and, the coordination of support. The main supporters of the dairy value chain in the study areas are office of agricultural and rural development (OoARD), Woreda administrations, credit and saving institution. Dairy produced in this area passes through retailers (café and restaurant) with 65% value being added before reaching to end users. The intermediate buyers obtain the milk from the farmers at a lower price and they sell to the consumers at a higher price.

The result of logistic regression results of market participation decision indicated that the probability to milk market participation is significantly affected by educational level, cross breed type, access to credit and access to extension service. Therefore, these variables require special attention if farmers margin milk market participation decision is to be increased. The result of Heckman selection model two-step estimates indicated that volume of milk supplied to market is positively and significantly affected by cross breed type and quantity of milk produced. Therefore, these variables require special attention if volume of milk supply is to be increased.

Constraints hindering the development of dairy value chain are found in all the stages of the chain. Those constraints are inadequate availability and high cost of feed, low volume of milk due to low productivity of the endogenous cattle breeds, low house hold income or low purchasing power of the house hold, unavailability of cooling facilities for milk storing, low market demand of the product due to the prolonged period of Orthodox Christian fasting, access to transport, land access, access to water, access to credit and access veterinary services.

5.2 RECOMMENDATIONS

- ✓ To increase milk market participation decision special attention needs on educational level, cross breed dairy cow, access to credit and access to extension service.
- ✓ To increase volume of milk supply to market special attentions needs on cross breed type of dairy cow and quantity of milk produced.

Dairy product marketing system was found to be traditional and under developed, fragmented and inefficient in the study area.

- Thus, government actions are required to license and inspect competing dairy product traders to ensure achievement of minimum hygiene and quality standards in order to facilitate the dairy production and marketing process.
- There is a need to form collective action in the form of dairy groups or cooperative that bulks milk from volunteers and sell to large consumers.
- As seasonal fluctuation of demand for milk and milk products associated with their perishable nature was vital problems of dairy value chain development and promotion of small scale processing technologies are critical to increasing smallholder producer's dairy production and dairy products market participations.
- The seasonal surplus in milk production and the mismatch between seasonal production and demand in the study area identify the need for processing facilities that would produce storable dairy products such as milk powders or hard cheeses.
- Adding capacity to produce stored dairy products could improve the profitability of the industry and enhance food security in the study district.

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APPENDIX

Appendix table 1 Household Characteristics between local and cross breed cows

Variables	Local breed dairy cow owners (N=85)			Cross breed dairy cow owners(N=75)			Over all mean		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Age (Years)	85	49	8	75	47	9	160	48	8.5
Total family size (Number)	85	6	2	75	5.5	1.5	160	5.75	1.75
Total land (ha)	85	1	0.4	65	1.2	0.6	150	1.1	0.5
Experience in dairy farming (years)	85	14	5	75	11	4.5	160	12.5	4.75
Distance from market (km)	85	7	3	75	7	3	160	7	3
Total number of cows holding/household	85	1.5	0.7	75	1.5	0.7	160	1.5	0.7

Appendix table 2. The result of multi co linearity test

Variable	VIF	1/VIF
Access to credit	9.87	0.10
Sex	6.90	0.15
Distance	6.31	0.16
Educational level	5.66	0.18
Total milk product	5.00	0.20
Cross bred type	4.58	0.22
Extension service	3.91	0.26
Experience in dairy farming	3.11	0.32
Access to market information	2.82	0.35
Access to training	1.79	0.56
Land holding size	1.30	0.77
Mean VIF	4.66	

INTERVIEW

Analysis of Dairy Value Chain in Laelay Maychew and Adwa districts central zone of Tigray Ethiopia

I. General information of respondents

- 1) Name of the respondents; _____ code____ Woreda /district_____ Kebele_____
2. Sex of the household head 1.male 2. female
- 3) Age of the respondents' _____ years
- 4) Marital status (circle one) 1= Single 2= Married 3= Divorced 4= Widowed 5. Separated
- 5) Family sizes except house hold head

No	Age category	Number and sex		
		Male	Female	Total
1	age <15			
2	16 – 30			
3	31- 65			
4	>65			

6. Education level of the household head (circle one) 1= Illiterate 2= Church/mosque education
3= Grade 1- 4 4= Grade 5-8 5= Grade 9-12 6= >12
7. Religion of household head 1= Orthodox 2= Muslim 3=Catholic 4. Other (specify

II. farm house hold characteristics

1. Do you have your own land? 1. Yes 2. No
2. If you yes, how many hectares? _____ your Owen ____ ha, rent _____ ha
3. What is the main source of your income? 1=Crop production 2= Livestock production 3= both crop and livestock production 4= Off-farm activity 5.others specify
4. If the answer is Off-farm activity what is the total annual income in 2006/2007 EC

No	What are the Off-farm activities	Total annual income from Off-farm activities	Total annual income from crop	Total annual income from dairy source	Total annual income from other livestock source	Total annual income of the HH

5. What percent /share of your household expenditure come from the dairy production? _____

III. Dairy product activity

6. Do you have dairy cows? 1. Yes 2. No
7. If your answer is yes what is the number of dairy cows you own at 2006/07

Type of dairy cows	No of cows owned
Local	
Cross breed	
Total	

8. How long you have been engaged in dairy farming activity: _____ years

9. Who participates in the dairy farming activities? (If the responsible person is more than one for each activity please put all the codes

	Activities	1=Father, 2=mother, 3=female child, 4=male child, 5= house maid /worker 6=others
1	Feed collection	
2	Feeding	
3	Cleaning	
4	Dairy health follow up	
5	Herding	
6	Breeding	
7	Milking	
8	Processing	
9	Sale of dairy products	
10	Sale of dairy animals	
11	Purchase of inputs for the dairy farm	

10. What is role of dairy production for you and your family members? Rank them according to their importance from 1st 2nd 3rd

1. As source of food:_____ 2. As income source: _____ 3. Job creation:_____ 4.others specify_____

11. Inputs used for dairy and dairy products at 2006/2007 E.C

List of inputs		Quantity/cow	Unit price/cow	cost of input per cow	Source of input
Heifer	1 Cross breed heifer				Use code 1
	2. Local breed				Use code 1
Feed	1. Hay				Use code 2
	2. Straw				”
	3. Green fodder				”
	4. Concentrate				”
	5. Atella				”
	6. Others				
Total feed cost					
Labour	1. Herding				
	2. Milking				
	3.cleaning				
	4.milk processing				
	5.Others				
Total cost of labour					
Transport service	1.Bajaj,				
	2.Vehicle,				
	3. cart				
	4. animal power				
	3.Human labor				
Total cost of transport					
Vet service	1.AI service				Use code 3
	2.Vaccination/drug				
	3.hormone synchronizati4on				
Total cost of vet service					
Processing equipment	1.Modern				Use code4

	2.traditional			
Total cost Processing equipment				
Tax				
Total input cost				

Code1. 1= Purchased from market 2= Own farm 3= From BoARD 4= NGO.s
5= getting as a gift from family/relatives 6= others specify_____

Code2. 1= Own production 2= Purchased from market 3= Both 4= other specify

Code3. 1= from office of agriculture and rural development office
2= from private input suppliers 3 others specify_____

Code4. 1. from local market 2. From private input supplier 3.from public input supplier
4. Others specify_____

12. Amount and sales of dairy &dairy- product has been produced at household level at 2006/2007 E.C

Product	Unit	Total product(Q)	HH Consumption(Q)	MKT sales(Q)	Unit cost	Total Sales
Milk	Lit					
Butter	Kg					
Cottage Cheese	Kg					
Yoghurt	Kg					
Butter milk	Lit					
Whey	Lit					
Heifer	Unit					
Calves	Unit					
Dung cake	Pcs					
Manure	Qtl					
Total						

13. Have you satisfied with the supply of dairy inputs? 1= Yes 2= No
14.If No, why 1= low access of input 2=high price of input 3=bureaucracy4= others

Access to Credit

15. Did you borrow money in 2006/2007? 1=yes 2=no
16. If yes Q14 How mach many do you borrow? _____

17. If yesQ14 for what purpose do you borrow the money, 1=Purchase of animal 2=Purchase of farm equipments 3= Purchase of forage seeds 4=For feed purchase 5=Payment for hired labor 6=Others

18. If YesQ14 what is the, sources? 1=Micro finance 2= Bank 3=Cooperatives/Unions 4=Trader 5=Relative 6=Iqub/Iddir 7=others_____

19. Have you paid back the loan timely? (1=yes, 2=no)

20. If No paid back the loan timely, reason1= I have not yet get any profit 2= high interest rate 3= misuse of the credit 4= others (specify

21.Did you have problem of accessing credit (1=yes, 2=no)

22. If Yes what are the problem? 1=Limited credit supply 2=Limited transport access 3=Huge transaction cost/bureaucracy 4= others (specify

Access to Extension service

23. Do you have contact with extension agent? 1. Yes 2. No

24. If yes, how many times do you contact per month? _____

25. Who assisted you while you are participating in the improved dairy development? Show in rank

Service provided	Rank 1-7
1. OoARD	
2. NGO	
3. Universities	
4. TVET	
5. Research and development center	
6. Woreda administration	
7. Dedit and credit institution	
8. Others specify	

26. Did you have any formal training in dairy production? 1. Yes 2. No

27. If yes

	Type of training	Number of days	Trainer organization (use code 1)	Was the training applicable? (1=yes,2=no)	If Yes, in what way? (use code 2)
1	Dairy management				
2	Forage development				
3	Milk processing				
4	Input utilization				
5	Accounting records				
6	Marketing of dairy products				
7	Others				

Code 1 1=Agricultural Research Institute 2=Bureau of Agriculture 3= University 4= TVET 5= NGO's 6= others_____

Code 2 1= Improving dairy productivity, 2= improving profitability, 3= Diversifying the type of products produced, 4= Improving the quality of products, 5= Improving financial records, 6= Improving decision making, 7= acquiring know how on saving, 8= others

28. Have you satisfied with the service of extension agents? 1= Yes 2= No

29. If No, why 1=distance from development center 2=I don't need extension service 3=bureaucracy 4=others

Access to market information

30. Do you have information on dairy production and marketing? 1. Yes 2.No

31. If yes, how do you get the information?

1. from media 2.From farmer's association 4.From extension agent's 5.From neighboring and friends 6. Other specify_____

32. What type of information did you get? 1= Products/inputs price information 2= Market place information 3= Buyers' information 4= others (specify) _____

Production and reproduction performance of dairy cows

33. Milk production at 2006/2007 E.C

Animal breed	Total Number of milking Cow	Id number cow	Average daily milk yield/cow (Lt)	Average butter yield/cow (Kg)	Lactation length (months)	Lactation yield (Lt)	Dry period (days)	Age at First Calving (years)	Calving Interval (months)
Local									
Cross									
Total									
Total									

Dairy product marketing

34. Did you participate in dairy products marketing in 2006/2007? 1. Yes 2.No

S.N	Dairy products	Q35 if your answer for Q 34 is Yes rank from 1-6	Q36 if your answer for Q 34 is No (use Code 1) the reason for respective dairy products
1	Milk		
2	Butter		
3	Cheese		
4	Yogurt		
5	Butter milk		
6	Whey		
7	others specify		

Code 1: 1= Distance to market 2= Culture 3=low market price 4= low product yield 5= short shelf life of the products 6= low demand of the product 7= others specify_____

37. For what purpose did you use the money obtained from sales of dairy products (in percent)?

S. No	Purpose of money	Percentage	Remark
1	Household consumption		
2	School fees		
3	Saving		
4	For health service		
5	Purchase of inputs and dairy cow		
6	House furniture		
7	House construction		
8	Others		

38. What criterion do you mostly use in selecting your milk/milk products marketing out let? 1=Price 2= Distance 3= Reliability 4. Long term contract 5.Others_____

39. How far the distance of milk market to your home? _____ hrs

40. How far the distance of Woreda to your home? _____ hrs

41. How far the distance of road to your home? _____ hrs

42. How far the distance of FTC to your home _____ hrs

43. Are there seasonal variations in milk market pattern? 1. Yes 2. No

44. If yes, tick to the respective months

Variables	Period (months)												Price/L (ETB)
	Sep	Oct	Nov	Dec	Jan	Feb	mar	Apr	may	Jun	Jul	Aug	
Highest demand													
Lowest demand													
Highest supply													
Lowest supply													

45. Milk production and its marketing linkages (Put, 1= yes, 2=No)

Seller/producers to buyer	Milk	Butter	Cheese (kg)	Yoghurt/lt	Butter milk/lt	Whey (lt)
Producer to HH consumers						
Producers to milk collectors/cooperatives						
Producers to Brokers/whole seller						
Producers to hotels/cafeteria owners/retailer						
Producers to milk processors						

46. During fasting period and non-fasting period how much ETB will you sell milk and milk products per unit for different customers

Dairy products participant	fasting period				non-fasting period			
	Home	Cooperatives/milk collectors	Retailers	Local market	Home	Cooperatives/milk collectors	Retailer/café & hotel	Local market
Milk (liter)								
Butter (kg)								
Cheese (kg)								
Yoghurt(litter)								
Buttermilk (liter)								
Whey (liter)								

Dairy product processing

47. Do you process your milk? 1. Yes 2. No

48. If yes, what materials do you use to process the milk? 1. Clay pot 2. Plastic container

3. Modern equipment 4. Other (Specify) _____

49. What transporting materials do use for products? 1. Clay pot 2. Plastic container 3. Aluminum container 4. Other Specify

50. Do you have milk cooperatives in your area? 1. Yes 2. No

51. If yes, have you satisfied with the service of milk cooperatives 1=Yes 2= No

52. If you didn't satisfy with service of milk cooperatives, explain your reason? 1= low price of milk /milk products 2= Limited intake capacity of the cooperatives 3= delayed payments 4= long bureaucratic channel/less effectiveness in their service 5= others: Specify it: _____

53.?

During fasting period which dairy products do you process		Rank 1-4
1	Butter	
2	Cheese	
3	Yoghurt	
4	butter milk	

54. What is the amount of milk required in liters to produce one kg of butter? _____

55. Storage period of dairy products

Dairy products	For how long do you store your dairy products during fasting period	For how long do you store your dairy products during non-fasting period
Fresh milk		
Yoghurt		
Butter		
Butter milk		
Cheese		
Whey		

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S.N	Factors affecting dairy value chain	Yes / No	If yes, please rank them
1	Low market demand for dairy products		
2	Shortage of feed/high cost of feed		
3	Low volume of milk production		
4	Access to land		
5	Access to transport		
6	Distance to market		
7	Low breed performance		
8	Lack of veterinary service		

9	Lack of credit access		
10	Un availability of cooling facilities for milk storing		
11	Lack of training access		
12	Low house hold income/low purchasing power		
13	Others specify		

Checklists for Focus group discussion of key informants, DAs and district level expert

- i. Status of dairy production activities in the ‘Tabia’ = increasing or decreasing
 - ✓ A trend of livestock population among different livestock species in the tabia is increasing/decreasing/ stable?
 - ✓ A trend of crossbred and local dairy breeds number in the Tabias is increasing /decreasing/ stable?
 - ✓ Productivity of dairy (Average milk production/cow
 - ✓ Prospect of dairy farming, in the tabia in the coming five, ten and/or fifteen years time)
- ii. Dairy production and marketing constraints
 - ✓ Input related constraints (Feed (roughages and concentrate), Artificial Insemination, fodder materials, labor, water, animals ...)
 - ✓ Production related constraints (Feed, diseases, management ...)
 - ✓ Harvest and post-harvest production related constraints (milking, milk handling, milk preservation and processing, storage of dairy products ; transportation of dairy products, marketing of dairy products)
- iii. Efforts made so far to solve the above constituents
- iv. Opportunities
 - ✓ Possibilities of livestock value addition
 - ✓ Policy and enabling environments
 - ✓ Market demand
 - ✓ Infrastructure development
 - ✓ Agro-ecology
- v. Value chain actors and their responsibilities
 - ✓ Actors involved in the value chain of dairy production and product processing (input – production – post production)
 - ✓ Specific roles of each actor in the chain

Interview for input suppliers

Name _____ Woreda / town _____ Kebele _____ Address _____

a. Feed supplier

1. How long have you been in the feed supply business? _____
2. What was the source of your initial capital? 1. Own 2. Loan 3. Share 4. Others specify it _____
3. Did you own/operate the business alone or in partnership? 1=Alone 2=Partnership
3= Cooperatives, 4= other (specify)
4. Total number of peoples employed in your business? _____
5. Who are your beneficiaries? 1=farmer 2=Cooperatives 3=OoARD 4= NGOs 5=traders
6=Others _____
6. What type of feed do you supplied to your beneficiaries?

Type of feed supplied	Price of different concentrate feeds and roughage In different Season												
	Unit	S	O	N	D	J	F	M	AP	Ma	Ju	J	Au
Wheat bran (Frusca)													
Wheat middling (Fruscaloes)													
Mixture of wheat bran and wheat middling													
Cotton seed cake													

Noug seed cake															
Sesame seed cake															
Others															

8. Purchasing and selling price of feeds in 2006/2007

No	In puts	Quant ity	Purchasing price/kg (ETB) including transportation and labor cost for loading and unloading	Total purchasin g Cost of feed /Birr	Selling price /kg (ETB)	Net benefit Birr	sou rce of inp ut	Rank the demand of feed by your customer from 1-6
1	Wheat bran							
2	Wheat middling							
3	Mixture of wheat bran and wheat middling							
4	Cotton seed cake							
5	Noug seed cake							
6	Sesame seed cake							
7	Salary for employee							
8	Taxation							
9	House Rent							
10	Other cost							
	Total cost							

9. Is the feed supplying business economically profitable? 1. Yes 2.No

10. If yes; how much do you earn per annum from this business? _____

11. What is the economical contribution of this business for your family? _____

11. What are the **opportunities** in feed supply business? 1= good infrastructure facilities 2= high access to feed 3= high demand of the feed in area 4= good selling price of feed 5= availability of credit access 6= others specify it _____

12. What are the **challenges** regarding feed supply business?

1= inaccessibility of feed supply 2= low demand of feed 3= transportation problem 4= high purchasing price of feed 5= feed storage problem 6= taxation 7= limited capital 8= lack of credit access 9= others specify

c) Vet supplier (drug suppliers)

1. How long have you been in the drug supply business? _____

2. What was the source of your initial capital? 1. Own 2. Loan 3. Share 4. Others specify it _____

3. Did you own/operate the business alone or in partnership? 1=Alone 2=Partnership 3= Cooperatives, 4= other (specify) _____

4. Total number of peoples employed in your business? _____

5. Who are your beneficiaries? 1. Farmer 2.Cooperatives 3.OoARD 4.NGOs 5.traders 6=Others _____

6. How many farmers does purchased drug per day from you? _____

7. Which drugs types are mostly preferred by your customer? Rank them accordingly

1. _____
2. _____

7. What are the Cost of drugs and output in 2006/2007

No	In puts	Quanti ty	Unit price/Birr	Cost of drug /Birr	Cost of sells/Birr	Net benefit Birr	source of input
1	drug						
2	Salary for employee						
3	House rent						
4	Taxation						

5	others						
	Total cost						

8. What are the **opportunities** regarding drug supply? 1= infrastructure of the area 2= high access to drug 3= high demand of the drug in area 4= good selling price of drug 5= availability of credit access 6=others specify it _____

9. What are the **challenges** regarding drug supply?

1= inaccessibility of drug supply 2= low demand of drug 3= transportation problem 4= high purchasing price of drug 5= lack of refrigeration 6= taxation 7= limited capital 8= lack of credit access 9= others specify

Interview for milk collectors (processors)

Name of the collector/processor _____ woreda/town _____ Address _____ Sex _____

- How long have you been in the milk collecting business? _____
- What was the source of your initial capital? 1= Own 2= Loan 3= Share 4. =Others specify ____
- Total number of peoples employed in your business? _____
- How much milk do you collect per year? 2006/2007 _____
- Do you face any problem of milk adulteration during purchase from your customer? 1. Yes, 2.No
- Which equipment do you use to check whether the milk is adulterated or not? 1= lactometer, 2= lacto scan equipment, 3= I don't use any method, 4= other, specify it: _____
- Purchase price of milk and butter from different customer?

Product type	Purchase price of milk/litter in ETB from customers during fasting period		Purchase price of milk/litter in ETB customers during non-fasting period	
	From Cooperative members	From other dairy farms	From Cooperative members	From other dairy farms
Milk				

- What methods do you use to check the freshness of milk? 1= organoleptic methods (By smelling and tasting), 2= Clot on boiling test, 3= Lacto scan equipment, 4= if others, Specify it:
- How much milk collection capacity/day do you have? _____ Litter
- during collection of milk, for which parameters do you check the sampled milk? 1= Adulteration, 2= Freshness, 3= color, 4= presence of dirt's like manure, hairs etc, 5= milk compositions (fat, protein, SNF, etc), 6= others, _____
- Do you process your milk? 1. Yes 2. No
- What materials do you use to process the milk? 1. Clay pot 2. Plastic container 3. Metal container 4. Other (Specify) _____
- What is transporting materials for products? 1. Clay pot 2. Plastic container 3. Metal container 4. Other (Specify) _____
- During fasting period which dairy products do you process?

No	Dairy products	Rank them
1	Butter	
2	Cheese	
3	Yoghurt	
4	butter milk	

15. Input cost and out puts in 2006/2007 E.C

No	In puts	Unit	Qua ntity	Unit price/B irr	Cost of Inputs/ Birr	Milk products	Cost of sell/Birr	Net benefit Birr	sourc e of input
1	Fresh milk					Milk			
2	House rent					Butter			
3	Cooling facility					Cheese			
4	Processing equipment					Yoghurt			
5	Transport service					butter milk			
6	Labour					Whey			
7	Total								

16. Is dairy product processing economically important? 1. Yes 2. No

17. If yes how it is important, rank 1= as source of income-____ 2= as job creation____
3 =as source of food____ 4. Others specify _____

18. What are the **challenges** in participating in milk collecting and selling business?

1= Lack of initial capital 2=milk adulteration 3= Lack of credit access
4= low quality of milk, 5= Low market price, 6= low supply of milk
7= Low market demand 8= Long fasting season 9= lack of cooling facilities
10= lack of modern processing facilities, 11= lack of knowledge on milk handling and
preservation, 12= Lack of knowledge on processing of milk to various products, 13= other, specify
it: _____

19. What are the **Opportunities** in participating in milk collecting and selling business? 1=
infrastructure of the area 2= high access to market 3= high demand of the product in area 4= others
specify _____

5. What are the **opportunities** regarding milk and milk-products trading? 1= good infrastructure facilities 2= high demand of the milk and butter in area 3= good profitability of the product 4= others specify

6. What are the **challenges** regarding milk and milk-products trading? 1= perishability of the product 2= low quality of the product 3=low demand of the product 4=low supply of the product 5= lack of cooling facilities 6=others specify

Public and private services providers

1. What type of service do you provide to dairy producer farmer? 1=Credit service 2= AI service 3= Vet service 4= Training service 5= provision of products market information 6=Others____

2. For what purpose do you give the training or information to farmer?

Credit service providers

1. Do you give credit services for dairy producers/farmer? 1. Yes 2. No

2. Do you give credit services for milk collectors/processors and traders? 1. Yes 2. No

3. If your answer is No for Q1 and Q2 explain your reason? _____

4. If your answer is yes for Q1 and Q2 in what way did you give the credit? 1=In kind 2= in cash 3=Other_____

5. If yes for Q1 and Q2, for what purpose do you give the credit? 1= to purchase cross breed cow 2= to Purchase local breed cow 3=to Purchase dairy farm equipment 4=to Purchase feed 5= Other_____

6. How much credit do you give? 1=for cross breed cow_____ 2= for local breed cow_____ 3= for dairy farm equipment_____ 4=for feed_____ 5=for other_____

7. For how long did you give the credit? _____

8. What is the interest rate per annum? _____

9. Do they pay the credit timely? _____

10. If the customer did not pay their credit timely what measurement do you take? _____

11. What are the challenges regarding credit supply?

12. What are the opportunities regarding credit supply?

AI service

1. Do you give AI service for producer farmer? 1=Yes 2=No

2. If yes, how many cows did you inseminated per day? _____

3. Is the AI service accessible whole Kebeles of the woreda? 1. Yes 2.No

4. If No; Q3 why? _____

5. How much do you cost for AI service per cow? _____

6. What are the opportunities regarding AI service in the woreda? _____

7. What are the major challenges pertaining AI services in the woreda? _____

Vet service

1. Do you give vet service for dairy producer/farmer? 1=Yes 2=No

2. If yes, for which type of cattle disease do you give the vet service?

3. Which dairy cow disease/disorder is dominant in your area? Rank them accordingly their importance?

4. For how many cows did you give vet service per year? _____

5. Do the whole Kebeles of the woreda had vet service access? 1. Yes 2.NO

6. If No; Q4 why? _____

7. What is the opportunity regarding Vet service in the area? _____

8. What are the major challenges pertaining AI services in the woreda? _____

Interview for Extension services providers And DA's

1. Total population live in the Woreda male _____ Female _____ Total _____

2. Farming system of the Woreda _____

3. Male headed householder _____ female headed _____ total _____

4. Livestock production; total animal population _____

5. Total dairy cattle population in the Woreda _____ Cross _____ Local _____.

6

Farmer/headed householder /	Breed type owned		
	Cross	Local	Total
Male			
Female			

7. Number of dairy product and productivity in the woreda 2006/2007

Animal breed	Total milk yield in litter	Total milk consumed /Lit	Total milk soled in litter	Price/litter	Total income	Total butter yield/ Kg	Total milk consumed / Kg	Total butter soled in litter	Price/Kg	Total income
Local										
Cross										
Total										

8. Seasonal Variations in dairy product

		Period (months)												Average price/ETB /lit
Milk	Highest demand	Sep	Oc	Ne	Dec	Jn	F	mar	apr	may	Ju	Jul	Au	
		Highest supply												
Butter	Lowest demand													
	Lowest supply													

10. Did you contact with dairy producer farmer? 1. Yes 2.No

11. If yes how many times per month? _____

12. How do you give the information on dairy production/processing of milk for farmers? _____

13. was the information applicable? 1=Yes 2=No, If Yes in what way?

14. Who are the dairy and dairy product marketing service providers in the woreda?

From Public, _____

From private: _____

15. Who are the dairy product marketing input suppliers in the woreda?

From Public, _____

From private: _____

17. Do you have dairy cooperative in the woreda? 1. Yes 2. No

18. If yes, what is the benefit of cooperative members? _____

19. What are the major opportunities in dairy production and marketing? _____

20. What are the major problems in dairy production and marketing? _____