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Title: Drivers of Profitability and Livelihood Sufficiency in Small-Scale Dairy Farming: Evidence from Palabana, Zambia

¹Anesuishe Audrey Dzombe, ²Tom Muzenda and ¹Mellisa Chengetai Mpofu

¹Department of Agriculture and Environmental Sciences, College of Health, Agriculture and Natural Sciences, Africa University, Mutare, Zimbabwe

²Department of Applied Biosciences and Biotechnology, Faculty of Science and Technology, Midlands State University, Gweru, Zimbabwe

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Corresponding Author: Mellisa Chengetai Mpofu

Abstract

Promotion of small-scale dairy farming has been a livelihood option for rural households in sub-Saharan Africa but findings in terms of profitability and household welfare have been mixed. The aim of this study was to determine if small-scale dairy farming can generate adequate income for the rural households in Palabana, Zambia. A cross sectional survey was carried out among 80 farmers supplying milk to Palabana Milk Collection Centre. Profitability was determined by subtracting production costs from monthly milk revenues, and descriptive statistics, t-tests, ANOVA, chi-square tests and multiple regression were used to analyze the data. Results indicated that the dairy business is profitable with the mean net monthly profit of ZMW 22,438 (~1,200 USD) representing 67% of the household income. Larger herds had significantly higher margins at 63.5% compared to the smaller herds of 41.2%. The income from dairy was above basic expenditure of the household by 14,638 ZMW, which indicates sufficiency. The regression model ($R^2 = 0.764$) revealed that herd size, milk yield, credit access, education and farming experience were the positive predictors whereas feed cost was the negative predictor. Feed cost was reported as the biggest constraint to profitability, while credit problems were most prevalent on small farms (54%). The results indicated that smallholder dairy is a sustainable livelihood in Palabana with potential limitations of profitability due to feed costs and credit availability. Interventions should include feed cost reduction such as improved forages and bulk buying and provision of more credit facilities for small farmers, and further investment in farmer education and extension services.

Keywords: livelihood sufficiency, *Palabana zambia*, profitability drivers, small-scale dairy farming, Sub-Saharan Africa dairy systems

1. Introduction

Dairy farming has long been encouraged as a livelihood option for rural households in Zambia seeking to enhance their food security and income. In the 1990s, policy reforms were introduced to promote commercialization and integration of smallholders into formal markets, which were complemented by schemes such as the Livestock Development Plan, the Zambia Dairy Transformation Programme (ZDTP) and the National Dairy Development Programme (NDDP) (Neven, 2006, Chagunda *et al.*, 2016) [15, 3]. These programs included new breeds, artificial insemination, and Milk Collection Centres (MCCs), which connected farmers with processors such as Dairy Gold and Parmalat in a cooperative manner (Mumba *et al.*, 2024) [12]. There has been ongoing institutional support by the Ministry of Fisheries and Livestock, Dairy Association of Zambia (DAZ), and NGOs like Heifer International (Haachilala and Mwange, 2024, Kapende, 2024) [6, 7]. However, many of the smallholder dairy farmers in Zambia continue to make losses making it difficult to secure basic needs. High feed cost, lack of irrigation facility for fodder production, use of low yielding indigenous breeds, lack of cooling facility, poor access to formal markets are some of the persistent challenges (Cheng *et al.*, 2025) [4]. Several studies have

reported low gross margins, even losses, in smallholder dairy farming enterprises, questioning the sustainability of dairy farming as a livelihood option (Cheng *et al.*, 2025, Mumba *et al.*, 2024, Mumba, 2012) [4, 12, 11].

The small rural community of Palabana has a unique story. They have fertile soil, a supportive organization, and an operational MCC that supports farmers. While milk production has improved over last 20 years due to the introduction of improved breeds and training, empirical evidence of profitability and household welfare is limited. Given the absence of local data, policymakers can't create interventions based on the realities of Palabana farmers (Mudenda, 2022) [10].

Previous studies reveal a number of gaps. First, the majority of the Zambian studies provide average figures across the country that hide the variation at the local level. It is possible that the profitability may vary from what is observed in the country due to the unique conditions of Palabana, functional MCC, and wide-spread use of improved breeds in Palabana (Mumba, 2012, Kapende, 2024) [11, 7]. Secondly, previous studies have focused on either gross margins or cost benefit ratios, without considering whether dairy income can meet household food, education and healthcare needs (Kapende, 2024, Mumba,

2012)^[7, 11]. Third, evidence from Zambia and the region is mixed; some say smallholder farms are less profitable than commercial farms, and others indicate that smallholders can be more profitable than commercial farms (Mumba *et al.*, 2024, Cheng *et al.*, 2025, WorldBank, 2011)^[12, 4, 20]. These discrepancies suggest considerable context dependence but the explanation of why certain systems work and others do not is not clear.

The fourth is that predictive models used in regional studies generally do not explain much. For instance, similar Kenyan work yields R^2 values of less than 0.30, which means that most of the variation in profits is not explained by the work (Kiplagat *et al.*, 2024)^[8]. Stronger models are needed to inform interventions. Fifth, although credit constraint and low education are often referenced as constraints on profitability, the specific ways in which these factors affect profitability have not been tested by Haachilala and Mwange (2024)^[6] and Kapende (2024)^[7]. Is education a profitable way of improving profits with better record keeping and better yields? Does credit allow the expansion of the herd or better feed options? These pathways are relevant to policy design. Last but not least, there are methodological limitations. Most of the previous Zambian

studies have been descriptive or used bivariate analysis with few employing multivariate regression and adjusting for confounders (Odubote, 2022, Mudenda, 2022)^[17, 10]. None have used profit data, which is usually right-skewed, and log-transformed.

The aim of this research was to tackle these gaps; to carry out a dedicated profitability analysis for Palabana; to investigate if it is possible to cover basic household needs only with dairy income; to develop a multivariate model to identify key drivers of profitability. It looks at the impact of credit and education on profitability and generates data that is relevant at the local level that can be compared with data from other regions and countries in the world. The study integrates statistical analysis with farmer views, providing both economic results and farmer experiences.

2. Materials and Methods

2.1 Study Site

The research was conducted in Palabana Area, Chongwe District, Lusaka Province, Zambia (15.6330° S, 28.3486° E). The region features fertile agricultural land suitable for small-scale dairy farming and crop production.

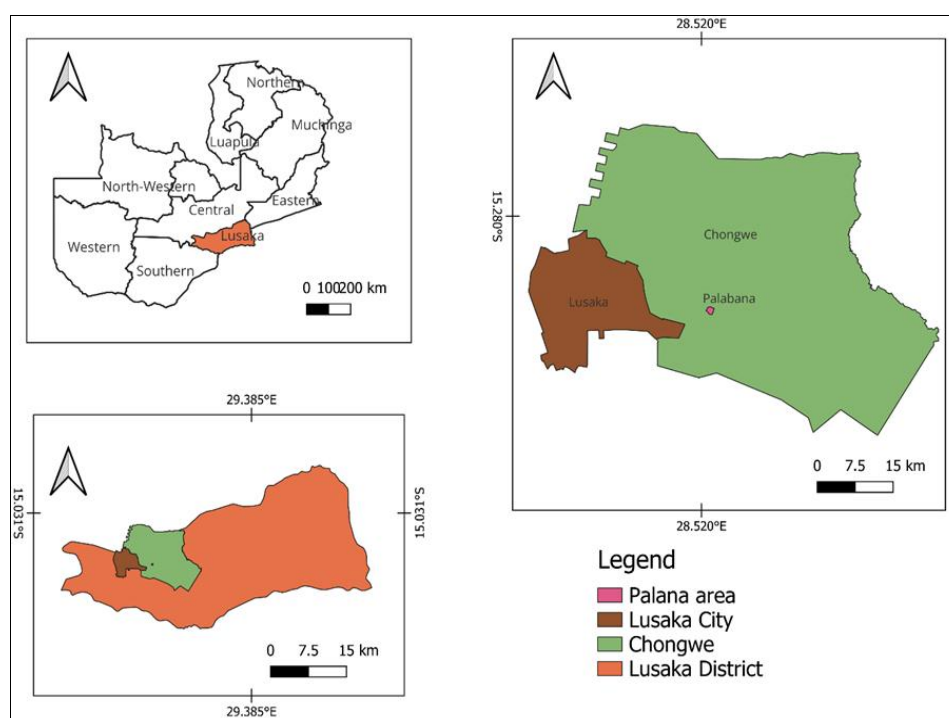


Fig 1: Map of Zambia showing Palabana in the Chongwe district.

2.2 Research Design and Sampling

The study population were registered small scale dairy farmers in Palabana. According to Kapende (2024)^[7], the total registered population was 104. The formula below was used to get the sample size for the study (83 farmers). The final sample of 80 farmers was completed. The inclusion criteria were possession of dairy cattle and regular milk delivery to the MCC for a minimum of 25 deliveries of milk per month. All adult participants, both male and female, 20 years of age and older were included. No vulnerable populations were present.

$$n = N/(1+N(E)^2) \text{ with 5\% precision}$$

x: Average of the responses (mean) of the desired sample size n of the population of interest.

d = Degree of freedom (the number of independent observations that can be used to calculate the standard deviation)

E = margin of error or level of precision (as a decimal)

A cross-sectional design that included both quantitative and qualitative data was used. This enabled the study to obtain production data, costs and incomes in addition to farmers' own experiences of problems. The sampling frame was created based on data from the MCC and the Ministry of Fisheries and Livestock. This data was used for purposive

sampling of the dairy farmers to ensure only those farmers who were actively practicing dairy farming and had their own dairy cattle and milked to the centre regularly were selected. This meant that all those who were interested had some experience in the field.

Then simple random sampling was taken. A different code was given to each of the eligible farmers on a slip of paper. Slips were placed in a bowl, thoroughly mixed, and drawn in a single by one until the desired sample was obtained. If a farmer failed to respond or did not return the questionnaire, he/she was replaced by randomly selecting another code from the ones that had not been returned. The last sample was then subdivided by herd size into small (2-5 cows), medium (6-10 cows) and large (11-17 cows) size. This enabled the study to make comparisons of profitability patterns between the various scales of operations.

2.3 Data Collection

Socio-demographic information, input costs, milk production, milk sale, household basic needs and challenges were the areas covered in semi-structured questionnaires to gather the primary data. The questionnaire was conducted in English and Nyanja (local language). The data were collected in Kobo ToolBox. A pre-test was conducted on 10 dairy farmers who were not in the final sample. Secondary data were obtained from academic literature, Government reports, DAZ records, MFL records and MCC logs.

2.4 Hypotheses

1. **H₀:** Mean profit = 0
2. **H₀:** Profit ≤ Expenditure
3. **H₀:** No herd size effect
4. **H₀:** No credit effect
5. **H₀:** No education effect

2.5 Data Analysis

Data analysis was done in R version 4.5.2. Data on demographic and economic characteristics of the respondents were summarized using descriptive statistics. Means, minimum, maximum and standard deviations were obtained for continuous variables (milk yield, input costs, household spending). Frequencies and percentage were calculated for categorical variables (gender, education, and breed). The one-sample t-test was used to determine if the mean monthly net profit was different from zero. The differences in profit between herd sizes were compared using a one-way ANOVA followed by Tukey's HSD. Each farmer's net profit was compared with the expenditure of the total family on food, education, and health using a paired t-test to determine whether or not the farmer's dairy income could meet basic needs. Independent t-tests were used to compare the herd size, milk production and profit of farmers with and without access to credit. A multiple linear regression determined the factors that affect profitability. Frequency tables and percentages were used to analyse reported problems by farmers. Chi-square tests were used to test for differences in challenge reporting related to herd size. For open-ended responses, these were analysed and collapsed into themes.

3. Results

3.1 Demographic Information

The majority of farmers were male (83%), aged 55 years

and above (53%), married (90%), and had attained tertiary education (52%). Household size was predominantly 4–9 people (67%). Most respondents had 1–5 years of dairy farming experience (56%). Friesian cattle were the most common breed (42%), followed by Jersey (38%). All respondents (100%) used semi-intensive feeding systems combining grazing and commercial feed. With respect to marital status, the overwhelming majority of farmers were married (89.6%). Over half of the respondents (51.9%) had attained tertiary education. The majority of respondents (51.9%) had between 1 and 5 years of experience.

Table 1: Demographic Information of respondents at the Milk Collection Center in Palabana

Category Variable		Number (n=77)	Percentage (%)
Gender of respondent	Female	13	17%
	Male	64	83%
Age group	25-34	5	7%
	35-44	24	31%
	45-54	7	9%
	55 and above	41	53%
Marital status	Married	69	90%
	Single	5	7%
	Widowed	3	4%
Highest level of education	Primary	19	25%
	Secondary	18	23%
	Tertiary	40	52%
Household	1-3 People	11	18%
	4-9 People	40	67%
	> 10 People	9	15%
Experience	1-5 years	40	56%
	6-8 years	10	14%
	>10 years	21	30%
Main breed type kept	Crossbreed	16	21%
	Friesian	32	42%
	Jersey	29	38%
Feeding system used	Semi-intensive	77	100.0%

3.2 Profitability of Dairy Farming

The analysis confirmed that small-scale dairy farming in Palabana is profitable. The mean net monthly profit was 22,438 ZMW (≈1,200 USD), with an average profit margin of 57% and profit per litre of 7.71 ZMW. A one-sample t-test (Table 2) showed this profit was significantly greater than zero ($t(76) = 9.74, p < 0.001$).

Table 2: One-Sample T-Test (H₀: Mean Profit = 0)

Statistic	Value
Mean Net Profit	22,438 ZMW
t-statistic	9.74
Degrees of freedom	76
p-value (one-tailed)	<0.001
95% Confidence Interval	17,786 – 27,090 ZMW

Profitability varied strongly by herd size (Figure 2). Farmers with 2–5 cows earned 6,842 ZMW per month (margin 41.2%), while those with 6–10 cows earned 18,456 ZMW (margin 54.8%). Farmers with 11–17 cows achieved the highest profits, averaging 41,250 ZMW per month (margin 63.5%). ANOVA confirmed these differences were significant ($F(2,74) = 24.6, p < 0.001$), with Tukey HSD tests (Table 3) showing all pairwise differences were statistically meaningful.

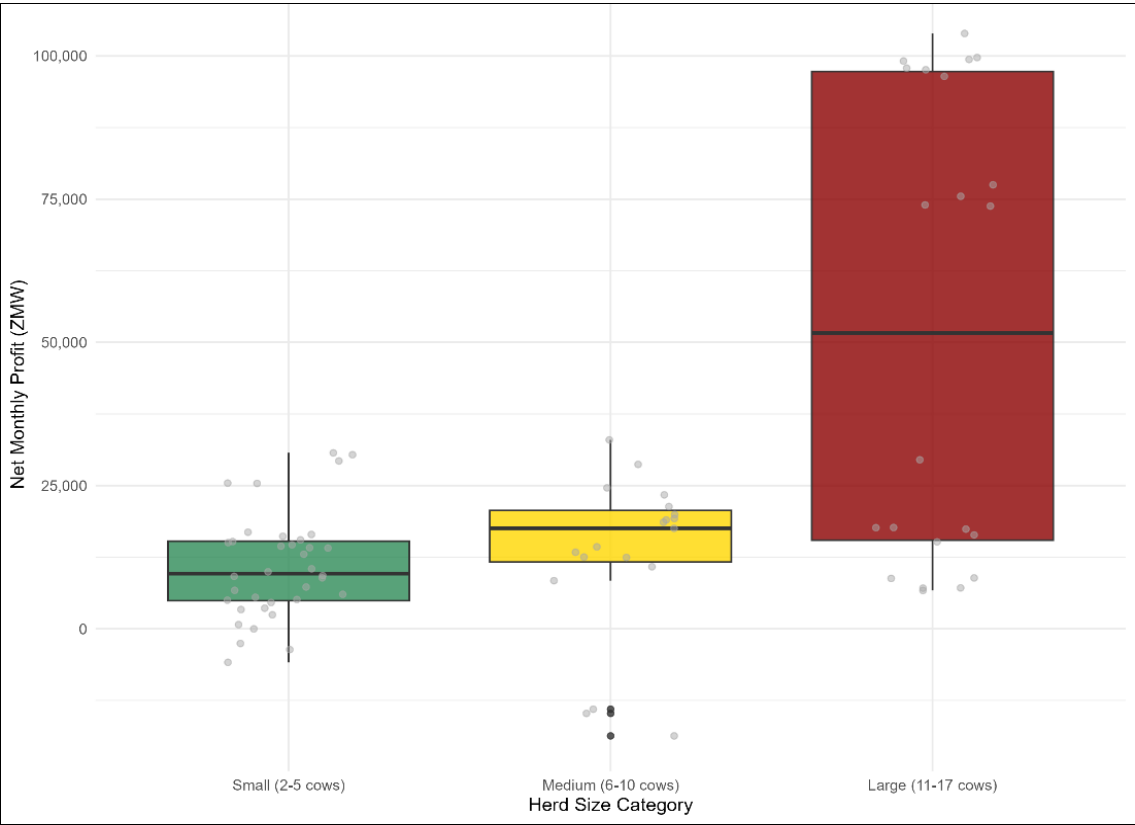


Fig 2: The comparison of net profit attained by herd size category

Table 3: Tukey HSD Post-hoc Test Results

Comparison	Difference	Lower 95% CI	Upper 95% CI	p-value (adj)
Medium – Small	11,614	5,234	17,994	<0.001
Large – Small	34,408	27,836	40,980	<0.001
Large – Medium	22,794	15,824	29,764	<0.001

3.3 Contribution of Dairy Income to Household Needs

Dairy income exceeded basic household expenditure by 14,638 ZMW per month (Table 4). Farmers spent an average of 7,800 ZMW on food, education, and health,

while dairy profits provided a surplus that could be reinvested or saved. A paired t-test (Table 5) confirmed that this difference was statistically significant ($t(76)=11.2$, $p<0.001$).

Table 4: Comparison of Dairy Profit vs Basic Expenditure

Metric	Mean (ZMW)
Monthly Dairy Net Profit	22,438
Monthly Basic Expenditure (Food + Education + Health)	7,800
Monthly Surplus	14,638

Table 5: Paired T-Test Results (Profit vs Expenditure)

Statistic	Value
Mean difference (Profit - Expenditure)	14,638 ZMW
t-statistic	11.2
Degrees of freedom	76
p-value (one-tailed)	<0.001
95% CI for difference	12,043 – 17,233 ZMW

*Conclusion: Dairy profit significantly exceeds basic household needs.

3.4 Factors Influencing Profitability

Regression analysis explained 76.4% of profit variation ($R^2 = 0.764$). Significant positive predictors included number of cows milked, milk yield per cow, credit access, education level, and years of farming experience (Table 6). Feed cost was the only significant negative predictor: a 10% increase in feed cost reduced profit by 2.9%. Veterinary cost, labour cost, cooperative membership, record keeping, and transport cost all showed non-significant relationships with profitability in the model.

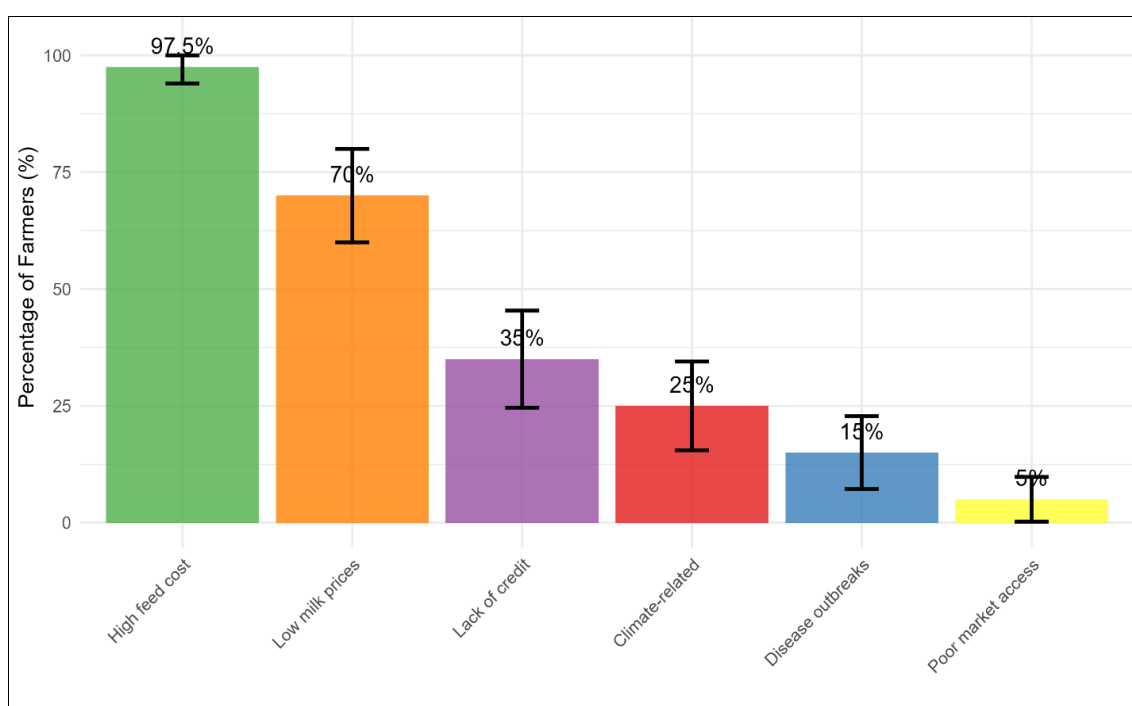
Table 6: The table summarizes the relative influence of key farm and management factors on profitability.

Predictor	Standardized β	p-value	Effect
Number of cows milked	0.412	<0.001	+20.6% per cow
Feed cost (log)	-0.318	<0.001	-2.9% per 10% increase
Milk per cow/day	0.267	<0.001	+9.3% per litre
Access to credit	0.208	<0.001	+51% with credit
Education level	0.156	0.007	+19.5% primary→tertiary
Years farming	0.132	0.012	+2.3% per year
Veterinary cost (log)	-0.042	0.180	
Labour cost (log)	-0.038	0.177	
Cooperative membership	0.089	0.560	
Record keeping	0.112	0.302	
Transport cost (log)	-0.018	0.346	

3.5 Challenges Facing Dairy Farmers

Challenges reported included high feed cost (97.5%), low milk prices (70%), lack of credit (35%), climate-related

shocks (25%), disease outbreaks (15%), and poor market access (5%).

**Fig 4:** Major challenges affecting dairy profitability in Palabana, Zambia.

Credit constraints were most severe among small-scale farmers (54%). Education was positively associated with both record-keeping and milk yield (Table 7): tertiary-educated farmers achieved 16.1 litres per cow per day compared to 11.2 litres among primary-educated farmers.

Table 7: Chi-Square Tests (Challenges by Herd Size)

Challenge	Small (n=28)	Medium (n=24)	Large (n=25)	χ^2	p-value
High feed cost	100%	96%	96%	1.2	0.549
Low milk prices	58%	71%	79%	4.8	0.091
Lack of credit	54%	33%	18%	8.9	0.012

*Conclusion: Credit constraints are significantly more severe among small-scale farmers.

3.6 Education, record keeping, and milk yield

Table 8 shows that education level is directly related to both record keeping and milk yield with higher levels of education being associated with greater record keeping and

higher milk yield. The production records were kept by 74% of farmers with primary education who had an average cow output of 11.2 L/day. When farmers are educated up to secondary level, record keeping goes up to 88% and milk yield to 14.5 L/day. Farmers with tertiary education did best, with 95% who kept records and an average yield of 16.1 L of milk per cow per day, which is 44% more than the primary-educated farmers. The standard deviations are higher with the higher education level, suggesting larger differences in yield among more educated farmers.

Table 8: Education Level vs Milk Yield and Record Keeping

Education Level	N	Record Keeping (%)	Mean Milk/Cow/Day (L)	SD
Primary	19	74%	11.2	3.4
Secondary	18	88%	14.5	4.1
Tertiary	40	95%	16.1	4.8

The ANOVA was used to determine if the milk yield differences between education groups are statistically significant. Since this p-value was <0.05 , we concluded that education level had a statistically significant effect on milk yield. This probably meant the increase in milk production among farmers with tertiary education relative to farmers with only primary education is not likely to be a random occurrence. The higher residual sum of squares (1,591.2) than education sum of squares (245.6), however, means that other factors in addition to education are important, such as feed quality, herd management, and veterinary care, which also affect milk yield.

Table 9: ANOVA Results (Milk Yield by Education level)

Source	df	Sum Sq	Mean Sq	F-value	p-value
Education	2	245.6	122.8	5.71	0.005
Residuals	74	1,591.2	21.5		

A chi-square test was used to test for the statistical significance of the relationship between education and record keeping. Since the p-value was <0.05 , we reject the null hypothesis that there is no association. This validates the concept that education and record keeping are related; that is, farmers with more education are actually more likely to maintain production records than are farmers with less education.

All three tables show education's consistent importance for managing and being productive on a dairy farm. Farmers with more education keep records more consistently and achieve higher milk yields per cow. Both relationships are statistically significant and indicate that improvements in dairy performance in Palabana may be realized with investments in farmer education and training.

Table 10: Chi-Square Test (Record Keeping vs Education Level)

	Chi-square	Df	p-value
Pearson's X^2	6.31	2	0.043

*Conclusion: Significant association between education level and record-keeping practices.

4. Discussion

The Profitability of Small-scale Dairy Farming Palabana

The findings of this study clearly indicate that the small scale dairy farming in Palabana is profitable and can sustain household livelihood. In Zambia, earlier reports indicated that margins were low, whereas Palabana's closer proximity to a functional MCC, use of better animal breeds and the support of the cooperative have led to better profit margins, at 22,438 ZMW per month. In the study of Palabana dairy cooperative, Kapende (2024) ^[7] found that socio-economic factors, production cost and production methods accounted for 61.2% of the variation in farmer's profitability in dairy farming, with majority of farmers making positive returns. The profitable data from Palabana differs from the data from other sub-Saharan Africa countries. Kiplagat *et al.* (2024) ^[8] stated that in Kenya, 12% of smallholder dairy farms in Nandi and Makueni counties operated at a loss during the year, and 35% earned a profit of less than 500 Kenyan Shillings (or 4 USD) per year. This stark contrast of results with the present study shows the importance of the locality which is to be emphasized. Kenyan smallholders are often faced with high cost of inputs and lack of market access,

however, Palabana farmers enjoy organized collection by their cooperative which offers a uniform outlet for their milk and lowers transaction costs.

Economies of Scale and Herd Size Effects

The study clearly reveals that there are economies of scale in dairy farming since the profit margin increases as the size of the herd increases from small (2-5) to medium (6-11) and to large (11-17). This pattern was also found by Mumba (2012) ^[11] who determined the herd size in six provinces of Zambia to be one of the most significant factors influencing profitability and Abin (2020) ^[1] who found in South Africa that the gross margin of larger herds is higher due to the proportional increase in revenues and the proportional increase in costs is lower. This economic principle is reflected in Palabana with higher milk volumes reported by farmers with larger herds, enabling them to allocate fixed expenses like transportation and cooperative fees over a larger milk volume for greater efficiency. The policy implication is clear: supporting smallholders to expand their herds through targeted credit programmes or heifer-in-trust schemes could substantially enhance profitability and strengthen the sustainability of small-scale dairy farming.

Sufficiency of Dairy Income for Household Needs

The study demonstrated that income from dairy farming was adequate to support households in Palabana as the average income was 14,638 ZMW higher than the basic monthly expenditure. The discovery underscores the potential of making dairy an acceptable primary livelihood option for a community where most of the smallholder families are trapped in subsistence farming. It is in line with the evidence from the region that dairy farming offers a route out of subsistence farming in Kenya and Zimbabwe (Mutsvairo, 2025, FarmBizAfrica, 2026b) ^[13, 5].

The FAO Family Farming Knowledge Platform reported that evidence from the East African highlands demonstrated that market-oriented dairy technologies like crossbred cows and improved feeding have helped to boost household incomes, which in turn has helped to increase household spending on food, education, health and other urgently required services. For the Zambian context, the surplus created as a result of dairy farming acts as a financial buffer for families to enhance nutrition, school fees, access to medical care and to invest in farm facilities. However, it is worth noting that there are variations in profits between farmers. However, communal cowshed systems resulted in better economic returns but not necessarily better nutrition for all in Zanzibar, as reported by Lumenyela *et al.* (2023) ^[9]. Those with very small herds or high feed costs may still struggle to obtain adequate income to meet household needs. This serves as a reminder that there is a difference between income sufficiency and household welfare outcomes.

Credit Access as a Transformative Factor

Access to credit was found to be transformative as farmers reported 51% higher profit when they had access to credit. This finding resonates with Kenya's cooperative-linked credit model, where structured input-supply loans have driven rapid growth in cooperatives such as Katheri and Kibiyet (PanAfrican-Agriculture., 2025b) ^[18]. The success

of Kenya's cooperative-linked credit schemes where the Cooperative Bank has provided over Sh10 billion to smallholder farmers through input-based financing with 100% repayment rates (Ndiritu, 2023) ^[14]. Similarly, the Kenya Development Corporation has recently provided a Sh500 million facility to Githunguri Dairy Cooperative for procurement of feed and herd expansion (Ngugi, 2025) ^[16]. These findings highlight the potential benefits of targeted credit interventions to unlock profitability for smallholder dairy farmers, with over half of small farms still credit constrained, compared to only 18% of larger farms credit constrained.

The Central Role of Feed Cost

High feed cost was the most prevalent constraint cited by the dairy farmers in Palabana (97.4%) and was also significantly confirmed as a negative predictor in the regression model. It is interesting to note that an increase in the price of feed by 10% will decrease the net profit by 2.9% indicating the sensitivity of Palabana farmers to feed price changes.

This finding is similar to what was reported in literature from all over sub-Saharan Africa. The same Palabana cooperative was used in the study by Kapende (2024) ^[7] who found that the cost of feed was the main factor affecting production costs and had a statistically significant effect on profitability. In the same manner, Akpainyang and Okon (2026) ^[2] observed that poor feed and fodder access are a major problem for the smallholder dairy farmers in Nigeria as most of the local cattle breeds give only 0.5 – 2L of milk per day due to poor nutrition. The Nigerian experience, however, indicates that feed constraint is not only price-related but also a quality and availability related issue.

Kiplagat *et al.* (2024) ^[8] in Kenya identified feed cost (along with labour) as the major factor influencing profitability differences between farms, and suggested that policies should focus on making farm inputs, particularly feed and water, affordable and accessible for farmers. The present study extends this recommendation by quantifying exactly how much the feed cost effect means: a 10% drop in feed costs will result in an increase of about 3% in profits.

The following are some strategies that might be used to overcome the feed cost issue in Palabana. Improved pasture production and forage conservation methods (e.g. silage making and hay making) will help farmers to reduce reliance on purchased commercial feed. In Nigeria, it has been proposed that a National Pasture Development Programme be launched to provide a steady supply of good quality pasture (Akpainyang and Okon, 2026) ^[2]. Second, bulk purchasing by the dairy cooperative may provide opportunities to farmers for economies of scale and better pricing. Third, farmers should be motivated to practice more mixed farming as suggested by Kapende (2024) ^[7] and produce their own feed, thereby lowering feed costs.

Education, Record Keeping, and Milk Yield

Record-keeping practices and milk yield per cow are significantly related to education level and this finding is an empirical confirmation of the Managerial Efficiency Theory of Profits. This indicates that better educated farmers are more likely to have better resource management and to be

more able to use more efficient technologies (Sanyal *et al.*, 2019) ^[19]. Results from ANOVA confirmed that the discrepancies in milk yield among the education levels were statistically significant and the chi-square test confirmed that the relationship between education and record keeping was also statistically significant.

The results are consistent with the results by Mumba (2012) ^[11] who found that level of education was one of the three most important determinants of profitability of smallholder dairy farming in Zambia. In the present study, an increase in education was found to directly increase profitability, which was also observed in the regression model, with the added benefit that education had a direct impact through improved milk yield/cow and record keeping.

The significance of this discovery is that it means that investments in farmer education and training may have payoff in the dairy sector that is significant. Kapende (2024) ^[7] suggested that cooperatives should carry out targeted training and develop capacity building programmes, with a provision to have demonstration farms to demonstrate best husbandry practices. The current study validates this and further recommends that the training should be targeted mainly at farmers who have completed their primary and secondary school education, who have the highest potentials in improvement. The higher productivity of the tertiary-educated farmers at 16.1 L of milk per cow/day compared with the primary-educated farmer at 11.2 L/day clearly shows the potential that can be realized with effective extension and training programmes.

Limitations of the Study

Several inferences were drawn from this study, which need to be acknowledged as limitations. It was a cross section design and therefore associations cannot be considered as definite causalities; for example, if people have access to credit they are more likely to earn higher profits, but this could also be because that more profitable farmers are more likely to meet the criteria for credit. Self-reported information may be subject to recall bias because farmers are not always able to remember their costs or revenues. The data presented in the study is from one cooperative with a working MCC and a relatively high educational level of the farmers, which further restricts generalizability to other parts of Zambia with varying conditions. Furthermore, 76.4% of the variation in profitability was explained by the regression model, but 23.6% of the variation in profitability was not explained. This remaining difference might be due to other factors not measured in the survey, such as variations in management expertise, farm facilities, or outside influences such as weather and disease outbreaks. These restrictions indicate avenues for additional research.

5. Conclusion

This study showed that small-scale dairy farming in Palabana is a profitable business and can sustain human livelihoods. The profitability is highly dependent on herd size, and there are definite economies of scale to larger herds. The number of cows milked, the milk yield per cow, availability of credit facility, education and experience on farming are the most important factors contributing to profit while high cost of feed is the single most important constraint facing almost all farmers. Credit restrictions are

especially problematic among the smallholders, highlighting the need for specific interventions to increase access to low-cost credit and lower input prices.

From the statistical findings, there are several clear policy and practice recommendations. The most effective measure is to reduce feed costs and this can be done through better pasture systems, silage and hay production, and cooperative bulk purchasing, which can lead to a gain of about 3% in profit for each 10% reduction in feed. Enhancing credit availability is also vital; farmers who obtain credit experience 51% more profit; more targeted credit models based on cooperatives, which offer inputs in lieu of cash, and have repayments drawn from milk sales would benefit the most constrained small scale farmers. Education and training is also important, as tertiary education is associated with almost 20% increase in profits, and increased strength in extension programs for farmers with primary and secondary education could result in significant profits. Other priorities include optimizing herd size, adding a milked cow to the herd will lead to an increase in profit of more than 20% but this needs to be balanced with control over feed costs so as not to negatively impact on margins. Lastly, milk price negotiation is vital, as 70% of the farmers considered low milk prices a problem; enhancing the negotiating strength of the milk producer cooperatives or implementing price stabilization mechanisms would aid producers in getting better prices for their milk.

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Ethical approval and informed consent statement

Ethical approval was obtained from the Africa University Research Ethics Committee (AUREC) (Approval Number 4257/26). Full informed consent was obtained from all participants verbally. Participation was voluntary, with no payment provided. The principle of no harm was applied throughout.

Declaration of conflicting interests

No conflicting interests declared.

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Data availability statement

Data available on request.

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