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| **Milk Value Chain Analysis in North Mecha Woreda of Amhara Region, Ethiopia** |  |
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|  |  | **ABSTRACT** |
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| **Received:** February 20, 2024**Revised:** May 30, 2024**Accepted:** June 21, 2024**Available online:** June 30, 2024 |  | *Ethiopia is the country that has benefited less compared with its potential of dairy production. Thus, milk value chain analysis is crucial and prior process for value chain development in dairy sector. This study was conducted in Mecha woreda with the general objective of analyzing cow milk value chain. Rapid market appraisal (RMA), key informants interview, focus group discussions (FGD) and survey were employed to collect both quantitative and qualitative data. The data were collected from primary data sources (200 milk producers, 35 traders, five supermarkets, ten hotels and ten cafes and restaurants, three dairy cooperatives, two milk processors, and 60 consumers). Milk producers were selected using systematic random sampling techniques. Traders, supermarkets, hotels and cafes, restaurants and consumers were sampled using snowball sampling method while all dairy cooperatives and milk processors were included for interview. Descriptive analysis and value chain analysis were used to analyze data. Milk producers, dairy cooperatives, milk processors, supermarkets and hotels, butter traders, cafes and restaurants and consumers are key value chain actors. Raw milk market access may suppress the traditional milk process and products. Milk producers had the highest share (65.07%) while cafes and restaurants had the least share (0.82%) of consumer price. The higher percentage of value addition was recorded by milk producers and processors. The type of value chain governance was predominantly captive type. Semi-process and product upgrading were the main upgrading types. I*mproved forage delivery, and strengthening improved breed program services, *strengthening and forming of dairy cooperatives, upgrading milk and traditional milk products, transforming captive governance to market governance, offering improved processing technology, and further research on value addition techniques and traditional milk products need to be considered to improve the milk value chain development.*   |
| **Keywords**: *Cow milk, value addition, Mecha woreda, Ethiopia* |  |

1. **INTRODUCTION**

The dairy industry is a critical component of the agricultural sector worldwide, contributing significantly to food security, nutrition, and rural livelihoods. In Ethiopia, dairy production represents one of the most promising development opportunities within agriculture. The country boasts over 20 million dairy animals, accounting for 31.13% of the total cattle population, and annually produces 3.87 billion liters of milk with an average yield of 1.45 liters per cow per day (CSA, 2022). The dairy sector is recognized for its vital role in supporting the national economy, providing employment, and enhancing food and nutrition security for smallholder dairy producers and the country at large (FAO, 2018).

The Amhara National Regional State is one of the Ethiopia’s foremost milk-producing regions, second only to the Oromia Region. The Region contributes 22.2% of the country’s milking cow population and produces over 692 million liters of milk annually, representing 17.9% of the national milk volume (CSA, 2022). North Mecha woreda in the West Gojjam Zone stands out as a significant milk-producing woreda in Amhara region. North Mecha woreda alone is home to 37,347 milking cows, yielding more than 22 million liters of milk per year (Mecha Woreda Livestock Development Office, 2019).

Smallholder milk producers in this area have a long-standing tradition of processing milk into various products such as butter, ghee, ergo (yogurt), ayib (cottage cheese), metata-ayib (fermented and spiced cheese), ititu (fermented cow milk) and buttermilk (arera). Fresh milk, butter, ergo (yogurt), cottage cheese (ayib) and buttermilk are commonly marketed dairy products (Azage et al., 2013; Alganesh and Yetenayet, 2017). Despite this rich tradition, the demand for milk and milk products often necessitates imports. Unlike countries like India, which have successfully improved and commercialized indigenous milk products (Chawla et al., 2009; Prasad et al., 2017), Ethiopia faces significant challenges in enhancing milk product quality, promotion, and processing technologies (Frew & Getnet, 2013; Mengistu et al., 2016).

The dairy value chain in Ethiopia, particularly in regions like Amhara, is fraught

with challenges that hinder its efficiency and competitiveness. Low milk quality, inadequate promotion of milk products, and underdeveloped processing technologies are primary constraints. Addressing these issues requires a comprehensive analysis of the value chain, focusing on both formal and informal segments. Inadequate infrastructure, limited access to modern technologies, and insufficient market linkages further exacerbate these challenges, leading to inefficiencies and losses at various stages of the value chain. While numerous studies have examined cow milk production, processing, and utilization in Ethiopia and the Amhara region (Yitaye et al., 2009; Eyassu & Asaminew,2014; Shewangzaw et al., 2016; Ayalew, 2017), these often concentrate on the formal value chain. Critical aspects such as value chain governance and upgrading are insufficiently explored. There is a notable gap in research that comprehensively covers both the formal and informal milk value chains in North Mecha woreda. This lack of comprehensive analysis impedes the formulation of effective strategies to enhance the sector's performance.

This study aims to fill this knowledge gap by providing a detailed value chain analysis of milk in North Mecha woreda. The specific objectives are to identify value chain actors, their roles, and linkages, and to map the value chain of cow milk; to analyse the marketing performance of the milk value chain; and to assess upgrading and governance issues within the milk value chain. By addressing these objectives, the study seeks to offer valuable insights for decision-makers and stakeholders involved in the dairy industry, ultimately contributing to the enhancement of the sector's efficiency, competitiveness, and sustainability. These insights will support the development of targeted interventions to improve productivity, market access, and value addition, thereby fostering the growth and resilience of the dairy industry in Ethiopia.

1. **MATERIALS AND METHODS**
	1. **Description of the Study Area**

This research was conducted in North Mecha Woreda, which is located 30 km south-west of Bahir Dar city and 524 km north-west of Addis Ababa. Geographically, the woreda is located at a latitude of 11°29'59.99" North and a longitude of 37°00'0.00" East (satellite map result). North Mecha woreda comprises 40 rural and 3 urban kebeles (Figure 1). According to the projected population size of 2020, the Woreda has total population of 365,127, with 184, 2245 males and 180,882 females. Covering an area of 112,438 hectares, the Woreda includes various land uses: 12,677.19 hectares of cultivated land, 12,818.98 hectares of grazing land, 2,156.6 hectares of bush land, 4,120.6 hectares of settlement land, 6,670.98 hectares of natural forest, and 2,592 hectares of plantation forest. The woreda supports a substantial dairy population, with approximately 6,570 crossbreed dairy cows and 114,722 local breed dairy cows. Of the 37,347 lactating cows, 4.77% are crossbreeds (Yeshiwas et al., 2020).



 **Quolela**

**Figure 1: Location of study area, 2019;**

* 1. **Data Types, Sources and Methods of Data Collection**

This study employed a cross-sectional design incorporating both quantitative and qualitative data. Data were collected from primary and secondary sources using formal survey methods. Pretested structured questionnaires were utilized to gather data from sampled value chain actors. Rapid market appraisals were made on dairy products markets, dairy cooperatives, and milk processing centers at Bahir Dar city and Merawi town to understand the production and marketing systems. Two focus group discussions were held with 12 milk producers on randomly selected of two kebeles to understand milk production. Key informant interviews were held with 15 experts to understand input supply, production, and marketing of milk products and with 5 women milk producers to understand traditional milk processing in the area.

* 1. **Sampling Procedures and Sample Size Determination**

The sample size for milk producers was determined using the same methodology as described in our previous research (Yeshiwas et al., 2020). Specifically, about 200 milk producers of total sample size was determined using Yamane formula, as detailed in the prior study. Due to absence of complete lists, snowball method was used to select of milk value chain actors except producers. About 35 butter traders (25 assemblers and 10 retailers), ten hotels, ten cafes and restaurants, five supermarkets of Bahir Dar city, 3 dairy cooperatives (Tebabiren, Ediget and Bachima dairy cooperatives of North Mecha woreda), 2 milk processors and 60 milk consumers were interviewed using checklists.

* 1. **Methods of Data Analysis**

***Descriptive analysis and value chain analysis***

The collected data were analyzed using descriptive such as mean, ratio, percentage, standard deviation. The dairy sector value chain is so complex that using a generic linear flow chart mapping method may mislead the general representation value chain activities, actors and linkages. Value chain mapping as grid chart illustrates the different market channels within a dairy sector. Thus, milk value chain in the study area included both formal and informal channels.

A value chain analysis approach developed by Kaplinsky & Morris (2001) was employed in this study. First, value chain mapped the core functions, main actors and value chain supporting actors in milk value chain. Second, market margin and profit margin analyses were used to examine and determine the benefiters in milk value chain using the formulas written below this paragraph. Third, assessment of milk value chain governance was conducted to identify the governance structure among the five types of governance (market, modular, relational, captive and hierarchy value chain governance) and then select appropriate interventions and leverage points for policy initiatives (Gereffi, 2009). Finally, the five categories of upgrading (process, product, functional, intra- sectorial and inter-sectorial upgrading) were assessed to examine the role of upgrading and identify the upgrading strategies executed by each value chain actors (Dunn, 2005; Springer, 2008; Webber & Labaste, 2010).

The average volume of fresh whole milk required to produce one kilogram of butter ranges 16.5 to 18.1 liters (Behanu et al., 2014; Eyassu & Asaminew, 2014). Thus average, 17.3 liters of milk for 1 kg of butter was used as conversion factor to calculate the amount of milk value added. About 10 liters of milk are required to produce one kg of cheese (<https://www.beemstercheese.com>). The price of raw milk, butter, cheese and yogurt is collected form each value chain actors. The values of all milk and milk products are expressed in terms of fluid milk. For instance, the average price of 1kg of butter was 200 birr means the price of 17.3 litter of milk was 200 Birr. The same procedures were conducted for other milk products.

***Marketing performance analysis***

Marketing margin was calculated by taking the difference between producers and traders’ prices. The producers’ share was calculated mathematically as, the ratio of producers’ price to consumers’ price; which can be expressed as:

$Ps=\frac{Pp}{Cp}=1-\frac{MM}{CP} (2)$

Where PS is Producer’s share, $Pp$ is Producer’s price, $CP$ is Consumer price and $MM$ is marketing margin.

Total gross marketing margin was calculated by the following formula (**Mendoza, 1995)**.

$$TGMM=\frac{End buyer price-First seller price}{End buyer price }x100 (3)$$

Where TGMM is total gross marketing margin

$$GMMPS=\frac{End buyer price-Marketing gross margin}{End buyer price }x100 (4)$$

Where GMMPS=Gross marketing margin of producers

According to Springer (2017), the value created by each value chain actor at each value chain stage can be measured by value added. The list of intermediate costs and value of inputs and services were identified along milk value chain before calculating value addition.

$$Value added =VG – VINTP – VOINSER (5)$$

Where $VG$ is the value (revenue) generated by selling milk and or milk products; $VINTP is $value of intermediate product that is the value of product that is going to be input for next product and $VOINSER$ is value of other inputs and services which are costs of using input and service to produce end product, it can be energy or operation machines.

***Definition of terms***

**Dairy product:** A dairy product is a food product made from the milk of mammals, specifically cows. Common dairy products include milk, cheese, yogurt, butter, and ice cream (National Dairy Council, 2021).

**Market chain: T**he market chain refers to the sequence of stages through which a product passes from the producer to the final consumer.

**Value chain:** It refers to the full range of activities which are required to bring a product or service from conception, delivery to final consumers, and final disposal after use (Kaplinsky & Morris, 2000). Value chain is the series of internal departments that carry out value-creating activities to design, produce, market and support a firm’s products (Gary & Kotler, 2012).

**Formal milk market channel:** It is a route through which smallholder dairy farmers deliver their milk directly to dairy cooperatives which buy milk from producers and subsequently sell to milk processors.

**Informal milk market channel:** It involves the direct sale of raw milk by the farmer to the consumer or via vendors who later trade them to consumers.

**Value addition:** Value addition of a product is a process of changing its current place, time and form from one set of characteristics to other characteristics that are more preferred in the marketplace (Boland *et al.,* 2009).

**Value chain governance:** Governance refers to the power relationships, the role of coordination and roles of identifying profitable opportunities and roles of key players in the value chain. Value chains imply the linkage interactions of actors while governance ensures that interactions between actors along a value chain reflect organization (not randomness) (Kaplinsky & Morris, 2000).

**Value chain upgrading:** Upgrading involves the improvements in quality and product design and or diversification in the product lines served, allowing the producers to gain higher value (Department for International Development, 2008).

1. **RESULTS AND DISCUSSIONS**
	1. **Descriptive Results**

***Demographic and socio-economic characteristics of sampled milk producers***

The results of demographic and socio-economic characteristics of milk producers in this research are the same as described in our previous publication (Yeshiwas et al., 2020). The results indicate that a significant majority of the sampled milk producers were male-headed (92.5%), married (90%), and engaged in crop production (68.8%). In terms of land use, about 57% and 29% of household land was allocated for crop production and Eucalyptus tree plantation, respectively, with the remaining 14.2% designated as grazing land. On average, respondents owned 1.44 hectares of land per farmer, which exceeds the Amhara region average of 1.3 hectares (Ethiopian Statistical Service and World Bank, 2023). Each household typically held about 2 lactating cows and had a TLU of 5 on average (Yeshiwas et al., 2020).

* 1. ***Milk Value Chain Analysis***

The value chain map shows that under input supply stage livestock feed were supplied by traders, dairy cooperatives and agricultural unions. Private and government veterinary clinics supplied veterinary drugs to producers. Improved dairy breeds were supplied to producers by bureau of agriculture and Andassa Livestock Research Center. Milk producers supplied 53.7% of milk to formal milk market channel through cooperative and the remaining 46.3% of milk was delivered to informal market channel. Dairy cooperatives supplied 82.87% of its purchased milk to milk processors while 7.26%, 2.61% and 7.26% of milk was supplied directly to consumers in the form of fresh milk, boiled milk and butter and cheese respectively. Milk processors supplied all its products (cream, butter and cheese) to hotels and supermarket which in turn supplied it to consumers. Milk producers sold 3.5% and 1.7% to consumers and cafes and restaurants respectively in the form of fresh milk in informal market channel. They also sold 15.7% of milk to consumers by processing and producing butter, ghee and metata ayibe. The remaining 25.4% of milk was sold to butter assemblers in the form butter. Butter assemblers sold all portion of its butter to retailers and then retailers sold it to consumers. Consumers received the largest portion of milk (44.5%) from hotels and supermarkets and they received 25.4% of milk from assemblers.

* 1. **Milk value chain core functions, actors, value adding activities and linkages**

*Dairy inputs supplying*

Essential farm inputs such as feed, water, improved breeds, and veterinary drugs are crucial for the sustainability and productivity of the dairy industry. Smallholder milk producers typically source their dairy feed either from their own resources or through purchases. During periods of feed scarcity, neighboring farmers are the primary suppliers of hay and crop residues to these milk producers. The availability of improved forage remains limited; however, the Woreda Agricultural Office has been providing improved forage seeds, including Rhodes grass seeds and elephant grass seedlings, to farmers. This initiative aims to enhance the quality and availability of feed. Additionally, the production of local beverages is a prevalent practice in the area. By-products from local brewing, specifically from the production of Areki (a traditional alcoholic beverage), are commonly sold by local brewers to neighboring farmers. These by-products, known locally as “brint,” serve as an additional feed resource for dairy producers.

Input dealers and agricultural unions, such as the Merkeb Union and Damot Union, play a significant role in supplying agro-industrial byproducts. These byproducts include wheat and maize bran, concentrate, soybean bran, and nug cake, which are essential for dairy feed. Among the sampled milk-producing households, about 89% utilized these types of feed to varying degrees. Despite the contributions of these unions, the current supply does not meet the demand, compelling dairy producers to purchase feed from private feed traders. This situation often forces producers to buy without adequate verification and assurance of feed quality, posing potential risks to the health and productivity of their livestock. In addition, about 29.5% of milk producers accessed improved forage seed from research centers, NGOS (SNV, LIVES, and CASCAPE) and livestock development office.

Milk producers obtain water for their dairy farms from various sources, including rivers, wells, and pipelines. In urban areas, the urban water resource development office is responsible for supplying piped water. In contrast, rural areas rely more heavily on natural sources such as rivers and wells. In this study, approximately 58% of the sampled milk producers used their own well water sources to meet the needs of their cattle. This highlights the significant reliance on personal wells for water in rural dairy farming operations.

Enhancing the genetic potential of local cows through breed improvement is critical for increasing milk productivity. The government actively promotes artificial insemination (AI) services to achieve this goal, while farmers also use natural mating with improved bulls to enhance their breed stock and productivity. In North Mecha Woreda, the Animal Resource and Development Office facilitates the distribution of exotic semen from a centralized semen collection center to provide AI services to milk producers. Additionally, farmers augment their herds by purchasing exotic dairy calves from neighboring dairy producers, further improving the quality and productivity of their livestock. About 9% and 44% of the respondents accessed the bull and AI services respectively while the remaining proportion of milk producers used bull mating which is available in their local.

Veterinary services are crucial for maintaining the health and productivity of dairy cows. These services include the provision of veterinary drugs, which are supplied by both government and private veterinary clinics established in each kebele. In this study, 42% of the sampled milk producers reported obtaining veterinary drugs and health services from private veterinary pharmacies and clinics. This indicates a significant reliance on private veterinary care among dairy farmers, complementing the support provided by government services.

#### Diary production

The dairy production system of the study area is pre-urban which resembles with attributes adapted by Solomon *et al*. (2016) for characterize dairy production system. The average milk productivity in the study area was 2.3 ±0.97 liters per local cow per day whereas the average productivity of cross breed was about 5.9±2.4 litters. The finding of the average cross bred cow milk productivity was less by 2.1 litters compared with national minimum average milk yield of crossbred cow (8 litters) while the local cow milk productivity is similar with that of national average milk yield of a local cow (1.8 to 2.7 litters) (Gezu & Zelalem, 2018). The survey result indicated that the daily average milk produced by a household was about 6.8 litters. Of the total milk produced 87% of it was covered by cross dairy cows and the remaining portion of milk was produced from local cows. None of the milk producers who kept only local dairy cows participated in the raw milk marketing. About 47.2% and 32.9% of total daily milk sold in raw milk and processed forms respectively while 19.9% consumed home.

The value chain actors at this stage are primarily small-scale milk producers. These producers engage in key activities such as dairy cow husbandry, feeding, breeding, and milking. They typically use traditional semi-indoor housing systems for crossbreed cows and outdoor housing systems for local breed cows. At night, all cattle are housed in corrugated structures. In over 75% of the sample respondents, dairy houses were not separated from human residences, a deliberate measure to protect against theft. The feeding systems and allocation of feed by milk producers depend on the economic value of the livestock breed and the purpose of production. Crop-based, market-oriented farmers tend to feed their oxen better than dairy cows, whereas dairy production-oriented farmers prioritize feeding their dairy cows. Raw milk market is shifting the gender function of dairy husbandry practices in this area. Previously, women were loaded with dairy production activities. Currently, understanding the livelihood support of milk, men elders and youths are also participating in cleaning the dairy house, milking, keeping, feeding and marketing raw milk.

Local lactating dairy cows are commonly kept on pasture lands and fed hay and crop residues when they return from grazing in the evening. More than 92% of respondents use a stall feeding system for dairy production, while about 6% use a semi-grazing feeding system. This aligns with the characteristics of urban and peri-urban dairy production, where milk producers have limited access to grazing land and therefore purchase industrial by-products and feed to use at home. This finding is consistent with the research of Solomon et al. (2016).

Bull mating (natural mating) was the dominant reproduction mechanism among the study respondents. The sources of crossbreed stock held by households were bull mating, artificial insemination (AI), and the local market, accounting for 36.6%, 30.7%, and 32.7% respectively. Farmers used to prefer AI services to natural mating due to its lower cost and reduced physical strain on the cow. However, farmers have increasingly resorted to natural bull services after observing that locally available AI services were less effective and sometimes inaccessible.

* 1. **Milk collection and handling practices**

In the study area, milk producers take their milk-to-milk collection centers. The three dairy cooperatives serve as the sole milk collection centers, acting as a bridge between producers and processors. Tebabiren and Ediget dairy cooperatives collected 1167 and 217 litters of milk per day on average respectively. These two dairy cooperatives collected 67.7% and 65.9% of milk with respect to its capacity while Bachima dairy cooperative collected only 151 litters of milk per day. These cooperatives conduct milk quality tests (alcoholic and fat content tests) on the milk supplied by producers. The milk is transported to the cooperative compound using large aluminum milk containers, and then transferred into milk cooler tankers to be sold to milk processors.

* 1. **Milk processing and milk products**

While the primary function of processing typically pertains to milk processors, in the study area, both milk producers and milk cooperatives were involved in processing activities. Two distinct methods of milk processing were identified: traditional and modern. In traditional milk processing, women smallholder milk producers utilized indigenous knowledge and skills to transform milk into various products. These producers engaged in primary processing to create yogurt, butter, and cheese. Further processing of butter and cheese yielded ghee (4.04 kg per year per household on average) and a traditional fermented cottage cheese known as metata-ayib (6.49 kg per year per household on average), respectively. Conversely, milk processors and dairy cooperatives employed advanced technology for milk processing. For instance, Emebet and her children, operating a dairy processing unit in Bahir Dar city, primarily produced cheeses such as Mozzarella and Provolone, along with butter and a small quantity of cream. Similarly, Getu milk processor in Addis Ababa specialized in the production of butter, cheese, and pasteurized milk.

* 1. **Milk products marketing**

Raw milk is marketed daily, both in the morning and evening, throughout the year. Producers mainly sell butter on the weekly market days, which are Saturday and Wednesday, while ghee and metata-ayib are primarily marketed during Christian holidays such as Christmas and Easter. Approximately 62% of raw milk market participants deliver their products using human labor, while 38% use bicycles. In contrast, butter, ghee, and metata-ayib are transported exclusively by human labor (Figure 2).

Milk is sold either through informal contracts or daily trading. In informal contracts, buyers and sellers agree on a predetermined price for milk delivery over a month. Butter, ghee, and metata-ayib are traded for immediate delivery. Unlike raw milk, ghee and metata-ayib lack standardized measurements during transactions, with cups being used instead. Melted and filtered ghee incurs higher production costs than non-melted ghee. Consequently, producers typically sell non-melted ghee, as the buyers are often unaware of the product quality.

Milk cooperatives handle raw milk collected from both member and non-member producers. The purchasing price of milk from non-members was the same as members and the payment was made with similar modality of members. The difference was non-member milk producers couldn’t get membership benefits like dividends, discount concentrate sale, and other material supports coming from projects. Milk processors collect the milk using their transport, ensuring quality testing upon collection. Typically, milk cooperatives and processors sign six-month contracts, with payments made monthly after delivery. Dairy cooperatives occasionally negotiate contract modifications with milk processors if producers raise concerns about milk prices.

53.7%

100%

1.4%

44.5%

100%

100%

100%

 **46.3%**

100%

100%

100%

100%

100%

**IV**

**IV**

Boiled milk

  **Feed**

-private traders

Cooperatives

-Merkeb union

-Damot union

**Veterinary drug**

-Private clinic

-Government

**Improved breed**

-ALRC

-BOA

15.7 %

82.87%

**III**

 **I**

**III**

 **II**

**I**

1.7%

25.4%

3.5%

7.26%

2.61%

7.26%

Production

Feeding

Breeding Milking

Collection

Collecting, cooling/ storing, quality test

Processing, fumigating, churning

Distribution, Transporting

Producers

32895.34

Litters/month

Cooperatives

Butter

Fresh milk

Processors (cream, butter & cheese)

Hotels and supermarkets

Butter, ghee and *metata-ayib*

Fresh milk

Assemblers

Retailer

**Value chain supporting and enabling functions**

* Rules and regulations, policy and strategy, auditing and advisory, training, research, Extension, breeding services (Private and gov’t AI, Bull services) and veterinary service

Input provision

Input providers

Consumption

Consuming

Cafes and restaurant

Butter& cheese

Boiled milk

Consumers

**II**

NB.

Percentage numbers outlined by the rectangles along the rows shows the proportion from the side of the buyers whereas non-outlined percentage numbers indicated the proportion of milk from the side of sellers.

ALRC= Andassa Livestock

 Research Center

BOA= Bureau of Agriculture

 = Flow of money in ETB (Ethiopian birr) per litter of milk.

= Formal milk value chain

=Informal milk value chain

1.7%

25.4%

100%

100%

15.7%

3.5%

3.9%

3.9%

14

16.2

13

11.5

26.5

24.3

14

13.4

15.2

13.4

15.84

g

16.4

14.4

15

18

24

Fresh milk

**Figure** 2: Milk value chain map in Mecha milk shed area

In addition to raw milk, dairy cooperatives sell various products on-site, including boiled milk, butter, yogurt, and cheese, catering to local consumers. Milk processors distribute their products, such as Provolone and Mozzarella, to hotels and supermarkets mainly through an ordering system. These products reach regional markets in Gonder and Bahirdar, as well as the central market in Addis Ababa. In Bahir Dar city, five supermarkets sold these milk products.

In general, five market channels were identified in milk value chain. The first channel (the sum of channel I, II and III in formal channel) is the channel that producers sold fresh milk to cooperatives and then cooperatives sold directly to consumers in the form of raw milk, boiled milk, butter and cheese at milk collection center. The large volume of milk flows in the second channel on which cooperatives sold to milk processors. Then processors sold their products to hotels and supermarkets of Bahir Dar, Gonder, and Adiss Abeba. Channel III is the sum of channel I and II (see value chain map of informal channels) on which milk and milk products delivered from milk producers to consumes. About 1,151.3 litters of fresh milk and 5,164.6 litters of processed milk (298.5 kg butter and 516.5 kg of cheese) were delivered to local consumers in this channel per month. In channel IV, producers sold processed 8355.4 litters of milk (483 kg of butter) to butter assemblers who sold it to retailers of Bahir Dar city and Merawi town. Channel V is the channel that producers sold fresh milk to Merawi town cafes and restaurants who sold it consumers in the form of boiled milk (Figure 2 and Figure 3).

2998.3 (17.13%)

14638.4 (100%)

14638.4

 (100%)

14638.4 (82.87%)

8355.4

(100%)

8355.4

(100%)

Hotels and supermarkets

Cafes and restaurants

Producers

8355.4

(25.4%)

559.2 (1.7%)

 I

Producers

Producers

Consumers

 IV

Producers

Consumers

Cooperatives

III

Assemblers

Producers

 II

Consumers

Retailers

Consumers

 V

3026.4

(9.2%)

14638.4

 (44.5%)

 6315.9

 (19.2%)

Processors

Cooperatives

Consumers

559.2 100%

**Figure 3:** Milk market channels with volume of milk in litter per month

**Milk and milk products consumption**

Milk producers not only supply their products to the market but also retain a portion for household consumption. Among the milk consumed by producer households, approximately 19.9% is utilized domestically. This consumption is divided into raw milk (27.8%), yogurt (31.5%), and other processed dairy products (40.7%). In urban areas, purchasing raw milk directly from producers is a common practice, especially for families with babies who require fresh milk. Additionally, young people often consume boiled milk from snack houses and cafes. Female consumers typically purchase fresh butter for personal care, such as creaming their head and hair. However, urban consumers generally exhibit low levels of purchasing yogurt, *metata-ayib*, and ghee. This reluctance is primarily due to concerns about the quality and additives in these milk products.

* 1. **Milk and milk products loss and disposal**

Due to the small-scale nature of milk production, significant milk loss was not observed at the farm level. Producers often processed surplus milk to add value and for home consumption. Among the by-products of milk, whey was the least consumed. Whey is prone to rapid fermentation and acidification, making it less desirable for household consumption. Consequently, households did not consume all the whey produced, and more than 85% of the whey from cross-breed cows was fed to pets such as cats and dogs. In milk processing centers, whey is typically discarded after processing. In the study area, whey was often regarded as a waste product generated during butter production. However, whey contains valuable proteins—whey protein and casein—which are beneficial as supplementary food to reduce chronic fatigue and boost immunity against viral infections (Solak & Akin, 2012). Some milk producers use whey as supplementary feed for their dairy cows. For example, Shewy (2016) highlighted that the nutritive value of one ton of fresh liquid whey for dairy cows is equivalent to 71 kg of barley grain.

* 1. **Milk value chain supporting activities and enablers**

Credit and Savings Services: The Amhara Credit and Saving Institution (ACSI) is the primary credit provider in the study area, but its services for livestock production are limited. Over 86% of the respondents reported not having access to credit for milk and dairy production activities. Factors such as fear of risk, high interest rates, and mortgage requirements deterred dairy producers from borrowing. Veterinary Services: Both private and government veterinary clinics offer veterinary services and medications. Among the respondents, 58% preferred government veterinary services, citing them as cost-effective, reliable, and of high quality. The remaining 42% favored private veterinary services due to their availability and the convenience of door-to-door service provided by private veterinarians.

Training and Extension Services: Several organizations, including the Woreda Agricultural Office, Livestock Research Institutes (e.g., Andassa Livestock Research Center, ALRC), the Livestock and Irrigation Value Chains for Ethiopian Smallholders (LIVES) project, and Bahir Dar University, provided training on forage development and feeding practices for dairy producers. Approximately 48% of the sample dairy producers participated in training sessions related to dairy production. Topics covered included milk hygiene, quality, and market management, with training provided by the livestock agency, the Livestock Market Development (LMD) project, the Feed the Future project, livestock research centers, and the Amhara Agriculture Bureau. Members of milk cooperatives had greater opportunities for visiting model dairy farms and experience sharing compared to non-members.

Improved Breed Suppliers: The Woreda Agricultural Office offered Artificial Insemination (AI) services to milk producers. The Andassa Livestock Research Center (ALRC) introduced improved bull breeds and provided village-based bull services along with improved forage seeds. Additionally, the center distributed improved heifers to farmers' research and extension groups (FREGs). Private AI technicians also provided AI services. Basic improved forage seeds were supplied by research centers (e.g., Andassa Livestock Research Center), universities (e.g., Bahir Dar University), projects, and NGOs (e.g., LIVES, LMD).

Regulatory Services: The Woreda Trade and Transport Office was responsible for regulatory services in the milk and milk products market. However, the butter market remains underdeveloped, and the trade office's activities in market development for milk and milk products are limited. There is no quality control for milk products. In informal market channels, raw milk is distributed without any quality testing, and milk that fails quality tests in cooperatives is sometimes sold without disclosing this information. There is a lack of milk quality inspection and enforcement mechanisms in the area.

* 1. **Milk marketing performance**

The marginal analysis result shows that milk producers had the highest price and market shares in each market channels and chain. They shared marketing margin of 88.16, 50.57, 100, 70.99 and 58.33% in channel I, II, III, IV and V respectively. This result resembles with the study conducted by Jemal (2017). Similarly, milk producers had the highest marketing margin (65.07%) and profit margin (73.65%) along the value chain which is similar with the result of Woldemichael (2008) who indicated milk producers earned the highest profit among value chain actors. Milk producers had high consumer price share, in particular margins in informal milk market channel (III, IV and V) which rise up producers’ consumer price share in milk value chain.

Market margin analysis depends on the length of the market chain and the number of intermediaries involved. When intermediaries are less in value chain of agricultural commodity, producers’ share of consumer can be high (FAO, 1993; Kumar, V. *et al*., 2017). Milk cooperatives played the roles in decreasing transaction cost of raw milk producers by serving as bridge between sellers and end buyers in channel I and II. So that milk producers had highest profit margin in the chain. Unlike margins in channels, margins of actors in milk chain are influenced by overall volume of milk. Small scale milk producers are larger in number than other actors, lower number of milk and milk product buyers or traders with lower volume of purchase. Thus, price share of producers became high. Other milk market actors, cooperatives, milk processors, hotels and supermarkets, assemblers, retailers, and cafes and restaurants shared the consumer price by 2.05, 21.75, 4.65, 1.80, 3.86 and 0.82% respectively. Unlike the finding of Sosina (2016), cafes shared the lowest volume of milk and consumer price. The result indicates that low interventions of intermediaries in milk value chain make highest percentage of consumer price is shared to producers (Table 1).

Table 1: Marketing performance result in milk value chain

|  |  |  |  |
| --- | --- | --- | --- |
| Actors  |  Market Measure |  Market channels  | Along Chain |
| I | II | III | IV | V | margin  | % |
| Volume of milk in litter  | 3026.4 | 14638.4 | 6315.9 | 8355.4 | 559.2 |  |  |
| Milk producers  | Selling price(ETB)  | 13.4 | 13.4 | 17.5 | 11.5 | 14 |  |  |
| Production cost  | 6.79 | 6.79 | 9.8 | 4.7 | 7.1 |  |  |
| Marketing cost  | 1.71 | 1.71 | 1.2 | 1.2 | 2.5 |  |  |
| Cooperatives  | Market margin | 1.8 | 0.6 |   |   |   | 0.43 | 2.05 |
| Profit margin  | 1.57 | 0.5 |   |   |   | 0.37 | 1.74 |
| Milk processors | Market margin |  | 10.3 |   |   |   | 4.58 | 21.75 |
| Profit margin  |  | 8.09 |   |   |   | 3.60 | 17.08 |
| Hotels & supermarkets | Market margin |  | 2.2 |   |   |   | 0.98 | 4.65 |
| Profit margin  |  | 1.06 |   |   |   | 0.47 | 2.23 |
| Assemblers | Market margin |  |   |   | 1.5 |   | 0.38 | 1.80 |
| Profit margin  |  |   |   | 1 |   | 0.25 | 1.20 |
| Retailers | Market margin |  |   |   | 3.2 |   | 0.81 | 3.86 |
| Profit margin  |  |   |   | 2.9 |   | 0.74 | 3.50 |
| Cafes & restaurants | Market margin |  |   |   |   | 10 | 0.17 | 0.82 |
| Profit margin  |  |   |   |   | 7.39 | 0.13 | 0.62 |
| Total gross market margin  | 1.8 | 13.1 | 0 | 4.7 | 10 | 7.36 | - |
| Total profit margin  | 1.57 | 9.64 | 0 | 3.9 | 7.39 | 5.55 | - |
| Total gross market margin in % | 11.84 | 49.43 | 0 | 29.01 | 41.67 | 34.93 | 34.93 |
| Total profit margin in % | 10.35 | 36.40 | 0 | 24.07 | 30.79 | 26.35 | 26.35 |
| Producers’ market margin % | 88.16 | 50.57 | 100 | 70.99 | 58.33 | 65.07 | 65.07 |
| Producers’ profit margin % | 89.65 | 63.60 | 100 | 75.93 | 69.21 | 73.65 | 73.65 |

Source: Own computation result, 2019

**Value addition**

As detailed in Table 2, the milk value chain within the study area generated a total monthly income of 355,578.2 Birr, equating to 3.66 Birr per liter of milk. The formal milk value chain (Channels I and II) contributed approximately 71% of this total value, while the informal milk value chain accounted for the remaining 29%. Within the value chain, milk producers and processors were responsible for 41% and 38% of the total value addition, respectively. This translated to value additions of 9.1 Birr per liter by producers and 8.7 Birr per liter by processors. On the other hand, retailers and cafes and restaurants shared the least value addition in the chain. Milk producers, processors and cafes and restaurants added the value of 4.5, 9.1 and 8.7 birr per litter of milk along the value chain but cafes and restaurants added the least value in the chain that was due to the least volume share of milk in the chain (Table 2).

Table 2: Value addition per month in milk value chain

| **Indicators**  | **Producers**  | **Cooperatives**  | **Milk processors**  | **Hotels& supermarkets**  | **Assemblers**  | **Retailers**  | **Cafes & restaurants**  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Channel I** |  |  |  |  |  |  |  |
| Quantity of milk (Lt)  | 3026.4 | 3026.4 |  |  |  |  |  |
| Revenue (ETB/Lt) | 13.4 | 15.2 |  |  |  |  |  |
| Intermediate cost (ETB/Lt) | 8.5 | 13.5 |  |  |  |  |  |
| Value added (ETB/Lt) | 4.9 | 1.7 |  |  |  |  |  |
| **Channel II** |  |  |  |  |  |  |  |
| Quantity of milk (Lt)  | 14638.4 | 14638.4 | 14638.4 | 14638.4 |  |  |  |
| Revenue (ETB/Lt) | 13.4 | 14 | 24.3 | 26.5 |  |  |  |
| Intermediate cost (ETB/Lt) | 8.5 | 13.6 | 15.2 | 25.1 |  |  |  |
| Value added (ETB/Lt) | 4.9 | 0.4 | 9.1 | 1.5 |  |  |  |
| **Channel III**  |  |  |  |  |  |  |  |
| Quantity of milk (Lt)  | 6315.9 |  |  |  |  |  |  |
| Revenue (ETB/Lt) | 17.5 |  |  |  |  |  |  |
| Intermediate (ETB/Lt) | 9.35 |  |  |  |  |  |  |
| Value added (ETB/Lt) | 8.15 |  |  |  |  |  |  |
| **Channel IV**  |  |  |  |  |  |  |  |
| Quantity of milk (Lt)  | 8355.4 |  |  |  | 8355.4 | 8355.4 |  |
| Revenue (ETB/Lt) | 11.5 |  |  |  | 12.6 | 16.2 |  |
| Intermediate (ETB/Lt) | 11 |  |  |  | 11.5 | 12.6 |  |
| Value added (ETB/Lt) | 0.5 |  |  |  | 1.1 | 3.6 |  |
| **Channel VI** |  |  |  |  |  |  |  |
| Quantity of milk (Lt)  | 559.2 |  |  |  |  |  | 559.2  |
| Revenue (ETB/Lt) | 14 |  |  |  |  |  | 24 |
| Intermediate (ETB/Lt) | 5.9 |  |  |  |  |  | 15.3 |
| Value added (ETB/Lt) | 8.1 |  |   |  |  |  | 8.7 |
| Total milk volume (Lt) | 32895.3 | 17664.8 | 14638.4 | 14638.4 | 8355.4 | 8355.4 | 559.2 |
| Total value added (ETB) | 146739.3 | 11000.24 | 133209.4 | 20493.76 | 9190.94 | 30079.44 | 4865.04 |
| Total unit value added (ETB/Lt) | 4.5 | 0.6 | 9.1 | 1.4 | 1.1 | 3.6 | 8.7 |
| Unit value added in the chain (ETB/Lt) | 1.5 | 0.11 | 1.4 | 0.21 | 0.09 | 0.31 | 0.05 |
| value adding share (%) in the chain  | 41 | 3 | 38 | 5.7 | 2.5 | 8.5 | 1.4 |

 Source: Own computation result, 2019

Note: ETB/Lt indicates the Ethiopian birr per litter of milk.

* 1. **Value chain governance and upgrading**

***Value chain governance***

The Woreda Trade and Transport Office, acting as a regulatory body, mandated that feed traders possess professional qualifications in animal science and/or animal nutrition to enhance livestock feed quality. However, none of the input traders met this requirement.

Milk producers lacked the capacity and influence to set parameters in both formal and informal value chains, instead following the directives of more powerful market actors. This indicates that achieving the highest profit margin does not necessarily equate to market power. Robert & Gregory (2013) noted that profit margins and even economic profits are unreliable indicators of market power, as exogenous factors beyond market actors' control must also be considered. Although milk producers received informal feedback from consumers, there were no product specifications or standards for milk products marketed through the informal value chain. Raw milk that did not pass the quality checks of milk cooperatives was often sold in the informal market. Ghee and *metata-ayibe,* produced solely by smallholder producers as income sources and preservation methods, also lacked standards.

Milk producers not affiliated with cooperatives sold freely to urban consumers without facing any sanctions, whereas those in the formal value chain had to adhere to by-laws and parameters set by the cooperatives. These by-laws, established through participatory processes, included requirements such as attending regular meetings, applying individually for membership (no group memberships), owning at least one improved lactating cow, supplying a minimum of three liters of milk per delivery, and providing quality milk exclusively to the cooperative in the evening and morning. Penalties were imposed for non-compliance, such as missing meetings, delivering poor quality milk, or selling outside the cooperative. Members exhibited strong vertical coordination, minimizing the likelihood of selling milk products outside the cooperative and reducing cheating.

Milk processors were the lead firms in the milk value chain, holding dominance due to their technological expertise, capital, assets, market access, and information on value chain activities and global trends. Consequently, they managed, controlled, and coordinated most value chain roles and activities. Government parameters for the value chain were established by milk processors and disseminated to cooperatives and producers. Processors demanded organic milk with a density (creaminess) of 20-35 degrees on the lactometer scale. Producers and cooperatives relied heavily on processors to sell raw milk. While processors could reach regional and national consumers, producers and cooperatives served only a limited number of local consumers with inconsistent consumption rates due to fasting days. Processors tailored their products to meet milk demands, and supermarkets and hotels purchased milk products as needed.

Among the five types of value chain governance (market, modular, relational, captive, and hierarchy), captive value chain governance was predominant in this study. Gereffi (2005) identified transaction complexity, information codification, and suppliers’ capabilities as key determinants of value chain governance. To access large-volume buyers, milk producers faced high transaction costs and challenges in transferring information and knowledge. The lack of clear technical standards for information resulted in information asymmetry. Producers had poor market demand information, could not speculate on quantities, and lacked the technical and technological knowledge to test milk quality. Additionally, they struggled to deliver milk on time due to transport and technology deficiencies, hindering their ability to meet lead firms' requirements. This led to the application of captive value chain governance. Milk producers had limited information on quantity, price, and market locations, while other actors had better information. Small-scale producers and cooperatives depended heavily on processors, who purchased a large proportion of the milk. Suppliers faced high costs and delays in finding new customers if a processor ceased purchasing.

In the informal value chain, trust was the foundational practice between milk producers and consumers. Informal markets for ghee, *metata-ayibe*, and butter were somewhat relational, based heavily on trust, reputation, and spatial proximity.

* 1. ***Value chain upgrading***

Four types of upgrading strategies (process, product, functional, and intra-sectorial upgrading) were identified in the milk value chain within the study area, though none were fully implemented.

Process Upgrading: Farmers received enhanced cow breeding services through artificial insemination (AI) and improved forage seed supplies from research institutes and universities. Dairy cooperatives delivered concentrate feed to milk producers, reducing costs compared to individual purchases. These activities, including AI services, forage seed distribution and demonstration, and group purchasing of dairy concentrates, were part of efforts to improve milk productivity. Process upgrading involved not only milk producers but also other value chain facilitators, such as dairy cooperatives and milk processors, who provided technical advice.

Product Upgrading: Milk quality testing was a standard practice by milk cooperatives, ensuring that only quality milk was delivered through the formal value chain. Milk quality enhancement began with producers, who received training from cooperatives and NGOs. Producers adopted practices like washing cows' udders, washing hands during milking, using milking towels, and filtering milk post-milking. Among producers participating in the raw milk market, approximately 40%, 46.4%, and 60.8% washed cows' udders, used milking towels, and filtered milk, respectively. Raw milk meeting cooperative standards was processed by sophisticated technology at milk processors, such as Getu milk processor, which pasteurized milk to extend its shelf life to two to three weeks. However, only 27% of the milk delivered to processors was sold as pasteurized milk.

Functional Upgrading: Milk cooperatives processed only 9.8% of the total milk into boiled milk, butter, and cheese during surplus collections and contract terminations. Boiled milk was sold with bread to attract consumers, demonstrating an initial step towards functional upgrading. This activity reduced milk loss and directly connected the cooperative to final consumers, adding value. The cooperative engaged with two end markets: local urban dwellers (17%) and milk processors (83%), indicating both functional and channel upgrading. This strategy minimized the risk of milk loss during surplus deliveries from members.

Intra-sectorial Upgrading: The cooperative's efforts to manage surplus milk through processing and direct sales represent intra-sectorial upgrading. By engaging in both milk collection and processing, the cooperative decreased milk loss and added value, demonstrating its adaptive strategy within the value chain.

1. **CONCLUSION AND RECOMMENDATIONS**

Input suppliers (woreda agricultural office, local breweries, agricultural unions, and urban water resource development office, private and government veterinary clinics, forage dealers), small holder milk producers, dairy cooperatives, milk processors, supermarkets and hotels, butter traders, cafes and restaurants and consumers are key value chain actors in milk value chain. Milk producers which accounted 89% bought industrial byproducts for milk production which implied high demand of dairy feed in the area. Below the half percentage of milk producers accessed improved breed services; bull (9%) and AI (44%). Large proportion of milk was supplied to the market compared to that of processing and consumption. This implied milk market is playing a role in production and supplying of raw milk. On the hand as raw milk marketing is expanded milk processing; the volume as well as the skill/endogenous knowledge of making ghee and *metata-yibe* may decrease. Supportive actors, such as universities and research centers transferred knowledge on forage; milk and dairy cows’ performance but there was low advocacy and technical knowledge transfers on traditional milk processing and milk products. The marketing margin analysis result revealed that milk producers shared the highest (65.07%) of consumer price while cafes shared the lowest (0.82%) of consumer price. Similarly, producers and milk processors shared 41% and 38% of the total value added respectively. These results indicate lower interventions of intermediaries in milk value chain and the overall marketing performance in milk value chain is inefficient.

Marketing of milk by producers and cooperatives was dependent on milk processors; captive governance type was clearly observed between these actors. In informal milk value chain, relational type of governance which is dependent on trust, reputation and spatial proximity was adapted. The upgrading strategy was mainly practiced by producers, cooperatives and milk processors which aimed to escape risk of loss in dairy business. Though the value chain is found in infant upgrading, process and product upgrading were better than functional and inter-sectorial upgrading strategies. To improve efficiency and the development of dairy value chain, interventions need to be made on improved forage delivery, and strengthening improved breed program services (bull and AI). Stakeholders should intervene to empower producers and dairy cooperatives, need to pave ways to shift captive /relational type value chain governance to market governance. The government needs to enhance milk market access by increasing number of dairy cooperatives, planting milk cooling tanker, and improving road and infrastructures to encourage distant small scale milk producers for milk marketing. Further scientific investigation, verifications and promotions need to be conducted on the nutritional and medicinal properties of traditional milk products, and the government regulation mechanisms like products standardizations need to be made to improve milk products quality and to increase consumers’ confidence on the safety of these products, in addition we suggest to preserve or upgrade local knowledge of traditional milk processing.

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