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Value Chain Analysis of Dairy Products: The Case of Lemo District of Hadiya Zone, Southern Ethiopia

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Abstract
This study was aimed at identifying the actors, activities, the distribution of costs and benefits among them and identifies factors affecting farmers' participation in milk marketing and marketed volume in Lemo district of Hadiya zone, Southern Ethiopia. In this study, both primary and secondary data were used and a total of 180 sample farm households were taken. The Heckman two-stage econometric estimation procedure was employed to identify factors that determine milk market participation decision and milk sale volume of the farm households. The first step of the Heckman two stages procedures results showed that dairy households' participation decision in milk market was strongly and significantly affected by age of household head, number of household members under 5 years old, volume of milk output produced and distance to principal market. And the second stage estimation result revealed that marketed milk volume was found to be strongly and significantly affected by income from non dairy sources, volume of milk produced, amount of butter produced, experience in dairy production and inverse Mill's ratio (LAMBDA). Milk producers, local collectors, cooperative traders, cafes and restaurants and retailers were found to be important milk market intermediaries. Whereas, butter producers, local collectors and retailers were the only butter market intermediaries found in the study areas. As a recommendation, improving access to services to address problems like lack of access to credit, market accesses are the actions to be taken to strengthen the sector's development.
Keywords: Value chain analysis, Dairy products, Heckman two-stages, Lemo District of Hadiya Zone, Southern Ethiopia

1. INTRODUCTION

Ethiopia holds the largest livestock population in Africa estimated at about 52.13 million heads of cattle, 22.6 million goats and 0.99 million camels. However, the total national milk production remains among the lowest in the world, even by African standard. The estimate of total cow milk production of the country during the year 2012 is about 3.33 billion liters, which translates to 1.54 liters per cow per day (CSA, 2012). Dairy production, among the sector of livestock production systems, is a critical issue in Ethiopia where milk plays a very important role in feeding the rural and urban population of Ethiopia (has high nutritional value, best source of calcium and vitamin D in the diet) (Aglaee, 2011) and means of providing an additional source of employment and income to smallholder producers.

The smallholders produce about 93% of dairy product, but it is only small quantity of this production that is marketed in the form of liquid milk; the larger volume is processed into different dairy products for home consumption and sales. Large scale marketing and processing of milk is limited to the area around Addis Ababa, which is the Addis Ababa milk shed. It appears that butter dominates dairy marketing, and the transaction in the form of raw milk is limited around major urban centres. There are a few milk-processing plants in Ethiopia, one is owned and operated by the government Dairy Development Enterprise (DDE) and others are private. The processed products of these plants are pasteurised fluid milk, table butter, hard cheese, yoghurt and *ayib* (cottage cheese) (Zegeye, 2003).

In Ethiopia, fresh milk sales by smallholder farmers are important only when they are close to formal milk marketing facilities such as government enterprises or dairy cooperatives. Farmers far from such formal marketing outlets instead prefer to produce other milk products such as cooking butter and cottage cheese. In fact, the vast majority of milk produced outside urban centers in Ethiopia is processed into products by the farm households and sold to traders or other households in local markets (Holloway *et al*., 2000). The term 'formal' describes marketing systems in which governments intervene substantially in marketing.

The existing excess demand for dairy products in the country is expected to induce rapid growth in the dairy sector. Factors contributing to this excess demand includes the rapid population growth (estimated at 4 percent annually), increased urbanization and expected growth in incomes. With the shift towards market economy and liberalization policies, private entrepreneurs are expected to respond to the increased demand through increased investment in dairying and milk processing. While the response of the private sector to the increased demand for dairy is expected to be significant, the small-scale household farms in the highlands hold most of the potential for dairy development (Mohammed *et al*., 2006). So as to exploit the opportunity of the current growing demand for milk and milk products, development programs and approaches which bring all milk actors together is fundamental to improve quality and strengthen linkages. Despite this potential and huge demand in the urban and suburban areas, current income generating capacity of dairying is not encouraging and share of final price going

to the producer is apparently small. So in this study, dairy value chain including input supply, production, marketing and value adding activities were identified and analyzed by using data obtained from producers and market participants in Lemo District of Hadiya Zone, Southern Ethiopia.

2. LITERATURE REVIEW

Value Chain Analysis

Although the value chain approach in general has a long tradition especially in industrial production and organization, its application in international development and agriculture, has gained popularity only in the last decade. Value chain approaches have been used to analyze the dynamics of markets and to investigate the interactions and relationships between the chain actors. The agricultural value chain approach is utilized by many development interventions that intend to engage smallholders either individually or collectively into the production of market oriented high value crops. Concepts and analytical tools for analyzing the functioning of agricultural value chains are, therefore, important to understand the impact of chain development interventions on smallholders and the rural poor. Similar to the agricultural innovation systems perspective, value chain approaches help orient agricultural development thinking more towards a systems perspective (Rich *et al*., 2008).

Value chain analysis is conducted for a variety of purposes. The primary purpose of value chain analysis is to understand the reasons for inefficiencies in the chain and identify potential leverage points for improving the performance of the chain, using both qualitative and quantitative data. In general, agricultural value chain analysis can be used to understand how an agricultural value chain is organized (structure), operates (conduct) and performs (performance) (Anandajayasekeram and Berhanu, 2009).

Value chain analysis facilitates an improved understanding of competitive challenges, helps in the identification of relationships and coordination mechanisms, and assists in understanding how chain actors deal with powers and who governs or influences the chain. Developing value chains is often about improving access to markets and ensuring a more efficient product flow while ensuring that all actors in that chain benefit. Changing agricultural contexts, rural to urban migration, and resulting changes for rural employment, the need for pro-poor development, as well as a changing international scene (not least the increase in oil prices) all indicate the importance of value-chain analysis (Anandajayasekeram and Berhanu, 2009).

Kaplinsky and Morris (2001) argue that there are three main sets of reasons why value chain analysis is important in this era of rapid globalization. The first reason they raised is that with the growing division of labour and the global dispersion of the production of components, systemic competitiveness has become increasingly important. Second, efficiency in production is only a necessary condition for successfully penetrating global markets. Third, entry into global markets which allows for sustained income growth requires an understanding of dynamic factors within the whole value chain.

The value chain can help to answer questions regarding how the produce reach the final consumer; the structure (economic relationships) between players in the chain; how this structure is likely to change over time; the key threats to the entire value chain; and the key determinants of your share of the profits created by your chain. It helps policy maker to find out where the bottlenecks are. Which part of the chain holds up in the others? Which bottlenecks deserve priority attention of government? Where can the donor agencies help? (Hubert, 2005).

3. Methodology for Value Chain Analysis

Value chain analysis is very effective in tracing product flows, showing the value adding stages, identifying key actors and the relationships with other actors in the chain. It is actor oriented. Generally, Taylor (2005) has outlined the following summary of value chain analysis methodology.

Understanding supply chain structure and selecting a target value stream: The objective of value chain analysis is to improve supply chain performance with a view to enhance competitiveness. A pre-requisite, therefore, is an understanding of the scope of the processes, which make up the supply chain system. Because most firms are part of complex supply networks, it is common to find that they do not have a clearly defined picture of their supply chain structures. A first task for the value chain analysis team is to develop a supply chain structure map.

Analysis of the individual facilities along the chain: In order to collect the data necessary to understand the overall chain, the individual plant and facilities along the chain will be analyzed. Process activities mapping is used to record identify and quantify the value adding or non-value adding steps in the process.

Analysis of issues and opportunities along the whole chain: Mapping of the complete chain inevitably throws up many issues and improvement opportunities. The value stream mapping model naturally leads to classification of issues into those related to physical flows and those related to information flows. It is suggested, however, that it is useful to consider further dimensions in terms of issues related to the organization, management and control of the chain.

Milk marketing in Ethiopia: Milk marketing is an incentive for farmers to improve production. It stimulates production, raise milk farmers' income and living standards and create employment in rural areas (Asaminew,

2007). Provision of improved and sustainable milk marketing arrangements in villages is, therefore, important in the aspiration for advancement of the sector. The Ethiopian milk marketing system is not well developed. This can be reflected from the fact that only 5% of milk produced in rural areas is marketed as liquid milk. This has resulted in difficulties of marketing of fresh milk where infrastructure especially transportation facilities are extremely limited and market channels have not been developed. In the absence of an organized rural fresh milk market, marketing in any volume is restricted to the urban and peri-urban areas (Getachew, 2003).

Mohamed *et al.* (2006) reported that milk products in Ethiopia are channeled to consumers through both formal and informal milk marketing systems. The informal market involves direct delivery of fresh milk by producers to consumers in the immediate neighborhood and sale to itinerant traders or individuals in nearby towns (Debrah and Berhanu, 1991). In the informal market, milk may pass from producers to consumers directly or it may pass through two or more market agents. The informal system is characterized by no licensing requirement to operate, low cost of operations, high producer price compared to formal market and no regulation of operations. The term 'informal' is often used to describe marketing systems in which governments do not intervene substantially in marketing.

Varies researchers have undertaken an in-depth assessment of the value chain analysis of milk and milk products marketing through identifying actors (operators and facilitators) and relationships, to identify the challenges, possible opportunities and threats of the subsector, and to analyze the underlying causes for the diminishing supply of milk in Ethiopia. Woldemichael (2008) used the Heckman two stage model to identify factors affecting milk supply in Shashemene, Hawassa and Dale district's Milkshed, Southern Ethiopia. In the study, the first stage of the Heckman two-stage model a "participation equation" attempted to capture factors affecting participation decision, this equation is used to construct a selectivity term known as the "inverse Mills ratio" which is added to the second stage "outcome equation" that explains factors affecting volume of milk supply. The second stage involves including the Mills ratio to the milk supply equation and estimating the equation using Ordinary Least Square (OLS). He identified six variables which determine the probability of milk market participation. These are age, education level, family size in adult equivalent, experience in dairy production, access to milk market and number of cross breed milk cow.

4. METHODOLOGY

Description of the Study Area: Lemo is one of the 10 rural Districts of Hadiya Administrative Zone in Southern Ethiopia. It is bordered on the south by the Kembata Tembaro Zone, on the southwest by Duna and Soro Districts, on the west by Gomibora District, on the northwest by Misha District, on the north by Gurage Zone, on the northeast by Ana Lemo District, and on the southeast by Shashogo District. It is located some 230 km south of Addis Ababa and 175 km west of Hawassa town. There are a total of 33 *kebeles* in the District. Rural towns in the District are Belesa and Lisana. It has a total land of 34,973 hectare. The town of Hosanna is surrounded by Lemo District. Based on the 2007 Census conducted by the CSA, the District has a total population of 118,594, of whom 58,666 were men and 59,928 were women; 2,049 or 1.73 percent of its population were urban dwellers. However, based on 2012/13 annual household survey of the District, it has a total population of 150,719, of whom 74,574 were men and 76,145 were women. The majority of the inhabitants were Protestants, with 74.07 percent of the population, 12.37 percent were Muslim, 7.2 percent were Ethiopian Orthodox Christian, and 6.14 percent were Catholic.

Livestock population In the year 2008 the total estimated size of livestock population of the district was 8 out of which about 79581 cattle, 43345 goats, 39531 sheep, 2358 horses, 421 mules and 21451 asses were found.

Data Sources, Sampling and Data Collection: To select sampled respondent farmers, two-stage simple random sampling technique was employed. Use of administrative units is necessary to select representative study sites within the District. The smallest administrative unit in the District is *Kebele*. There were 33 *Kebeles* in the District. Three *Kebeles* namely: Ambicho Gode, Jawe and Shurmo were randomly selected. The reasons for choosing the simple random sampling technique are its simplicity and existence of similarity in farmers' socio-economic conditions in all midland *Kebeles* of the District. Thus, those chosen *kebeles* were assumed to be representative of Lemo district. By taking the list of farm household heads from each selected *Kebeles* as a sample frame, 180 representative farm household heads were randomly selected in probability proportion to size of each *Kebele's* population (Table 1). Representative sample size was determined using the formula which is developed by Yamane (1967): $n = \frac{N}{1 + N(e)^2}$

Where, n is sample size, N is target population and e is level of precision, in this case it is 7%.

Table 1. Total number of the sampled farmers and population in the sampled *kebeles*

Kebele	Total number of households	Sampled farmers
Ambicho Gode	889	58
Jawe	904	60
Shurmo	922	62
Total	2715	180

Source: Own computation, from LDOARD

In this study, both primary and secondary data sources were used to gather necessary data regarding value chain analysis of dairy products. The data used for this study were collected from a sample of dairy farmers through structured questionnaires, which were prepared for the study. Information pertaining to respondents, socio-economic characteristics and institutional situations etc. were obtained directly through the interview, which was conducted at household level. Secondary data were obtained from published and unpublished documents of different organizations

Methods of Data Analysis: Descriptive statistics like means, frequencies, percentages, maximum, minimum, and range were used to describe the descriptive result while the Heckman's sample selection model was employed. Mapping a value chain facilitates a clear understanding of the sequence of activities and the key actors and relationships involved in the value chain. This exercise is carried out in qualitative and quantitative terms through graphs presenting the various actors of the chain, their linkages and all operations of the chain from pre-production (supply of inputs) to consumption.

Specification of the models: The model first estimates the participation equation (the probability of participating in milk market) and derives maximum likelihood Probit estimates from the coefficient of the participation equation. Using these estimates, a variable known as the inverse Mills ratio is calculated. The inverse Mills ratio is a variable for controlling bias due to sample selection (Heckman, 1979). The second stage involves including the Mills ratio to the milk supply equation and estimating the equation using Ordinary Least Square (OLS) technique to estimate the model.

The participation/the binary probit model is specified as:

$$Y_{1i} = X_{1i}\beta_{1i} + \varepsilon_i \qquad i = 1,2,..., n$$

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

Where MMP is milk market participation; Y_{1i} is a dummy variable indicating the probability of sampled household milk market participation; X_{1i} are the variables determining participation in the probit model; β_{1i} is unknown parameter to be estimated in the probit regression model; ε_i is random error term

Then the parameters can consistently be estimated by OLS over n observations reporting values for Y_i by including an estimate of the IMR denoting λ_i as an additional regressor in equation (6). More precisely the observation equation/the supply equation is specified as:

$$Y_i = X_i\beta_i + \mu_i\lambda_i + \eta_i$$

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

Hypothesis and Variable Definition

Dependent variables: This study used the following two dependent variables in two stages of the value chain analysis.

Milk market participation decision (MMP): is a dummy variable that represents the probability of market participation of the household in the milk market that is regressed in the first stage of the Heckman two stages estimation procedure. For the household who participate in milk market the variable takes the value of one where as it takes the value of zero for the household who did not participate in milk market.

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

Independent (explanatory) variables

Volume of total milk output (MILKOUTPUT): It is a continuous variable measured in liters per day. A marginal increase in dairy production has obvious and significant effect in motivating market participation and

volume of milk supply. The variable was expected to have a positive contribution to market participation and marketed surplus. Woldemicheal (2008) identified factors affecting volume of milk supply and milk market participation decision by dairy household in Southern Ethiopia. He observed that milk production significantly affected market supply positively.

Amount of butter produced (BUTTER): It is a continuous variable measured in kilogram per week. Butter production is hypothesized to have negative influence on market participation and marketed surplus.

Distance to the principal market (DNPM): It is a continuous variable measured in kilometer. The closer the market the lesser the transportation charges, reduced walking time, reduced loss to spoilage, reduced transaction costs, and reduced other marketing costs. Therefore, it was hypothesized that this variable is negatively related to market participation and marketed surplus. A study conducted by Holloway *et al.* (1999) on expanding market participation among smallholder livestock producers in the Ethiopian highlands revealed that distance to market causes market surplus to decline.

Education level of household head (ELHH): It is a continuous variable and measured in years of schooling of the household head. Formal education is hypothesized to have positive influence on market participation and marketed surplus. Holloway *et al*. (1999) observed that education and visits by an extension agent had significant and positive effects on quantity of milk marketed in the Ethiopian highlands.

Age of the household head (AGE): It is a continuous variable and measured in years. Age is a proxy measure of farming experience of household. Aged households are believed to be wise in resource use, and it is expected to have a positive effect on market participation and marketed surplus. Tshiunza et al. (2001) identified age as the major farm characteristics that significantly affected the proportion of cooking banana planted for market. He found that younger farmers tended to produce and sell more cooking banana than older farmers did.

Experience in dairy production (EXPERI): it is a continuous variable measured in terms of the number of years of dairy production and management experience of the dairy household; it was expected to have a positive effect on milk market participation and milk supply to market.

Sex of household head (SEX): This is a dummy variable that takes a value of one if the household head is male and zero otherwise. The variable was expected to have a positive relation with milk market participation and milk sale volume. Gizachew (2005) found negative relation between sale volume of milk and male-headed household. Study conducted by Rehima (2006) confirmed the same result.

Household members under five years old (HHMM5YR): It is a continuous variable, measured in terms of the number of children below age of five in the sample household. Mostly milk as a major food and its importance in children growth is widely accepted and recognized both in rural and urban areas. An increase in the number of children in this age category usually decreases the marketed surplus and therefore it was expected to have a negative relation with related to marketed surplus of milk and reduces the ability of the smallholder in market participation.

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

Market price of milk (MILKPRICE): This is the price offer a farmer receives from selling his produce. It is a continuous variable in Birr and it was expected to influence market participation and supply decisions positively. As farmer sees better price, the probability of entering a market and it is anticipated that volume of milk supply will increase.

Income from the non-dairy sources (INFNDS): It is a continuous variable measured in Birr. The variable represents income originating from different sources, other than dairy activity, (i.e., other on-farm, non-farm, and off-farm incomes) obtained by the sample household. Through improving liquidity, this income helps to cover the financial requirement of the sample household and tends to consume the amount of milk produced. Thus, income from non-dairy source was hypothesized to affect milk market entry decision by household and sale volume of milk negatively.

Access to dairy production extension services (ACEXT): This variable is measured as a dummy variable taking a value of one if the dairy household has access to dairy production extension service and zero, otherwise. It was expected that extension service widens the household's knowledge with regard to the use of improved dairy production technologies and has positive impact on milk market participation decision and sale volume of milk. Holloway and Ehui (2002) analyzed factors affecting volume of milk supply and milk market entry decision by dairy households in Ethiopia highlands (Lemu Ariya, Arsi and Shoa regions) using Probit and Tobit models. Their finding indicated that number of extension visits exhibited positive relationship with milk market entry decisions and marketed milk surplus. Therefore contact with extension agent was assumed to have direct relation with market participation and volume of marketed surplus.

Access to credit (ACCR): This is a dummy variable which enables milk producers to increase their financial capacity to participate in milk market and to supply milk to the market. Holloway *et al*. (1999) observed that

visits by an extension agent had significant and positive effect on quantity of milk marketed in Ethiopian highlands. Therefore, it was expected to have positive impact on milk market participation and milk marketed surplus.

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

5. RESULTS AND DISCUSSION

In this study, it is learnt that the major actors participating in dairy value chain are input suppliers, producers, collectors (small and mobile traders who visit villages and rural markets), retailers (who distribute products to consumers in small quantity), cafes and restaurants, cooperatives traders and consumers of dairy products were identified. The main functions include input supply, production, collecting and transporting, processing and marketing of dairy products. These are presented and discussed below.

Input suppliers: These are actors who provide inputs for dairy milk production. And they are the starting point in the chain. Actors including livestock development agency that is accountable to the Hadiya zone office of agriculture and woreda agriculture office provides improved dairy breed and provide technical services (AI and animal health services), traders were also involved in providing dairy feed meal mainly "fruska" and hay.

Producers: These are those types of actors who produce and sell milk. These are the basis of the milk and milk products value chain. They have two major functions; one is livestock management so that production and productivity of livestock increases or at least maintained at current levels; second deciding the production volume of milk sold to the market, hence dairy products are used as a family diet and income sources for the dairy producing households. Producers can supply milk in two ways. First direct sale of milk by smallholder farmers to cooperatives and intermediaries may be milk collectors found around their village, and the independent traders then sell the milk to either retailers in urban centers, cafes and restaurants or directly to consumers (households, mainly in the neighborhoods).

Dairy cooperatives: There are few small primary dairy farmer cooperatives who are involved in milk collection, processing and marketing activities. It is one of the most important and most promising dairy cooperative dealing with collection, processing and marketing of milk in the study area.

Local collectors: These are traders who collect milk from milk producers in the village for the purpose of reselling it to consumers, cafes and restaurants or urban retailers in district/regional market. They use local acquaintance to bulk milk from surrounding areas. These traders do focus on the villages where they have relatives or their clan members or stronger networks. Local collectors use transportation cars to transport milk from their collection center to terminal markets.

Retailers: This is one of the final links in the chain that delivers milk to consumers. They are very numerous as compared to local collectors and their function is selling milk to consumers in small volumes after receiving large volumes from rural assemblers and producers.

Cafes and restaurants: These are retailers in urban areas who supply milk to consumers. They buy milk from local collectors, retailers and producers and sell fresh milk directly after boiling and/or in the form of tea or *"makyato"* and yoghurt.

Consumers: This is the last link in the dairy value chain. Milk and milk products value chain ended at consumers who buy the products for the ultimate consumption. In both studied areas, marketed milk reach the consumers, through direct purchasing from restaurants and teashops, retailers and producers and small quantities are also purchased from local collectors. Eventhough the number of consumers vary from place to place; the consumers are mostly residents of the pre-urban and towns, peoples visiting markets, travelers, etc. In the studied areas, the culture (traditions/norms), economy (Consumers' consumption patterns/demand structure, purchasing power) and social background largely affect the market volume and type of product for agricultural commodities in general, and milk and milk products in particular.

Supportive actors: Value chain supporters or enablers provide support services and represent the common interests of the value chain operators. They remain outsiders to the regular business process and restrict themselves to temporarily facilitating a chain upgrading strategy. Typical facilitation tasks include creating awareness, facilitating joint strategy building and action and the coordination of support activities (like training, credit, input supply, etc). The main supporters of the dairy value chain in the study areas are Bureau of Agriculture and Rural Development (BoARD), marketing and cooperative development and Bureau of Trade and Industry.

In the present study, eight marketing channels are identified in both woredas and they are presented as follows.

Channel I: Milk producer ➔local collectors ➔Retailer ➔Consumers

Channel II: Milk producer ➔local collectors ➔ cafes and restaurants ➔Consumers

Channel III: Milk producer ➔local collectors ➔Consumers
Channel IV: Milk producer ➔ cafes and restaurants ➔Consumers
Channel V: Milk producer ➔retailers ➔consumers
Channel VI: Milk producer ➔retailers➔cafes and restaurants➔consumers
Channel VII: Milk producer ➔ Consumers
Channel VIII: Milk producer ➔cooperative➔consumers

Marketing Costs, Margins and Profit Share of Dairy Value Chain Actors

The important points to be considered in value chain analysis are marketing costs (cost for value located on the product at different level by market actors along channels), margin and share of producers as well as intermediaries from consumers' price or end buyers for dairy products. So as to investigate the shares and margins of several market agents, who are involved in dairy value chain different channels starting from farm gates to consumer. Accordingly, main channels (which accommodate a number of intermediaries) were followed beginning from farm gates of milk producer households up to the end users.

Price per liter of milk and price per kilogram of butter was used for the marketing margin calculations. Results of analysis of marketing costs and margins were used to determine whether or not there were excess profits and serious inefficiencies or whether or not wide margins are due to technical constraints (such as transportation, asymmetry information/ high transaction cost) and shows value addition by intermediaries along the chain to the product. Margin and cost calculation was carried only for key dairy products (milk and butter) because they were the two most important traded dairy products in the districts during the survey period. Butter was used for household consumption and cosmetics, while milk was used as food only.

Marketing costs and margins for milk traders: Table 9 depicted that the highest and the lowest total gross marketing margin (TGMM) was found to be 52.5% and 0% in channel II and channel VII, respectively. In line with producer's share of milk retail price, which is also shows the value added by producers, the survey results revealed that the maximum and minimum gross producers' share of the milk marketing channels were estimated to be 100% and 47.5% in channel II and VII, respectively. And this maximum share is due to the absence of intervention of any intermediaries who could reduce the share of producers, producers have directly sold their produce to consumers.

Table 2. Marketing costs, margin and profit share per liter of milk for marketing participants during the production year 2017/18

Marketing actors	Marketing measures per liter	Marketing channels							
		I	II	III	IV	V	VI	VII	VIII
Producers	Selling price	9.5	9.5	9.5	12	11	11	14	13
	GMMp (%)	55.88	47.5	59.37	60	64.7	55	100	72.22
	Marketing cost	0	0	0	0.12	0.12	0.12	0.12	0.12
	Production cost	5.23	5.23	5.23	5.23	5.23	5.23	5.23	5.23
	NMM (%)	25.12	21.35	26.69	33.25	39.12	28.25	61.75	42.5
Local collectors	Selling price	14	15	16	-	-	-	-	-
	GMMcol (%)	26.47	27.5	40.63	-	-	-	-	-
	Marketing cost	0.35	0.35	0.45	-	-	-	-	-
	NMM (%)	24.41	25.65	37.81	-	-	-	-	-
Cooperatives	Selling price	-	-	-	-	-	-	-	18
	GMMcop(%)	-	-	-	-	-	-	-	27.78
	Marketing cost	-	-	-	-	-	-	-	0.5
	NMM (%)	-	-	-	-	-	-	-	25
Retailers	Selling price	17	-	-	-	17	16	-	-
	GMMr (%)	17.65	-	-	-	35.3	25	-	-
	Marketing cost	0.1	-	-	-	0.1	0.1	-	-
	NMM (%)	15.06	-	-	-	34.7	24.5	-	-
Cafes & restaurants	Selling price	-	20	-	20	-	20	-	-
	GMMcr (%)	-	25	-	40	-	20	-	-
	Marketing cost	-	0.75	-	0.75	-	0.75	-	-
	NMM (%)	-	21.25	-	36.25	-	16.25	-	-
	TGMM (%)	44.12	52.5	40.63	40	35.3	45	0	27.78

Where: GMMp= Gross Marketing Margin for producers, GMMcol= Gross Marketing Margin for collectors, GMMcop= Gross Marketing Margin for cooperatives, GMMr= Gross Marketing Margin for retailers, GMMcr= Gross Marketing Margin for cafes and restaurants, NMM and TGMM are Net Marketing Margin and Total Gross Marketing Margin, respectively.

Source: computed based on survey result

Profit share of milk traders: Marketing profit for milk traders is summarized in Table 9. Maximum return for

dairy producer in the study area was found to be 8.65 Birr per liter of milk (61.75% share of the end user price), from channel VII which was the highest among the milk marketing intermediaries, and minimum return of 4.15 Birr per liter of milk (25.12%, 21.35% and 26.69% of the end user price) from channels I, II and III, respectively. The reasons for difference in producers' return/liter of milk across the channels seems to be due to different level of marketing costs and access to urban market consumers. I.e. length of the channel.

Marketing profit for butter traders: Marketing profit for butter traders are summarized in Table 10. During the survey period it was observed that butter gets supplied only through marketing channels I, V and VII. Average of 17.46 Birr and 23.75 Birr profit/kg of butter were respectively obtained by local collectors and retailers. The reason why butter retailers had the highest profit was that the majority of butter retailers were found to purchase butter either directly from producer farmers at local markets with cheaper prices and they were found to incur relatively less cost or even butter could be directly delivered by local collector traders at their business site with no transport cost. Table 3. Average prices, marketing cost and margin and profit share per kg of butter for butter traders by channel in woredas during production year 2017/18

Marketing actors	Marketing measures (Birr/kg)	Butter marketing channels		
		I	V	VII
Producers	Producing price	41.84	41.84	41.84
	Marketing cost	2.375	8.375	11.374
	Selling price	80	90	100
	Profit	35.785	39.785	46.786
Local collector	Purchasing price	80	-	-
	Marketing cost	1.04	-	-
	Selling price	100	-	-
	Profit	19.96	-	-
Retailer	Purchasing price	100	90	-
	Marketing cost	1.25	1.25	-
	Selling price	120	120	-
	Profit	18.75	28.75	-
Consumers	Purchasing price	120	120	100

Source: computed based on survey result

Econometric Analysis

Factors affecting milk market supply: Milk is produced for both market and household consumption in the study areas. Various variables are assumed to determine milk market participation decision and the sale volume of milk by sampled dairy households.

The econometric analysis for the Heckman two-step estimation procedures was performed using STATA version 11. The Heckman two-step selection model was employed in order to control the selectivity bias and endogenity problem and obtain consistent and unbiased parameter estimates. The model in the first stage predicts the probability of participating in the milk market of each household; and in the second stage, it analyses the determinants of volume of milk supply to market. Based on the Heckman's selection assumption (i.e. the selection equation should contain at least one variable that is not in the outcome equation) which enables the inverse Mill's ratio to predict correctly, distance to principal milk market center was taken as exclusion restriction and included in the participation equation but not in the observation equation.

The probit (participation) equation:

The result of the probit model is summarized in Table 11. In the first stage, households decide whether they would be cow milk sellers or not. The decision to participate in cow milk market was estimated by probit maximum likelihood estimator. A total of fourteen potential predictor variables (four dummy and ten continuous) were selected and entered into the selection/probit model. The probit model was significant with a $\chi 2$-value of 113.64.

Out of fourteen explanatory variables, four of them were found to determine the probability of participating in cow milk market. These are: age of household head (AGE), number of household members under 5 years old (HHMM5YR), volume of milk output produced (MILKOUTPUT) and distance to principal market (DNPM) (Table 11). Explanatory variables that appeared to be statistically significant are presented and discussed here under.

Table 4. First-stage probit estimation results of determinants of probability of milk market participation

Variables	Coefficient	Z	Marginal effect
_cons	-5.689252	-1.75	
AGE	-.1135758	-1.72***	-0.0030553
SEX	0.4068383	0.62	-0.2561462
ELHH	-.0661637	-0.56	-0.0187397
HHMM5YR	-0.555562	-2.13**	-0.278376
FSHH	0.1523002	0.81	0.1607234
EXPERI	0.0302361	0.47	-0.1180097
MILKOUTPUT	0.801188	3.17*	0.9018795
MILKPRICE	0.168805	0.89	-0.1234218
BUTTER	-5.252758	-0.86	-1.43195
DNPM	-.968543	2.98**	0.2047815
INFNDS	-0.0000186	-0.30	-2.70e-06
MKTINF	0.3365658	0.39	0.0886135
ACCR	0.7269448	1.10	0.9913742
ACEXT	-0.0126225	-0.85	-0.0139808

Number of observations= 180 Prob > chi2 = 0.0000, LR chi^2 (14) = 113.53, Pseudo R^2 = 0.71, Log likelihood = -26.004774

The dependent variable (MMP) is a dummy variable that takes the value 1 if the farmer had participated in milk market, 0 otherwise.

***, ** and * represents significance at 1%, 5% and 10% probability levels, respectively.

Source: survey model output

Age of the household head (AGE): age was expected to affect participation decision positively. However, the opposite has been observed in the result. The model result depicts that age of the household head had a negative impact on market participation decision of the sampled dairy households and it was significant at 1% significance level. The negative and significant relationship between the two variables indicates that as the household head gets older carrying the product to the market becomes more difficult which in turn decreases the probability of the household decision to enter the milk market. The marginal effect also confirms that when the age of household head increases by one year, the probability of participating in the milk market decreases by 11.3%.

Household members under five years old (HHMM5YR): As expected, the variable had a negative effect on probability of cow milk market participation decision of household and it was statistically significant at 5% probability level. The negative and significant relationship indicates that as the number of children in this age category increases, milk consumption by households increases which results in the decline of the probability of milk market participation of dairy households. The marginal effect of the variable shows that for every under five years old child increase in the household, the probability of milk market participation decision of the households falls by 55.5%.

Volume of milk produced (MILKOUTPUT): As was expected, this variable had positive relationship with household cow milk market participation decision and it was found to be statistically significant at 10% probability level. The positive and significant relationship between the variables indicates that as the volume of milk output produced increases, the probability of market participation and amount of milk sold to the market also increases. The marginal effect of the variable also confirms that a one liter increase in volume of milk produced leads to the rise of the probability of dairy household milk participation by 80.11%.

Distance to principal market (DNPM): This variable has negative effect on milk market participation and found to be statistically significant at less than 5% significance level. The negative relationship indicates that the farther a household is located from the milk market, the more difficult and costly it would be to get involved in the milk market. The marginal effect also confirms that a one-kilometer increase in milk market distance from the dairy farm owner reduces the probability of participation in milk market by 20.5%. In other words, as the dairy households become closer to milk market center by one kilometer, the probability of his/her participation in milk market rises by 96.8%. Similarly, studies conducted by Holloway and Ehui (2002), Gizachew (2005), and Weldemichael (2008) found the negative relationship between distance to market and the probability of participation in milk market.

Results of the supply

Heckman's second stage of estimation identifies the significant factors that affect volume of milk marketed surplus by using the selection model which included the inverse Mill's ratio calculated from a maximum likelihood probit estimation of cow milk market participation decision. Of thirteen hypothesized variables in the observation equation of the model, five variables were found to be significant determinants of the level of cow milk volume marketed surplus including inverse Mill's ratio (LAMBDA). These variables are income from non

dairy sources (INFNDS), volume of milk produced (MILKOUTPUT), amount of butter produced (BUTTER), experience in dairy production (EXPERI) and inverse Mill's ratio (LAMBDA) (Table12).

Table 5. Supply equation model output

Variables	Coefficient	Z
_cons	-1.139921	-0.51
AGE	0.0020553	0.1
SEX	-0.2561461	-0.50
ELHH	-0.0187397	-0.23
HHMM5YR	-0.278377	-1.38
FSHH	0.1607234	1.17
EXPERI	0.1180097	1.83***
MILKOUTPUT	.9118796	41.63*
MILKPRICE	-.1234218	-1.07
BUTTER	-1.42196	-2.42**
INFNDS	0.9813742	2.23**
MKTINF	0.0886135	0.09
ACCR	-.0139808	-1.08
ACEXT	2.047815	1.26
Mills lambda	1.46122	2.95**
Rho	0.92041	
Sigma	1.6875212	
Lambda	1.5612131	
Number of observation = 180Wald chi2(13) = 2453.97 (0.0000)***, R-squared = 0.977, Adj R-squared = 0.9647.		

The dependent variable (MMV) is the quantity of milk sold.
*, ** and *** represents significance at 10%, 5% and 1% probability levels, respectively.

Source: model output,

Rho(ρ) is the correlation between the error terms of the substantive and selection models. Rho has a potential range between -1 and +1 and can give some indication of the likely range of selection bias. A correlation with an absolute value of 1 would occur if the regression coefficients of the selection model and the regression coefficients of the substantive model were estimated by identical processes (i.e., potential selection bias). Conversely, a value of rho closer to zero would suggest that data are missing randomly or the regression coefficients of the selection model and the regression coefficients of the substantive model were estimated by unrelated processes (i.e., less evidence of selection bias) (Cuddeback et al., 2004). In this particular case, a rho value of 0.92 indicates the existence of selection bias and this justifies the use of Heckman selection model. Following this, variables that are found to be statistically significant are presented and discussed below.

Experience in dairy production (EXPERI): As expected, experience in dairy production has a positive effect on milk sale volume per household per day because it is statistically significant at 5% probability level. The model output predicts that increase in experience in dairy production by one year causes the marketed milk surplus of the dairy household to increase by 0.12 liters per day per dairy household.

Volume of milk produced (MILKOUTPUT): As hypothesized, this variable is significant at 10% probability level and has positive effect on marketed milk volume. The model output predicts that the addition of one liter milk produced causes the marketed milk surplus of the dairy household to rise by 0.91 liter per day per dairy household. This result is plausible and suggests that marketed milk surplus of the household in the study areas are more responsive to volume of milk produced. Farmers with more milk output are usually market oriented since the higher production levels enable them to sell the surplus produce. Furthermore, this result elaborates that marketed milk surplus per day increases in response to the increase in amount of milk produced. Holloway and Ehui (2002) found that households with higher amount of milk were positively associated with volume of sale of dairy products.

Amount of butter produced (BUTTER): As hypothesized, butter production has negative influence on market participation and marketed surplus as it is statistically significant at 5% probability level. A marginal increase in one kilogram of butter production per week decreases the amount of marketed volume of milk by 1.42 liters per day per household. This result also concurs with the reality on the ground suggesting that marketed milk surplus of the households, in the study areas, are responsive to the volume of butter produced.

Income from non dairy source (INFNDS): Financial income from non dairy sources has positive effect on the sales volume and it is found to be significant at 5% probability level. The positive relation between the variables indicates that any additional financial income enables the dairy household to purchase more number of dairy cows and improved feed which can contribute to increased milk production and productivity per household per day and then contribute to increased volume of milk sale by dairy households. The model output predicts that an

additional gain of one Birr increases marketed milk surplus of the dairy household by 0.98 liters per day per dairy household. Weldemicheal (2008) found that financial income from non-dairy sources have positive effect on market participation decision and sale volume of milk.

LAMBDA: According to the model output, the Lambda (Inverse Mill's Ratio) or selectivity bias correction factor has positive impact on dairy household marketed milk surplus with 5% significance level. And this result suggests that there are unobserved factors that might affect both probability of dairy household market entry decision and marketed milk volume. And, 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.

5. CONCLUSIONS AND POLICY IMPLICATIONS.

Dairy value chain analysis of the study area reveals that the main actors in the chain are milk producers, local collectors, cooperative traders, cafes and restaurants and retailers. Whereas, butter producers, local collectors and retailers are the only butter market intermediaries found in the study area. Milk producers were working as joint actors and perform two or more functions of the value chain. They rear and manage milking cows, produce milk and milk products like butter and sell to different intermediaries and consumers.

The market channel of milk shows that the area has eight milk marketing channels and the major share of milk marketing goes to the VII channel (milk producer to consumer, 53.8%). This is mainly due to the preference of milk producers in the study area, to sell their milk directly to consumers and fetch better price for their product. Regarding the margins/costs of the chain actors, milk producers in the study areas had maximum gross margin of 100% and minimum of 47.5%. With regard to butter traders the average retailer trader had the highest profit of 23.6 Birr / kg of butter.

Heckman's selection model procedure was used to analyze factors affecting farmers milk market participation decision (selection equation) and volume marketed (observation equation). The maximum likelihood probit model analysis revealed that age of household head, household members under 5 years old, volume of milk output produced and distance to principal market were found to exert significant impact on probability of the households milk market participation. However, the supply equation procedure identified years of experience in dairy production, volume of milk produced, amount of butter produced, income from non dairy source and inverse Mill's ratio (LAMBDA) as important factors affecting sale volume of cow milk.

In the woredas, the existing situations to exploit the potential of dairy sector with regard to dairy production service sector were not encouraging. Extension service in line with improving dairy production (AI, medicament, introducing improved cow breed), credit service, producers and traders' cooperatives, and formal market information were very weak. These problems can be addressed via formation of milk producer unions and cooperatives and through intervention of governmental or non-governmental organizations in terms of improving possibilities for strong and successful collective marketing of dairy products. Thus, the government should consider better means of coping with access problems to milk and other dairy products market through increasing dairy market outlets by forming market oriented dairy producer led-cooperative, and increasing and improving infrastructure facilities in order to reduce transaction cost associated with distance from milk market outlets. It is also crucial to improve market access of the producers through establishing collection centers and to make the milk business sustainable and competitive through the engagement of the private sector who have the capacity to invest on milk processing facilities. Their engagement will improve the upward stream of the milk value chain in the area. The quality will get improved, the producers will get sustainable market for fresh milk, they will access nearby market and hence will not be forced to travel a long distance to sell the milk, will have rational margin through agreed and transparent market linkages. Consequently in implementing these processes the milk subsector becomes competitive and may capture the milk demand found at distant areas through the advantages of increased shelf life of the product. And, this could improve the profitability of the enterprise in the study areas in particular, and in the country in general.

The supply equation of the Heckman two step procedure model analysis revealed that income from non-dairy source of dairy household was found to affect the sale volume of milk positively. The positively related value of the variable suggests that through improving liquidity, this income makes the household to improve sale volume of milk through expanding dairy production. Therefore, increasing the dimension of access to well functioning formal financial systems is critical in influencing sale volume of milk per day per dairy household.

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