Determinants of Dairy Marketing Practices in the Northwestern Zone of Tigray, Ethiopia

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Abstract:

Ethiopia possesses significant potential for dairy development, supported by its large livestock population and favorable climate for improved breeds. The Northwestern Zone of Tigray, in particular, offers high milk production capacity but remains underexplored in scholarly research. This study investigates the determinants of dairy marketing practices in the region, thereby addressing a critical gap in Ethiopian dairy scholarship. Primary data were collected from 354 dairy producers through questionnaires and semi-structured interviews. Districts and sub-districts were purposively selected based on agro-ecological suitability and milk production potential. Descriptive statistics, including percentages and frequencies, were employed to summarize the data, while multiple linear regression analysis was used to identify the major factors influencing the volume of dairy supplied to markets. The findings revealed that dairy marketing is constrained by limited storage facilities, long distances to markets, poor infrastructure, inadequate processing technologies, and weak coordination among supply chain actors. In addition, deficiencies in knowledge, skills, attitudes, and policy, largely due to insufficient training and lack of awareness creation, were identified as major barriers to effective linkages among stakeholders. Socioeconomic factors such as education, farming experience, family size, and access to credit were found to significantly influence market participation, while ownership of crossbred cows and landholding size enhanced supply. Conversely, greater distance to marketplaces reduced the volume of dairy supplied. To enhance dairy marketing, stakeholders should prioritize investments in infrastructure, storage, and processing technologies, alongside capacity-building programs and institutional strengthening. These interventions are essential to reduce post-harvest losses, stabilize supply, and improve the profitability and sustainability of dairy production in Northwestern Tigray.

Keywords: *Dairy, Dairy marketing, Dairy producers, Marketing information, North Western Tigray*

Introduction

Economic growth in developing countries largely depends on the performance of the agricultural sector. Approximately 75% of the rural poor are engaged in livestock keeping for their livelihoods; hence, livestock plays a crucial role in poverty reduction and economic growth. Ethiopia has the largest livestock population in Africa, yet its potential remains underexploited (CSA, 2019).

In tropical regions, the dairy production system is predominantly subsistence-based, characterized by low productivity, reliance on local breeds, and management under extensive grazing and uncontrolled breeding systems. Dairy products are widely produced and consumed across the world, with dairy animals milked in almost every country, and approximately 14% of the global population living on dairy farms. Dairy plays a vital role in the global food system and is particularly important for the sustainability of rural livelihoods. Moreover, milk production accounts for about 8.5–10.5% of total agricultural production value. In terms of trade, the Food and Agriculture Organization (FAO) estimates that milk and milk products including milk, cream, butter, cheese, whey, buttermilk, milk powder, yoghurt, and lactose constitute approximately 6.4% of global agricultural trade (IDF, 2013).

In Ethiopia, about 95% of milk is produced from local breeds (FAO, 2011). Abera (2018) identified the major factors affecting dairy marketing as limited market access, low milk prices compared to feed costs, transportation challenges, poor quality and perishability of dairy products, and lack of institutional support. Because dairy products are highly perishable and produced daily, fasting-induced fluctuations in consumer demand create additional challenges for commercialization (AGP-LMDP, 2013). In Ethiopia, dairy production relies largely on indigenous, unimproved livestock mainly cattle, goats, camels, and sheep with cattle contributing the largest share (65%). Despite the country's considerable potential for dairy development, the productivity of indigenous livestock genetic resources remains generally low, resulting in a limited direct contribution to the national economy (CSA, 2020/21). According to the study conducted in Bangladesh the following constraints to dairy supply were identified, these are inadequate knowledge on dairy farm management, lack of high yielding dairy animals, scarcity of feeds, fodder and pasture land, lack of organized marketing system, lack of milk preservation and quality control facilities of dairy inputs and outputs, frequent occurrence of diseases on dairy animals, absence of regulatory body and lack of coordination within relevant agencies (Anisur , Nurul and Saha, 2013).

Another study conducted by Lore, Omore and Staal (2005) estimated annual post-harvest milk losses in Tanzania (USD 9.9 million), Ethiopia (USD 14.2

million), Kenya (USD 17.8 million), and Uganda (USD 23.9 million). These losses mainly result from spillage and spoilage caused by poor handling practices, limited market access, and unstable electricity supply. Similarly, Tadesse, Girma and David (2015) reported that about 9% of total milk production is lost daily across the supply chain, due to lack of immediate buyers, long waiting times at collection centers, poor communication among actors, inadequate transportation, and poor handling practices. Furthermore, Yeshiwas, Jema, Bosena, and Simegnew (2020) examined determinants of producers' participation in the milk value chain, while Abera (2018)] explored key drivers of upgrading decisions along dairy marketing channels.

Although some studies have analyzed dairy production and value chains in Ethiopia, the determinants of dairy marketing practices remain largely unexplored. There is a critical gap in information and knowledge on this issue, particularly in the Tigray region. Therefore, this study seeks to fill this gap by examining how dairy products reach markets, identifying the key factors affecting dairy marketing, and analyzing the determinants of the volume of dairy supplied to markets.

Literature Review

Dairy Production and Marketing

Globally, dairy production reached 730 million tons of milk in 2011. The largest share came from India, USA, and China. India ranked first with 110 million tons, followed by the USA with 85 million tons, and China with 40 million tons, while Pakistan produced 34 million tons. A major challenge during milk marketing is storage, which affects producers and other actors along the value chain (Muhammed, Nazakhter and kafayat, 2014). Several studies have examined factors influencing the marketable supply of agricultural products. For instance, Zegeyesh (2016) using a multiple linear regression model, found that market information, the number of extension contacts, and dairy farming experience positively and significantly affected milk supply, while family size had a significant negative effect.

Constraints to Dairy Production and Marketing

The major constraints associated with milk production and marketing have been ranked as follows: feed and water shortages, limited access to land, prevalence of diseases, low genetic potential of local cows, and inadequate extension and veterinary services (Assaminew and Eyassu, 2009).

A study conducted in Bangladesh identified additional challenges, including inadequate knowledge of dairy farm management, scarcity of high-yielding dairy animals, shortage of feeds and pasture land, lack of an organized marketing system, absence of milk preservation and quality control facilities, frequent

occurrence of animal diseases, lack of regulatory bodies, and weak coordination among relevant agencies (Anisur et.al, 2013).

In Ethiopia, demand for dairy products fluctuates due to long fasting periods observed by Orthodox Christians, which extend for more than 200 days annually (AGP-LMDP 2013). During these periods, producers face reduced demand and lower prices. Other challenges reported include lack of reliable milk markets, shortage of feed, water scarcity, low breed performance, and shortage of grazing land (Mekonnen, 2015). Similarly, Abera (2018) found that diseases, poor nutrition, feed and water shortages, harsh climatic conditions, poor management, and inadequate animal health services constrain dairy productivity. In addition, poor infrastructure, weak market linkages, milk quality problems, shortage of storage technologies, and lack of legal enforcement of milk quality standards were recognized as critical bottlenecks in the milk value chain.

Determinants of Dairy Marketing

Access to market information: Farmers' marketing decisions are highly dependent on market price information. Farmers with better access to reliable information are more likely to supply larger volumes of dairy products to the market (CIAT, 2004).

Credit services: Credit services enable users to obtain money, goods, or services in advance of payment, based on trust that repayment will be made in the future. Although several credit sources are available to both producers and service providers, the actual use of credit remains low due to the perceived high risks associated with borrowing.

Extension services: Extension services are provided by both public and private actors, including NGOs. Private extension services are mainly offered by agro-veterinary institutions, typically owned by animal health practitioners. Information is disseminated through various approaches such as farm visits, field demonstrations, exchange visits, training sessions, and telephone consultations (Auma, Kidoido and Rao, 2017).

Distance to market: This refers to the location of dairy producers relative to the nearest market, measured in kilometers. Greater distance discourages producers from selling large volumes of products. Conversely, the closer the market is to dairy farming households, the lower the transportation costs and post-harvest losses due to handling (Nega, Teshale and Zenebe, 2015).

Education level of dairy producers: Educated farmers make better use of available information and are more likely to choose appropriate market outlets.

Farming experience: Farming experience is a continuous variable measured by the number of years a farmer has been engaged in dairy production and marketing. Farmers with longer experience accumulate knowledge of farming

practices, enabling them to adopt improved dairy technologies that enhance dairy marketing performance (Belets and Birahanu, 2014).

Family size: This is a continuous variable referring to the total number of individuals in a household. Family members contribute to major dairy farm activities such as feeding, milking, storing and preserving milk, quality control, marketing dairy, and managing animal health.

Dairy market price: This continuous independent variable, measured in Ethiopian birr, represents the actual price received per liter of milk sold through market outlets.

Crossbreed cow ownership: This is a continuous variable measured by the number of milking crossbreed cows owned by a household head. As the number of crossbreed cows increases, milk production and sales also increase.

Landholding size: Landholding size is a continuous variable measured in hectares. It represents the total land owned by the household head, excluding grazing land.

Volume of dairy supplied to the market: This is a continuous dependent variable measured in liters, representing the actual volume of dairy supplied to the market.

Methods

Study Design: - This study employed a cross-sectional survey design, combining both quantitative and qualitative approaches. The design was chosen to capture a snapshot of dairy marketing practices and their determinants at a specific point in time. Quantitative data provided measurable insights into production and marketing variables, while qualitative data enriched the analysis by capturing expert opinions and contextual factors influencing dairy commercialization.

Study Area and Target Population

The study was conducted in the Northwestern Zone of Tigray, specifically in the Asgede-Tsimbla and Tahtay Koraro districts. Tahtay Koraro has 15 sub-districts, while Asgede-Tsimbla has 13, both recognized for their high milk production and dairy sales potential. From these, 12 sub-districts (seven from Tahtay Koraro and five from Asgede-Tsimbla) were purposively selected based on their dairy production and marketing potential.The target population comprised major dairy producers in the selected sub-districts. Dairy producers were listed in collaboration with sub-district leaders to ensure accuracy and inclusiveness. Out of a total of 5,290 dairy farmers, 372 representative samples of commercial dairy producers were selected using a simple random sampling technique.

Sample Size Determination

The sample size was determined using the simplified formula by Yamane (1967).

$n = \frac{N}{1+N(0.05)2}$,

Where: (n) = sample size, (N) = population size and (e) = precision level (0.05)

Substituting values: $\frac{5290}{1+5290(0.05)2} = 372$

Thus, 372 representative samples were selected.

Table 1: Total Number and Sample of Dairy Producers

Districts	**Sub-districts/Town**	**No. of Milk Producers**	**Sampled Dairy Producers**
Tahtay-Koraro	Lemlem	679	48
	Maytimket	582	41
	Adigidad	671	47
	Belles	690	49
	Shire town	784	55
	Village Semema	475	33
	Maidimu	413	29
Asgede-Tsimbla	Endabaguna 01	124	9
	Selam	348	24
	Dedebit	165	12
	Hitsats	145	10
	Adi Mohemeday	214	15
Total		**5290**	**372**

Source: Agriculture and Rural Development Office (2020/21)

Data Collection Procedures: - Data were collected using structured questionnaires administered to sample dairy producers and semi-structured interviews conducted with dairy experts from the District Office of Agriculture and Rural Development. In addition, triangulation was applied by comparing quantitative survey results with qualitative interview findings, thereby enhancing the validity and robustness of the study outcomes.

Data Analysis:- This study employed both descriptive and inferential statistical methods. Descriptive statistics such as percentages and frequencies were used to summarize the data. Inferential statistics, specifically multiple regression

analysis, were applied to identify the determinant factors influencing the volume of dairy supplied to the market. Multiple regression analysis was used to determine the extent to which independent variables explain variations in the dependent variable. Data analysis was conducted using the Statistical Package for Social Sciences (SPSS) version 20 software.

Conceptual Framework

This study is guided by a conceptual framework, illustrated in Figure 1, which depicts the relationship between selected independent variables and the dependent variable, the volume of dairy supplied to the market. Based on an extensive review of relevant literature, the independent variables identified as most significant in the study context include educational level of dairy producers, family size, farming experience, actors' coordination, income sources, number of local and crossbreed cows, frequency of extension contact, landholding size, credit access, distance to market, access to market information, and market price. These variables are assumed to exert both positive and negative influences on dairy marketing outcomes. The framework posits that the volume of dairy supplied to the market is the cumulative result of these interacting factors. It provides a structured basis for analyzing how socioeconomic, institutional, and farm-level characteristics shape dairy commercialization in the Northwestern Zone of Tigray.

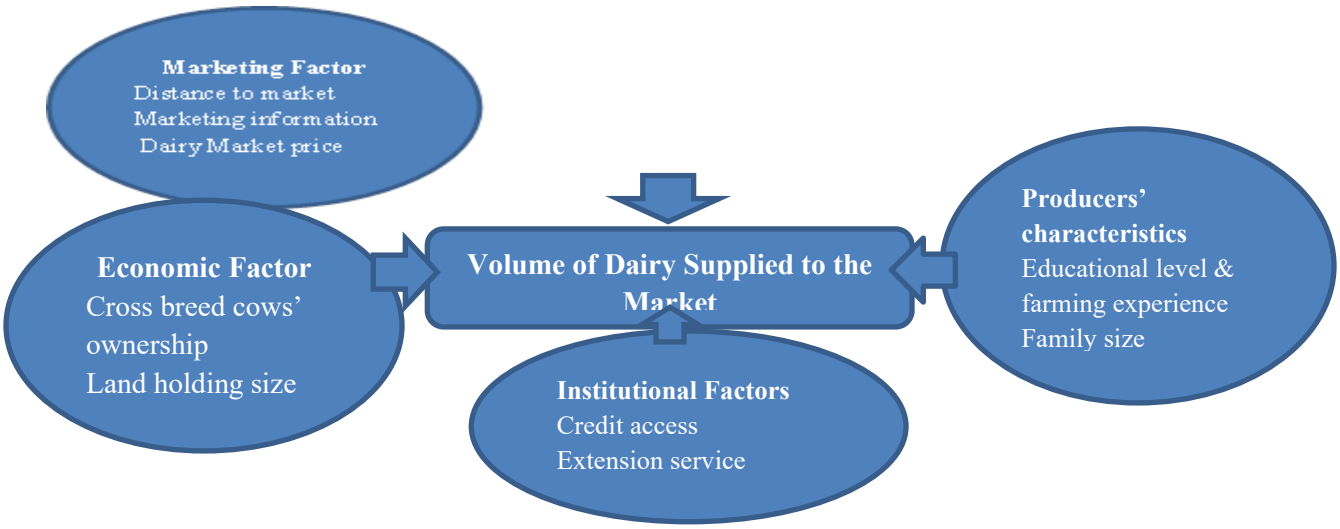

Figure 1: Conceptual Framework of the Study Source: Getachew (2015)

Descriptive Results

Educational level and farming experience

A total of 372 questionnaires were distributed to dairy producers during the survey. Of these, 354 were properly completed and returned, while 18 were rejected due to numerous omissions. Accordingly, the analysis was conducted based on the 354 valid responses.

As presented in Table 2, nearly half of the respondents (49.2%) had attained primary-level education, 26.8% had completed secondary-level education, 11% were diploma holders, 9.9% had no formal schooling, and 3.1% held a first degree. This distribution indicates that most dairy farmers were literate, which enhances their capacity to adopt and apply modern dairy production and marketing practices.

The majority of respondents (53.4%) reported having no prior knowledge of dairy farming, while 46.6% had some prior experience. This suggests that many producers entered dairy farming without foundational knowledge, which may limit production expansion, marketing efficiency, and the adoption of modern technologies.

Regarding farming experience, 45.2% of respondents had seven years or more of dairy farming experience, 39% had 5–6 years, 14.1% had 3–4 years, and only 1.7% had less than two years. Longer experience in dairy farming is likely to contribute to improved productivity, product quality, and marketing systems. In terms of family size, 46.3% of respondents had 5–6 members, 23.2% had 3–4 members, 21.5% had seven or more members, and 9% had fewer than three members. Larger households, particularly those with members of productive age, can contribute more labor to dairy production and marketing, which is labor-intensive.

With respect to dependent children, 52% of respondents had 1–2 children below seven years old, 47.2% had none, and 0.8% had three or more. This suggests that most households had relatively few dependents, allowing them to allocate more resources and labor to dairy production and marketing.

Finally, concerning family members aged 23–30 years, 58.5% of respondents had 1–2 members in this age group, 40.4% had none, and 1.1% had three or more. The presence of young adults in households is particularly important, as they can actively participate in milking, milk storage, feeding, and marketing activities. Their involvement significantly contributes to increasing the volume of dairy products supplied to the market.

Table 2 Descriptive statistics on educational level and farming experience

No	Description	Response	Frequency	Percent
1	Educational background of household head of dairy producers	No formal schooling	35	9.9
		Primary	174	49.2
		Secondary	95	26.8
		Diploma	39	11.0
		1st Degree	11	3.1
		Total	354	100.0
2	Number of years spent in school	less than 6 years	53	16.6
		6-10	194	60.8
		11-15	72	22.6
		Total	319	100.0
3	Did you have prior knowledge of dairy farming?	Yes	165	46.6
		No	189	53.4
		Total	354	100.0
4	Dairy farming experience in years:	Less than 2 years	6	1.7
		2-4 years	50	14.1
		5-6 years	138	39.0
		7 years and above	160	45.2
		Total	354	100.0

Source: Field survey result, (2020/21)

Marketing Information and Constraints

As presented in Table 3, almost all respondents (98.9%) reported having access to information on dairy product marketing, while only 1.1% lacked such information. The primary sources of marketing information were telephone communication, personal observation, and milk traders. This indicates that the majority of dairy producers are informed about market demand and pricing, which enables them to make better decisions and potentially supply larger volumes of dairy products to the market. Regarding the type of information collected, 49.4% of respondents focused on information about dairy buyers, 33.2% collected information on product prices, and 17.4% gathered information about marketplaces or trading locations. Access to such targeted information allows producers to sell their products at reasonable prices, optimize market opportunities, and increase the volume of dairy supplied to the market.

Concerning access to market price information for nearby markets, 66.4% of respondents reported having access, whereas 33.6% lacked such information.

Access to nearby market prices enables producers to compare alternative markets, make better marketing decisions, avoid exploitation by intermediaries, and ensure fair pricing for their products.

The survey also identified key constraints affecting dairy marketing. The majority of respondents (66.9%) reported difficulties in storing dairy products, 22.6% cited long distances to markets, 5.7% pointed to low product prices, and 4.8% mentioned other factors such as poor infrastructure, inadequate transportation, and weak coordination among supply chain actors. These challenges negatively affect the volume of dairy products reaching the market, thereby limiting producer income and market efficiency.

Additionally, fluctuations in dairy supply were attributed to problems with animal feed availability and price variability, as well as the long fasting season observed by Christian Orthodox followers, which reduces demand for dairy products during certain periods. According to the Agriculture and Rural Development District Office, further constraints include seasonal demand fluctuations, inconsistent price information, lack of modern dairy processing technologies, and perishability of dairy products, insufficient training, and weak linkages among marketing actors. Collectively, these factors hinder efficient dairy marketing, reduce market supply, and adversely affect the profitability and sustainability of dairy production.

Table 3 Descriptive Statistics on Marketing Information

No,	Description	Response	Frequency	Percent
1	Do you have market information for dairy products marketing?	Yes	350	98.9
		No	4	1.1
		Total	354	100.0
2	What type of information did you get?	Dairy price information	116	33.2
		Market place information	61	17.4
		Buyers' information	173	49.4
		Total	350	100
3	At what time interval did you get the information?	Daily	162	46.1
		Weekly	164	47.0
		Monthly	24	6.9
		Total	350	100
4	Did you know the nearby market price before you sold your milk	Yes	235	66.4
		No	119	33.6
		Total	354	100.0
5		Low price	20	5.7

	What marketing constraints do you face in marketing of milk and its products?	Difficult to store	237	66.9
		Long distance to the market	80	22.6
		Others	17	4.8
		Total	354	100.0

Source: Field survey result, (2020/21)

Payment and Price Determination

As indicated in Table 4, the majority of respondents (61.9%) reported receiving immediate cash payments for dairy products, while 14.4% received future payments and 23.7% received both immediate and future payments. This demonstrates that dairy producers employ different payment arrangements, with a clear preference for immediate cash. Immediate payments provide liquidity and reduce the financial risks associated with delayed transactions, thereby supporting household income stability.

Concerning the current market price of dairy products relative to past prices, 49.2% of respondents perceived prices as expensive, 46.3% considered them medium, and only 4.5% regarded them as cheap. This perception of high prices is likely linked to rising costs of animal feed, transportation, labor, and other production-related expenses. Such perceptions may influence consumer demand, producers' investment decisions, and marketing strategies.

Regarding the factors influencing dairy product prices, 53.4% of respondents identified seasonal variations as the main determinant, 10.7% cited distance from the market, 9.9% highlighted product quality, and 26% mentioned other factors such as input costs. These findings suggest that both external market conditions (seasonality and market distance) and production-related factors (quality and input costs) play critical roles in shaping dairy prices. Seasonal fluctuations, in particular, are associated with periods of low production or fasting seasons, which alter demand patterns and pricing dynamics.

With respect to price determination, 54% of respondents reported that prices were established through negotiation, 38.7% stated that producers set the prices, 6.8% indicated that retailers decided, and 0.6% mentioned other mechanisms. This highlights negotiation as the dominant method of price setting, allowing producers some flexibility to secure reasonable returns while balancing market demand and competition.

Table 4 Descriptive Statistics on Dairy Market Price

No	Description	Response	Frequency	Percent
1	What mode of payment do you use to receive your milk & milk products selling price?	Immediate cash payment	219	61.9
		Future payment	51	14.4
		Immediate & future cash payment	84	23.7
		Total	354	100.0
2	How do you feel on the current price of milk and milk products in the market in relation to the past prices?	Expensive	174	49.2
		Medium	164	46.3
		Cheap	16	4.5
		Total	354	100.0
3	What are the factors that govern price of the dairy in your locality?	Seasons of the year	189	53.4
		Quality	35	9.9
		Distance from market	38	10.7
		Others	92	26.0
		Total	354	100.0
4	When you are selling your milk product, who decides the price?	Myself	137	38.7
		Negotiated	191	54.0
		Retailers	24	6.8
		Others	2	0.6
		Total	354	100.0

Source: Field survey result, (2020/21)

Market Distance, Breeds, Milk Yield, and Land Availability

As presented in Table 5, the distance of marketplaces from dairy producers' residences varied considerably. Approximately 31.9% of respondents reported living 9 km or more away, 26.6% lived less than 3 km away, 25.1% lived 3–5 km away, and 16.4% lived 6–8 km away. Producers residing farther from markets may supply fewer dairy products due to the perishable nature of milk and the high costs of transportation.

Regarding transportation methods used to deliver dairy products, 44.6% of respondents relied on bajaj, 34.5% used public transportation, 15.8% depended on human labor, and 5.1% used other means such as bicycles, carts, horses, or motorcycles. The time required to deliver dairy products was influenced by both the type of transportation used and the condition of local infrastructure.

Concerning the distance of the Agriculture and Rural Development Office from producers' residences, 36.2% were located 9 km or more away, 26.6% were 3–5

km away, 23.2% lived less than 3 km away, and 14.1% were 6–8 km away. Producers living farther from these offices may receive fewer extension services and incur higher transportation costs to access them. Similarly, the distance of input suppliers varied: 35% of respondents lived 9 km or more away, 27.4% lived 6–8 km away, 25.4% lived 3–5 km away, and 12.1% lived less than 3 km away. Greater distances from input suppliers increase transportation costs and limit timely access to essential inputs.

Regarding livestock breed types, the majority of respondents (72.3%) kept crossbred cows, 24.9% kept both local and crossbred cows, and only 2.8% kept local breeds exclusively. Nearly all respondents (97.5%) expressed a preference for crossbred cows due to their higher milk yield, larger body size, and greater market value. The Office of Agriculture and Rural Development confirmed that crossbred cows are the most preferred breed in the study area.

In terms of milk yield from crossbred cows, 55.9% of respondents reported obtaining 9–12 liters per cow per day, 31.4% obtained 5–8 liters, 8.8% obtained 13 liters or more, and 4% obtained less than 5 liters. These results indicate that crossbred cows provide substantial milk output when adequately fed. However, feed shortage was reported by all respondents (100%), particularly during the spring, summer, and winter seasons. This inadequate supply of quality feed significantly constrains dairy production and marketing. Regarding the source of crossbred cows, 77.1% were purchased from the market, 21.5% were provided by the government, and 1.4% came from NGOs, highlighting market purchase as the primary source.

Land availability was identified as another major constraint. About 69.8% of respondents reported a shortage of land for milking cows, while 30.2% did not face this problem. In terms of land ownership, 75.7% owned land, while 24.3% did not. Regarding landholding size, 58% had ½–1 hectare, 26% had less than ½ hectare, and 16% had more than 1 hectare. For dairy production specifically, 78.5% had less than ½ hectare, and 21.5% had ½–1 hectare, either owned or rented. Overall, 59.2% of respondents had less than ½ hectare of agricultural land, 35.6% had ½–1 hectare, and only 5.2% had more than 1 hectare. These findings highlight the widespread problem of land scarcity in the study area, which limits the expansion of dairy production and marketing.

Table 5 Descriptive Statistics on distance to market place

No	Description	Response	Frequency	Percent
1	How far is the market place from your residential area?	Less than 3 K/ms	94	26.6
		3-5 K/ms	89	25.1
		6-8 K/ms	58	16.4
		9 K/ms and above	113	31.9
		Total	354	100.0
2	What type of transport do you use for your milk products to supply for the market?	Public transport	122	34.5
		Bajaj	158	44.6
		Carrying by human labor	56	15.8
		Others	18	5.1
		Total	354	100.0
3	Are all your selling centers accessible to vehicles?	Yes	290	81.9
		No	64	18.1
		Total	354	100.0
4	How far is the office of agriculture and rural development from your residential area?	Less than 3 K/ms	82	23.2
		3-5 K/ms	94	26.6
		6-8 K/ms	50	14.1
		9 K/ms and above	128	36.2
		Total	354	100.0

Source: Field survey result, (2020/21)

Sources of Capital and Credit Access

As presented in Table 6, the sources of capital for starting dairy farms varied among respondents. Nearly half (46.9%) of the producers relied on their own funds, 43.8% started their farms using credit obtained from microfinance institutions, 6.5% depended on gifts or loans from relatives, and 2.8% used bank loans. This indicates that personal savings and microfinance credit were the dominant sources of start-up capital. Access to credit is therefore crucial, as it enables dairy farmers to expand their operations and strengthen the dairy marketing system.

According to the survey, most respondents (89.3%) reported having access to credit in recent months or years, while 10.7% indicated no access. This demonstrates that credit facilities are available to dairy producers and widely utilized, particularly for purchasing animals, farm equipment, and animal feed. However, the credit provided was generally insufficient to fully meet producers' needs, limiting their ability to expand production.

Regarding loan repayment, 97.8% of respondents reported repaying their loans on time, while 2.2% did not. This suggests that dairy producers are generally

capable of meeting repayment obligations, likely through income generated from dairy sales.

The survey also identified key constraints in obtaining credit. High interest rates were cited by 45.2% of respondents as the primary barrier, 38.4% pointed to bureaucratic procedures, and 16.4% reported that credit organizations were unwilling to lend to smallholder farmers. These constraints negatively affect dairy production and marketing, slowing farm expansion and reducing the volume of dairy products supplied to the market.

Table 6 Descriptive Statistics on Credit Access

No	Description	Response	Frequency	Percent
1	What was your source of capital to start dairy farm?	Own fund	166	46.9
		Bank loan	10	2.8
		Gift from relatives	23	6.5
		Micro finance	155	43.8
		Total	354	100.0
2	Did you have access to credit in the past years/ months?	Yes	316	89.3
		No	38	10.7
		Total	354	100.0
3	Have you paid back the loan timely?	Yes	309	97.8
		No	7	2.2
		Total	316	100
4	Can you identify any constraints when trying to get credit?	High interest rate	160	45.2
		Credit organizations not willing to lend to smallholders	58	16.4
		Bureaucracy	136	38.4
		Others	354	100.0

Source: Field survey result, (2020/21)

Extension and Veterinary Services

As shown in Table 7, most respondents (94.9%) reported having access to extension services, while only 5.1% did not receive any support for their dairy farms. This suggests that dairy farmers with more frequent contact with development agents are better positioned to access information and advice on adopting new technologies, improving the quality of crossbred cows, and selecting appropriate medications for milking cows.

According to the survey, the majority of respondents (67.2%) received technical assistance (training) in dairy production, whereas 32.8% did not. This highlights the important role of technical assistance provided by agriculture and rural development offices in improving dairy production and marketing. Training topics included cow feeding systems and management, improving product quality, market information, breeding, and marketing strategies. However, respondents noted that the training was inadequate, as it was neither continuous nor always responsive to specific challenges. Advice and training on animal nutrition, reproduction, adoption of new technologies, milk handling, marketing, farm management, and overall production efficiency were not consistently available. Extension services for introducing new technologies were also insufficient.

The survey further revealed that 71% of respondents received extension service contacts 4–7 times per year, 11.6% received fewer than four contacts annually, and 17.4% received eight or more contacts per year. This indicates that the frequency of extension services is moderately sufficient and contributes positively to dairy marketing. Regarding future training requirements, almost all respondents (98.9%) expressed a need for additional training, while only 1.1% did not. This underscores the importance of providing continuous and targeted training to enhance dairy production quality and improve disease control practices.

Concerning veterinary services, 67.8% of respondents reported medium access, 24.6% reported high access, and 7.6% reported low access. In terms of service quality, 78.8% rated veterinary services as medium, 17.2% as high, and 4% as low. These findings suggest that the quality of veterinary services provided by the government does not fully meet the expectations of dairy producers, indicating a need for improvement in both accessibility and service delivery.

Table 7 Descriptive Statistics on Extension Service

No	Description	Response	Frequency	Percent
1	Did you receive any extension service for your dairy farm?	Yes	336	94.9
		No	18	5.1
		Total	354	100.0
2	Did you get technical assistance (training) on dairy production from government organization?	Yes	238	67.2
		No	116	32.8
		Total	354	100.0
3		Yes	241	68.1

	Are you getting regular extension service?	No	113	31.9
		Total	354	100.0
4	If your answer for question no, 4 is yes, how many frequency of contact? (number of visits per year)	Less than four times	28	11.6
		4-7 times	171	71
		8 times and above	42	17.4
		Total	241	100
5	Do you need any training support in future for expanding your dairy business?	Yes	350	98.9
		No	4	1.1
		Total	354	100.0
6	Access of veterinary service	High	87	24.6
		Medium	240	67.8
		Low	27	7.6
		Total	354	100.0

Source: Field survey result, (2020/21)

Multiple Regression Analysis

The multiple regression analysis was conducted to identify the determinants of the volume of dairy supplied to the market. The dependent variable was the volume of dairy supplied, while the independent variables included marketing information, dairy market price, family size, credit access, educational level and farming experience, crossbreed cow ownership, landholding size, extension service, and distance to marketplace (N = 354).

As presented in Table 8, the model explains a substantial proportion of the variation in dairy supply, with several predictors showing statistically significant effects.

Educational Level and Dairy Farming Experience: - had positive and highly significant effects ($p < 0.01$). A one-year increase in education or farming experience was associated with a 30.7% increase in dairy supply to the market. This indicates that education and experience enhance producers' capacity to produce and supply dairy efficiently by improving access to marketing networks and information.

Family Size: - positively and significantly influenced dairy supply ($p < 0.01$). An additional household member increased dairy supply by 18.5%. Larger households can allocate more labor to feed management, milking, and marketing activities, thereby increasing production and market participation.

Marketing Information: - Access to marketing information had a positive and significant effect ($p < 0.01$). Improved access increased dairy supply by 13.7%. Accurate and timely information enables producers to make informed decisions

about production and sales, while poor access may lead to inefficient product movement.

Dairy Market Price: - Market price was positively and significantly associated with dairy supply ($p < 0.01$). A one-birr increase in price resulted in a 26.7% increase in supply. Higher prices motivate producers to supply larger volumes, reflecting the responsiveness of dairy supply to market incentives.

Distance to Marketplace: - Distance to the market had a negative and significant effect ($p < 0.01$). Producers located farther from markets supplied smaller volumes due to higher transportation costs, perishability of milk, and reduced access to market information and facilities.

Crossbreed Cow Ownership: - Ownership of crossbreed cows positively and significantly influenced dairy supply ($p < 0.01$). Households with crossbreed cows increased supply by 13.1%. Crossbreeds produce higher milk yields, directly enhancing marketable volume.

Landholding Size: - had a positive and significant effect ($p < 0.01$). An additional hectare of land allocated to dairy production increased supply by 19.3%. Larger landholdings allow for better feed production and expansion of dairy activities.

Credit Access: - Access to credit positively and significantly affected dairy supply ($p < 0.01$). Credit enables households to acquire inputs and adopt improved technologies, thereby increasing production and marketing capacity.

Extension Service: - Extension services had a positive and significant effect ($p < 0.05$). An additional extension contact increased dairy supply by 7.4%. Extension providers disseminate new technologies and offer advice on farm management and marketing, encouraging higher production and improved market participation. Overall, the regression results confirm that education, experience, family size, marketing information, market price, crossbreed cow ownership, landholding size, credit access, and extension services are key drivers of dairy market supply, while distance to the marketplace remains a significant barrier. These findings are consistent with previous studies (Abebe, 2016).

Table 8 Multiple Regression Result

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	.483	.072		6.695	.000

Educational level and dairy farming experience	.092	.010	.307	9.057	.000
Family size	.073	.013	.185	5.490	.000
Marketing information	.076	.019	.137	4.041	.000
Dairy market price	.082	.010	.267	7.928	.000
Distance to market place	-.073	.007	-.374	-10.350	.000
Cross breed cows ownership	.060	.016	.131	3.760	.000
Land holding size	.094	.016	.193	5.673	.000
Credit access	.048	.012	.133	3.909	.000
Extension service	.046	.020	.078	2.309	.022

Source: Field survey result, (2020/21)

Note: Significant at 10%, 5%, and 1% level.

Discussion

This study provides important insights into the determinants of dairy marketing practices in Northwestern Tigray, a region with strong milk production potential but limited research attention. Unlike previous studies that mainly focused on dairy production and value chains, this research specifically examines factors affecting dairy marketing, thereby filling a significant research gap in Ethiopia. The study found that limited storage facilities, poor infrastructure, and lack of processing technologies negatively affect dairy marketing. These findings are consistent with previous Ethiopian studies, which reported that inadequate cold-chain systems, weak infrastructure, and poor road networks contribute to post-harvest milk losses and reduced market competitiveness. However, this study adds value by directly linking these challenges to market supply outcomes in Tigray.

Institutional challenges, including weak coordination among supply chain actors and limited training opportunities, were also identified as major barriers. Previous studies similarly highlighted the importance of institutional support, cooperative effectiveness, and extension services in improving dairy commercialization. The findings suggest that the quality of institutional services and enforcement mechanisms is more important than simply having institutions in place. Socioeconomic factors such as education, farming experience, and access to market information positively influenced marketable dairy supply. In contrast, family size negatively affected market supply, indicating that household consumption in Tigray may reduce the amount of milk available for the market. This differs from some earlier studies that viewed family labor as a positive factor.

The study also recognized the impact of cultural practices, particularly Orthodox fasting periods, which reduce dairy consumption and create seasonal demand fluctuations. Overall, the findings emphasize that improving dairy commercialization in Ethiopia requires integrated interventions, including better infrastructure, technological upgrading, institutional strengthening, farmer training, and improved market information systems. Future research should assess the effectiveness of interventions such as milk chilling technologies, cooperative governance improvements, and culturally responsive market strategies.

Conclusions and Policy Recommendations

This study revealed that the majority of sampled dairy producers in the Northwestern Zone of Tigray were active and possessed at least basic education, providing a foundation for adopting improved practices. Despite this, dairy marketing in the study area faces significant constraints, including limited storage facilities, long distances to markets, poor infrastructure, inadequate transportation, and weak coordination among supply chain actors. Seasonal fluctuations in dairy supply were primarily driven by feed shortages, prolonged fasting periods, weak market linkages, limited processing technologies, and unstable dairy prices. Producers located farther from agricultural and rural development offices had reduced access to extension services, which further constrained productivity and market participation. Feed shortages for milking cows were most pronounced during spring, summer, and winter, while inadequate landholding size emerged as a serious barrier to expanding dairy production. Weak linkages among marketing actors were largely attributed to limited knowledge, skills, and awareness, compounded by insufficient training and policy support. Veterinary services were also inadequate and untimely in both districts. Overall, dairy market supply was influenced by multiple interrelated factors, and nine explanatory variables were identified as significant determinants of the volume of dairy supplied to markets.

To address these challenges and strengthen dairy commercialization, several policy interventions are recommended. Rural infrastructure development, particularly road networks and communication systems, should be prioritized to facilitate the timely delivery of perishable products such as milk. Farmers' awareness and decision-making capacities need to be enhanced through training, skill transfer, and experience-sharing programs. Investment in storage facilities and the introduction of appropriate dairy processing technologies are essential to mitigate perishability and seasonal fluctuations. Marketing actors should collaborate in an integrated manner to reduce post-harvest losses,

enhance production, and establish sustainable market linkages. Agricultural and rural development offices should implement effective breeding strategies, promote environmentally adaptable breeds, and introduce new technologies to improve productivity. Research institutes and universities should work together to identify and disseminate high-yielding and disease-resistant dairy cow varieties. Since inadequate landholding size remains a serious constraint, agricultural offices should consider supporting farmers with access to additional land to expand production and marketing. Finally, future research should broaden its scope to include additional districts or zones in the region and examine wider determinants of dairy supply chain practices, thereby generating evidence that can inform scalable interventions for resilient dairy commercialization in Ethiopia.

Limitations of the Study

This study was limited to major commercial dairy producers in two districts of the Northwestern Zone of Tigray. A cross-sectional survey design was employed, which did not allow for the assessment of longitudinal trends. The study focused exclusively on cow-derived dairy products, excluding dairy from other livestock species. Furthermore, non-commercial dairy-producing households were not included, which may limit the generalizability of the findings to the wider population of dairy producers.

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Declarations

Author Contributions:

Dambush Negasi Hadush was responsible for study design, supervision of data collection, data entry, interpretation of results, and manuscript preparation. Mesfin Yemaneberhan Sibhatu and Abraham Gebrehiwot Yihdego contributed to the development of the literature review, participated in data collection and analysis, and provided manuscript editing support. All authors (D. N. Hadush, M. Y. Sibhatu, and A. G. Yihdego) jointly wrote, reviewed, and approved the final manuscript.

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Ethics Approval and Consent to Participate:
The study was reviewed and approved by the Aksum University Ethical Board. Participants were fully informed about the study's purpose, procedures, confidentiality measures, and their right to withdraw at any time without penalty. Written informed consent was obtained from all participants, and participation was entirely voluntary.

Competing Interests:-the authors declare that they have no competing interests.

Informed Consent: - All participants aged 18 years and above voluntarily agreed to participate after being fully informed of their rights and responsibilities.

Data Availability Statement:-The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

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