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Factors Influencing Milk Production and Sales Revenue among Smallholder Dairy Farmers in Lusaka Province, Zambia

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Abstract - Low milk production and inconsistent milk quality among smallholder dairy farmers remain major constraints to the development of Zambia's dairy sector. These challenges were reflected in the difficulties faced by processors such as Parmalat, whose exit from the Zambian market was partly attributed to insufficient volumes of quality milk and unfavorable pricing dynamics affecting farmer supply. Despite growing demand for dairy products, milk output from smallholder farmers remains constrained, limiting household incomes and broader sectoral growth. The study specifically identifies the key constraints affecting production capacity, the drivers of high milk production costs, and the underlying causes of poor milk pricing. Data were collected using a semi-structured questionnaire administered to 327 smallholder dairy farmers of Lusaka Province and analysed using descriptive statistics, cost–benefit analysis, and regression modelling. The findings indicated that low production capacity is the most significant factor negatively affecting milk sales revenue, primarily driven by poor breed quality, low calving rates, and inadequate feeding practices. Although high production costs and pricing-related social factors were widely perceived by farmers as major challenges, these variables were not statistically significant in the regression analysis. However, the cost–benefit analysis revealed substantial market margin gaps, indicating lost revenue opportunities arising from limited market access and inadequate pricing information. Farmers identified practical strategies to address low milk production and improve revenue, including increasing feeding frequency, improving animal health management, enhancing milk quality, and strengthening access to extension and support services. These strategies align with global best practices and present feasible pathways for improving productivity and profitability. The study recommended targeted interventions by farmers, government agencies, and support organisations to address structural production constraints and enhance the competitiveness and sustainability of smallholder dairy farming in Zambia.

Keywords: Smallholder dairy farming; Milk production; Sales revenue; Supply chain; Zambia; Agricultural productivity

1. INTRODUCTION

The dairy sector plays a significant role in agricultural development, food security, and income generation in developing economies. In Zambia, smallholder farmers dominate the livestock sector, yet their contribution to formal dairy markets remains limited due to low productivity and weak supply chain integration.

Despite growing demand for dairy products driven by urbanization and population growth, milk production among smallholder farmers remains low, averaging 1–3 liters per cow per day compared to 20–25 liters among commercial producers. This production gap limits household income and constrains the efficiency of the dairy supply chain.

Despite a recommended per capita milk consumption of 200 litres per year, Zambians consume only about 24 litres per capita annually, highlighting a significant nutritional and market gap (FAO, 2024)

Structural challenges such as poor infrastructure, limited access to markets, inadequate extension services, and climate variability further affect production and revenue generation. In addition, inefficiencies within the dairy value chain reduce farmers' ability to capture fair market value for their products. For example, Lactalis Zambia (formerly Parmalat) announced the closure of its local manufacturing facility in early 2025, shifting to an import-only model decision linked to the challenging economic environment, high operational costs, and limited raw milk supply. This move reduces local off-taking capacity, adversely affecting smallholder dairy farmers who depend on processors as buyers for their milk (Dairy Business MEA, 2025).

This study aims to analyse the factors influencing milk production and sales revenue among smallholder dairy farmers in Lusaka Province and to identify strategies for improving productivity and supply chain performance.

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2. LITERATURE REVIEW

Zambian Perspective

Dairy Sub sector

Zambia has three main types of dairy producers, the traditional farmers, smallholder farmers and the large scale commercial dairy farmers. (Neven *et al*, 2006). Traditional small-scale producers hold the largest number of cattle, but given that their cattle are composed mostly of local breeds, they represent only an estimated 45 percent of milk production and estimated 25 percent of marketed raw milk in Zambia. (Neven *et al*, 2006). Most of the milk produced is either consumed by the household or sold in informal rural markets and consumed as raw milk. (Mumba, 2012). Some traditional small-scale producers sell their milk to milk collection centers who in turn sell either as processors or directly to consumers. (Knoema ,2023).

Milk production and Consumption

Smallholder dairy farming in Zambia is practiced in a production system that integrates crop and dairy farming. (Knoema ,2023). Smallholder dairy farming can play a significant role in poverty reduction and employment creation in Zambia. (Knoema ,2023). In 2010, milk production in Zambia was estimated at over 215 million litres per year and about 115 million litres is the share from smallholder farmers. (Pandey, 2010).

According to Knoema (2023), in 2022 production of milk in Zambia was 514,308 thousand tonnes which showed sharp increase from what was existing in 1973 where the production capacity stood at 47,100 thousand tonnes respectively.

The increase in milk production in Zambia is consistent with the global trend and that of the Africa region. (Sida, 2020). World-wide, milk production was forecasted to increase from an estimated 843 million tonnes in 2018 to 859 million tonnes in 2019. (Sida, 2020). In Africa, production would increase from 47.7 million tonnes in 2018 to 48.0 million tonnes in 2019. (FAO, 2019). Warm and drought-prone weather which is noted to pose a threat to the rising trend may be part of the reason for the limited increase in Africa. (FAO, 2019).

Theoretical Perspective

This study is informed by three theoretical frameworks:

Theory of Constraints (TOC): Emphasizes the role of bottlenecks in limiting system performance, particularly production capacity constraints in agricultural systems. The theory of constraints is a management philosophy which is focused on the weakest rings in the chain to improve the performance of a system. (Kalender *et al*, 2014).

Rational Choice Theory: Explains how farmers allocate limited resources to maximize returns under constraints. The Rational Choice Theory postulates that individuals' rational calculations to make rational choices and achieve outcomes that are aligned with their own personal objectives. (Ganti, 2024)

Right Set of Circumstances Theory: Highlights the importance of favorable production and market conditions in achieving optimal outcomes. The proponents of this theory proposed that if all the circumstances which led to the sales were appropriate, the sales would be successful. (Jadhav, 2024)

These frameworks provide a basis for understanding how production, cost, and market factors influence dairy farming performance.

Empirical Evidence

Empirical studies highlight several constraints affecting dairy production:

Production factors: Farmers reported low calving rates and inconsistent milk yields, which aligns with findings by Ngongoni *et al*. (2007), who identified poor cow performance as a major constraint in Zimbabwe. The most cited strategy for improving revenue was increasing feeding frequency (48.6%), which directly impacts milk yield. FAO (2018) and Hatungumukama (2017) confirm that frequent feeding of high-energy diets improves milk fat and protein content. Another critical factor was farmers inability to keep abreast with current trends in the dairy sector despite having significant experience in the sector.

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Cost factors: Many farmers reported difficulty affording high-yielding breeds, consistent with Kugonza (2018), who found that native Zambian veld provides insufficient protein for lactating cows. Although veterinary care and labour were not frequently cited, they remain important components of the cost structure. The findings suggest that farmers may underestimate indirect or long-term costs, focusing instead on immediate and visible expenses such as feed and breeding stock.

Market factors: Farmers lacked access to real-time market data, leading to underpricing. Poldaru & Lindsaar (2020) emphasize that informed pricing decisions are critical for profitability. Middlemen and processors absorb a large share of the retail margin. For example, farmers selling 20+ liters earn ZMW 10.50 per liter, while the market pays up to ZMW 17.52 creating a ZMW 7.02 gap.

However, existing literature largely focuses on production outcomes, with limited emphasis on how these factors influence sales revenue within supply chains, particularly in Zambia. This study addresses this gap.

3. METHODOLOGY

Research Design

A quantitative case study design was adopted to examine relationships between production factors and sales revenue.

Study Area and Population

The study was conducted in Lusaka Province, targeting smallholder dairy farmers. The target population comprised 368 farmers, from which 327 participated, yielding a response rate of 88.8%.

Sampling Technique

A multi-stage sampling approach combining purposive and random sampling was used to select respondents.

Data Collected

Data were collected using semi-structured questionnaires covering:

- Demographic characteristics

Figure (2) below shows the percentage distribution of the gender of the respondents that took part in this study. The generated results from table (3) above shows that most (67%) of the respondents were males and only (33%) were females. The observed disparities in the numbers of males to females could be attributed to dairy farming initially being a preserve of males. The Land and Livestock is also predominantly dominated by male farmers.

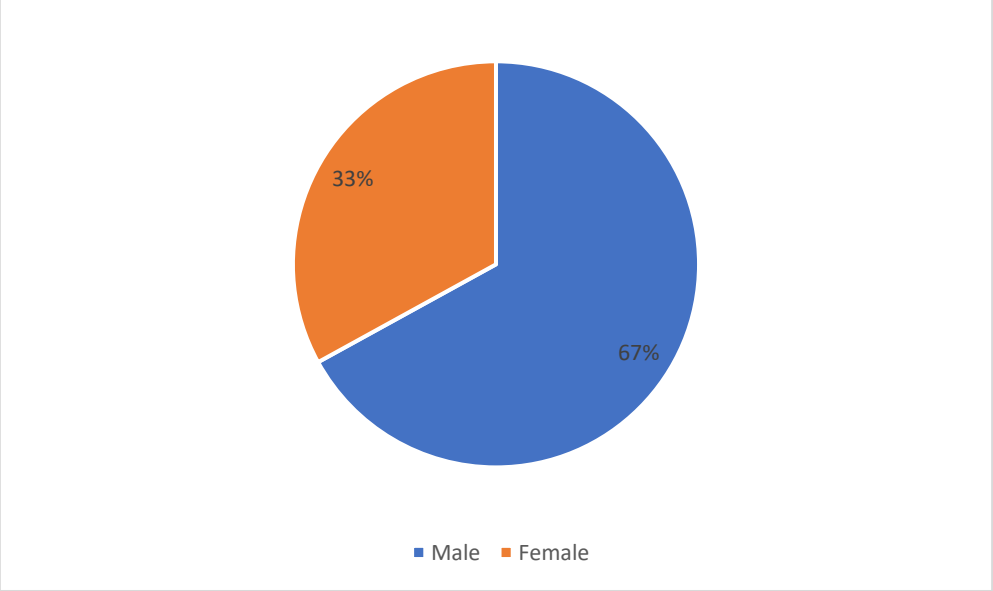

Figure 1: Respondents by gender

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- Production factors

Figure (6) shows the frequency distribution of the respondents on the milk they produced per day. The generated results in figure (4.5) above shows that most (209) of the respondents were of the view that they produced (5-10lts) of milk per day. The results in figure (4.5) also shows that the respondents who were of the view that they produced below (5lts) per day were the fewest and accounted for (16) respectively.

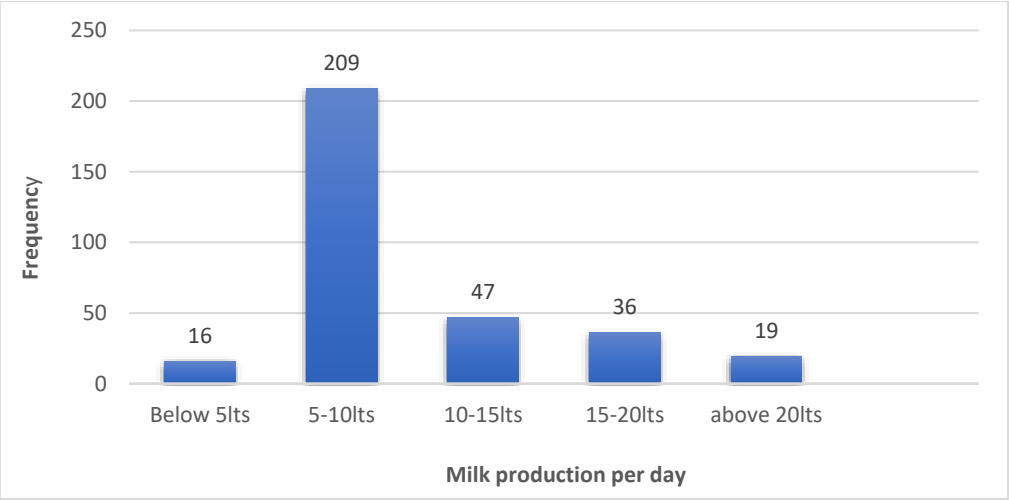

Figure 2: Milk Production per day

- Cost and pricing factors

Figure 9 shows that milk volume produced by the dairy farmers ranged from 1-20+L and that the production cost of milk across all the volume bands was lower than the price charged by the farmers. For the lowest band, (1-5L) the production cost was K28 while the selling price was K42.5 implying a K14.5 gross profit. Similarly, for the highest milk volume band (20+L), the production cost was K125 while selling price was 175, showing a gross profit of (K50). From the price charged for the lowest band (1-5L) we can observe that the average price per Liter was K8.5 which corresponds with the Business Times (2025) which reported the average price of milk charged by the farmers was K8.5

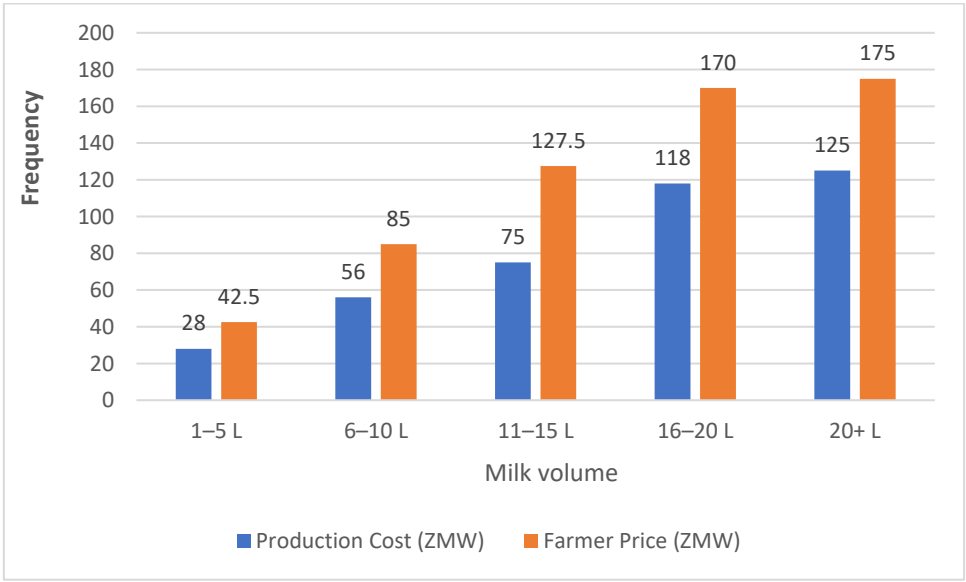

Figure 9: Volume, production cost and Price

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- Revenue enhancement strategies

Table 1: Revenue maximisation strategies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Improve the health care of cows	91	27.8	27.8	27.8
	Improve the milk quality produced	23	7.0	7.0	34.9
	Increased access to support services for dairy farmers	19	5.8	5.8	40.7
	Increasing feeding frequency of the cows	159	48.6	48.6	89.3
	Keep the milking cows close the milk col	24	7.3	7.3	96.6
	Partially separating calves from milk breeding cows	11	3.4	3.4	100.0
	Total	327	100.0	100.0	

(Source: Author, 2024)

Table (8) shows the strategies proposed by the respondents who took part in this study for maximizing revenue generated from dairy farming included improving the health care of cows, improving the quality of milk quality, increasing access to support services for dairy farmers, increasing the feeding frequency for cows, keeping the milking cows close the milk collector and partially separating the calves from the milk breeding cows. Of these strategies, most (48.6%) of the respondents were of the view that increasing the feeding frequency of the cows would maximize the revenue generated from dairy farming. Further, the respondents who proposed partially separating the calves from the milk breeding cows as a revenue maximization strategy were the fewest and accounted for (3.4%) respectively

Data Analysis

Data were analyzed using:

- Descriptive statistics

Figure (3) below shows the frequency distribution of the respondents who took part in this study. The generated results from table (3) above shows that most (210) of the respondents were in the age group (35-44) while those that were in the age group (18-24) were the fewest and accounted for (12). The generated results from table (3) further shows that those under the age of 25 are less likely to go into dairy farming as compared to those above that age.

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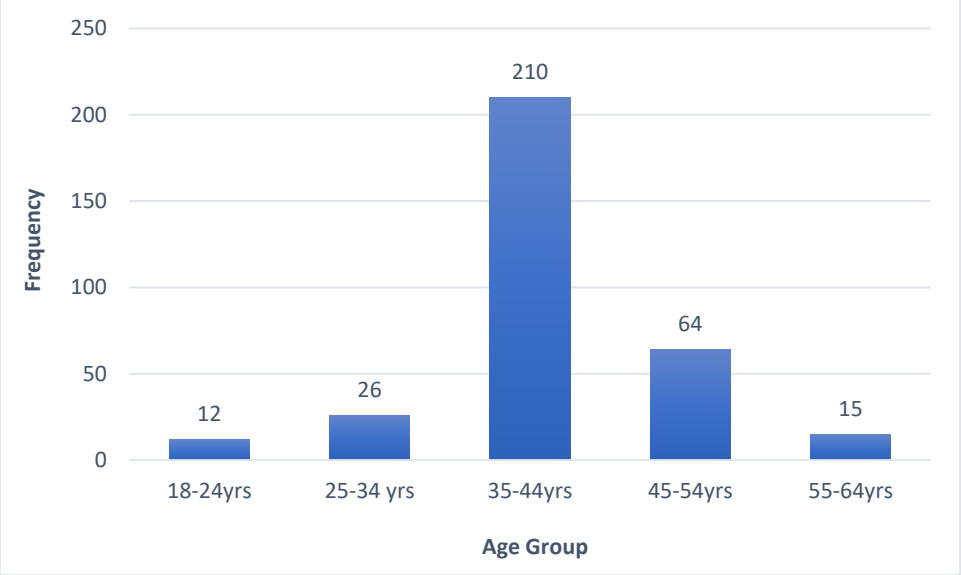

Figure 3: Age of Respondents

Figure (5) below shows the frequency distribution of the generated results on the education level of the respondents who took part in this study. The generated results show that most (116) of the respondents had attained tertiary diploma level in their education. This was followed by those who had attained grade 12 certificate (88) and tertiary certificate (86). The respondents who had attained master's level of education were the fewest and accounted for (2) respectively.

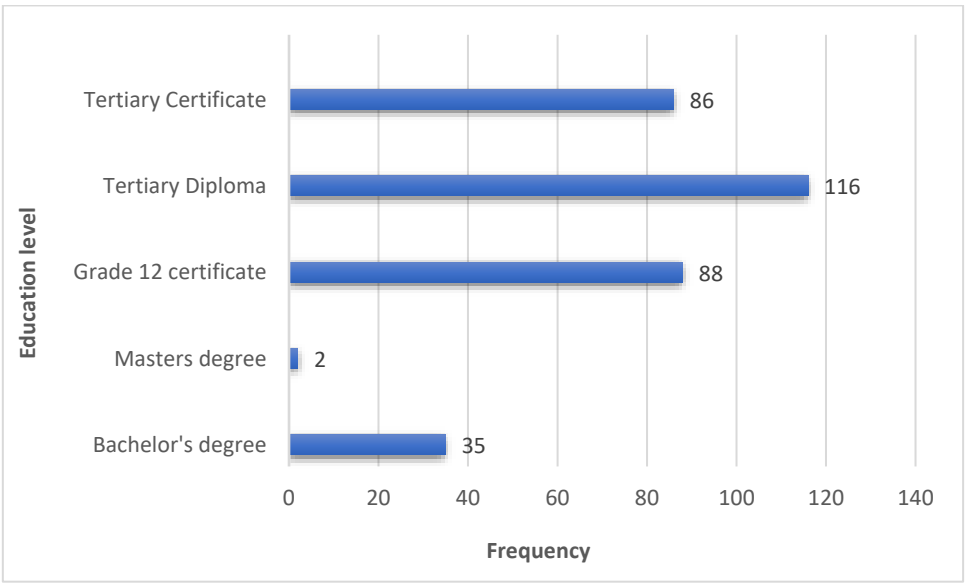

Figure 4: Respondents level of education

- Cost–benefit analysis

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Table 2: Cost Benefit Analysis

Milk Volume (Litres)	Production Cost (ZMW)	Farmer Price (ZMW)	Market Price Range (ZMW)	Profit Margin (Farmer vs Cost)	Market Margin (Market Vs Cost)
1–5 L	28	42.5	55-87.6	14.5	27-59.6
6–10 L	56	85	69.72–175.2	29	13.72-120.2
11–15 L	75	127.5	127.82–262.8	52.5	52.82-187.8
16–20 L	118	170	185.92–350.4	52	67.92-232.4
20+ L	125	175	<350.4	50	<225.4

Table (9) revealed the following:

Production Costs vs Farmer Prices

Across all volume categories, farmers are charging prices that exceed their production costs, indicating profitability at the farm gate level. Farmers producing 1–5 litres incur a cost of ZMW 28 but charge ZMW 42.5, yielding a ZMW 14.5 margin. At the highest band (20+ litres), the cost is ZMW 125, while the farmer price is ZMW 175, resulting in an ZMW 50 margin. This trend suggests that economies of scale are at play: as production volume increases, the cost per litre decreases, and profit margins grow. This incentivizes farmers to scale up operations where feasible.

Market Prices vs Farmer Prices

The prevailing market prices ranging from ZMW 11.62 to ZMW 17.52 per litre according to the Zambia Public Procurement Authority's Q1 2025 report are significantly higher than the prices charged by farmers. For example:

A farmer selling 10 litres at ZMW 85 earns ZMW 8.50 per litre, while the market fetches up to ZMW 17.52, double of the price charged by the farmers. This implies a potential ZMW 9.02 per liter gap. This disparity suggests that farmers are not fully capturing the retail value of their product. Middlemen, processors, and retailers likely absorb a significant portion of the value chain, leaving farmers with modest returns relative to market potential.

Profitability and Market Opportunity

The analysis shows that while farmers are profitable, they are missing out on higher margins available in the retail market. The market margin (the difference between market price and production cost) ranges from ZMW 13 to ZMW 225 across the volume bands. This highlights a substantial opportunity for farmers to increase earnings through direct-to-consumer sales, cooperative marketing and value-added processing (e.g., yogurt, cheese).

- Regression analysis (SPSS version 27)

The regression analysis performed showed that the prediction model employed was significant to show how the independent variables explained the changes in the dependent variables. The regression summary model as given through the (R-square) showed that the combined effect of production capacity related factors, cost of milk productions and Market Factors were only able to explain roughly about (2.4%) of the variations or changes in revenue generated. This could be attributed to the established results on the regression coefficients were only production capacity had a positive significant effect on production and revenue generated with the other two independent variables having positive insignificant relationships with revenue generated. This further showed that there could have been other factors outside the scope of production capacity related factors, cost of milk productions and Market Factors that affected the revenue generated from the sale of milk by dairy farmers in Lusaka Province.

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4. RESULTS AND DISCUSSION

Production Capacity Constraints

The study revealed that the majority of the farmers produced 5-10L of milk per day and had farm size ranging from 2-4 acres. The majority of these dairy farmers were male and had been involved in the dairy business for over 12 years. During the course of their dairy farming, the farmers were faced with a number of production constraints that limited their capacity to produce sufficient milk for sale, mostly to processors or off-takers.

The findings of this study indicate that smallholder dairy farmers in Lusaka Province operate at relatively low production levels, with the majority producing between 5–10 litres of milk per day on farm sizes ranging from 2–4 acres. Despite most farmers having over 12 years of experience, production capacity remains constrained, which significantly affects sales revenue, as confirmed by the regression results ($\beta = -0.139$, $p = 0.017$).

A key insight from the study is the disconnect between farmers' perceptions and actual productivity outcomes. While respondents acknowledged the availability of improved milk-yielding breeds and the need to increase production, many did not perceive milk yield as directly influencing revenue. This suggests a knowledge gap in understanding the relationship between productivity and income generation.

The study identified several critical production constraints. First, breed quality and low calving rates were highlighted as major limitations to consistent milk production. These findings are consistent with Ngongoni *et al*. (2007), who identified poor cow performance as a key constraint in smallholder dairy systems in Zimbabwe. Second, feeding practices emerged as a central issue, with nearly half of the respondents (48.6%) identifying increased feeding frequency as the most important strategy for improving revenue. This aligns with FAO (2018) and Hatungumukama (2017), who emphasize the importance of high-quality and frequent feeding in improving milk yield and composition.

Cost and Pricing Factors

Breeding stock acquisition: Many farmers reported difficulty affording high-yielding breeds, consistent with Kugonza (2018), who found that native Zambian veld provides insufficient protein for lactating cows.

Feed and forage: While some farmers found feed costs affordable, others highlighted seasonal shortages and poor nutritional value, especially during the dry season.

Veterinary care and labor: These were less frequently mentioned but remain relevant in broader cost structures. The findings suggest that cost reduction strategies should focus on breed subsidies, feed quality improvement, and cooperative purchasing models.

The regression analysis showed that production costs did not have a statistically significant effect on revenue ($\beta = 0.062$, $p = 0.267$). However, descriptive statistics revealed that farmers face several cost-related challenges that influence their operations.

One of the main cost drivers identified was the high cost of acquiring improved breeding stock. Many farmers reported that high-yielding breeds are expensive and difficult to access, limiting their ability to improve productivity. This finding is consistent with Kugonza (2018), who noted that the reliance on low-quality feed resources in Zambia further compounds the productivity challenges associated with poor breeds.

Feed and forage availability also emerged as a critical factor. While some farmers perceived feeding costs as manageable, others highlighted seasonal variability, particularly during the dry season, when feed quality and availability decline. This inconsistency affects milk yield and overall farm performance.

Although veterinary care and labour were not frequently cited, they remain important components of the cost structure. The findings suggest that farmers may underestimate indirect or long-term costs, focusing instead on immediate and visible expenses such as feed and breeding stock.

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Market Factors

Market price awareness: Farmers lacked access to real-time market data, leading to underpricing. Poldaru & Lindsaar (2020) emphasize that informed pricing decisions are critical for profitability.

Value chain inefficiencies: Middlemen and processors absorb a large share of the retail margin. For example, farmers selling 20+ liters earn ZMW 10.50 per liter, while the market pays up to ZMW 17.52 creating a ZMW 7.02 gap.

Lack of cooperative marketing: Few farmers engage in collective bargaining or direct-to-consumer sales, limiting their pricing power. These findings highlight the need for transparent pricing mechanisms and market access initiatives to help farmers capture more value.

These results were supported by Chileshe & Banda (2023) who found that smallholder farmers in Zambia often lack access to market pricing data, leading to undervaluation of their milk. Poldaru & Lindsaar (2020) emphasized the role of market transparency in improving farm profitability.

Although Market Factors were not statistically significant in the regression model ($\beta = 0.104$, $p = 0.066$), the descriptive statistics and cost-benefit analysis reveal substantial inefficiencies in the dairy value chain.

The study found a significant gap between farm-gate prices and market prices. For instance, farmers selling milk at approximately ZMW 10.50 per litre receive significantly less than the market price of up to ZMW 17.52 per litre. This disparity indicates that farmers are not capturing the full value of their product, with intermediaries such as processors and traders absorbing a large share of the profit margin.

Limited access to market information was identified as a key factor contributing to poor pricing decisions. Farmers often lack real-time data on prevailing market prices, leading to under pricing of their milk. This finding is supported by Chileshe and Banda (2023), who observed that smallholder farmers in Zambia frequently lack access to reliable market information. Similarly, Poldaru and Lindsaar (2020) emphasize that access to market information is critical for informed pricing decisions and improved profitability.

Revenue Enhancement Strategies

Farmers proposed several strategies to improve revenue, with feeding frequency (48.6%) and cow health (27.8%) being the most cited. These align with global best practices and literature:

Feeding and nutrition: Increasing feed frequency and quality improves milk yield and composition (FAO, 2018; Hatungumukama, 2017). Herd health: Poldaru & Lindsaar (2020) found that herd health significantly impacts profitability.

Milk quality and hygiene: Better hygiene practices can improve milk grade and pricing. Market access and pricing education: Farmers need training in pricing strategies and access to real-time market data. These strategies, if implemented with support from government and NGOs, could significantly enhance the competitiveness of smallholder dairy farmers.

Additionally, the study found limited participation in cooperative marketing structures. The absence of collective bargaining reduces farmers' negotiating power and limits their ability to access better-paying markets. This further reinforces their dependence on intermediaries.

These findings suggest that improving pricing outcomes requires interventions focused on market transparency, access to pricing information, and strengthening farmer cooperatives to enhance bargaining power.

Beyond production-related strategies, the findings highlight the importance of strengthening market access and pricing knowledge. Training farmers in business skills, pricing strategies, and market dynamics can significantly improve their ability to capture value within the dairy value chain.

These results underscore the need for a holistic approach that integrates production improvements, market access, and capacity building to enhance farmer livelihoods.

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Strategic Area	Recommended Action	Responsible Parties	Farmer Role	Expected Impact
Feeding & Nutrition	Increase feeding frequency and improve forage quality	Ministry of Agriculture, NGOs	Adopt seasonal feeding plans and monitor intake	Higher milk yield and improved quality
Breed & Herd Health	Subsidize high-yielding breeds and expand veterinary outreach	Government, Cooperatives	Maintain herd health and participate in breed programs	Improved calving rates and productivity
Market Access & Pricing	Provide real-time market data and pricing education	Dairy Boards, Extension Services	Use pricing tools and engage in cooperative marketing	Fairer pricing and reduced revenue gaps
Support Services	Offer training in business, hygiene, and milk handling	NGOs, Farmer Associations	Attend workshops and apply best practices	Sustainable growth and improved competitiveness
Cost Reduction	Evaluate and reduce breeding and feeding expenses	Farmer groups, financial advisors	Track input costs and optimize resource use	Lower production costs and increased profit margins

These strategies are consistent with best practices in dairy production and supply chain management.

5. CONCLUSION AND POLICY IMPLICATIONS

Conclusion

This study demonstrates that low production capacity is the primary constraint affecting milk production and sales revenue among smallholder dairy farmers in Lusaka Province. While farmers are profitable, they are not maximizing potential revenue due to production inefficiencies and weak integration into formal supply chains.

Policy Implications

To improve productivity and supply chain efficiency, the following interventions are recommended:

1. **Enhance Production Capacity**
   - Promote improved breeds and feeding systems
   - Strengthen animal health management
2. **Strengthen Extension Services**
   - Provide training on dairy management practices
   - Improve access to veterinary and advisory services
3. **Improve Supply Chain Integration**
   - Develop milk collection infrastructure
   - Support farmer cooperatives
4. **Promote Value Addition**
   - Encourage processing into dairy products
   - Facilitate direct market access
5. **Invest in Rural Infrastructure**
   - Improve road networks and transport systems
   - Enhance cold chain facilities

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