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Analysis of Challenges Facing and Factors Influencing the Profitability of Dairy Cattle Enterprises in Southwestern Uganda

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ABSTRACT

In this study, challenges experienced by dairy cattle enterprises in Southwestern Uganda and the factors influencing their profitability were respectively analyzed using exploratory factor analysis and multiple regression in STATA 15.0 statistical software. Eighteen questions relating to the challenges experienced by dairy producers in the study area were factor analyzed using principal components analysis with varimax rotation. Kaiser-Meyer-Olkin's measure of sampling adequacy was 0.643, above the commonly recommended value of 0.6, and Bartlett's test of sphericity was significant (χ^2 (153) = 1670.13, P<0.001). Using both the scree plot and eigenvalues greater than 1 to determine the underlying components, the analysis yielded five factors explaining a total of 67.42% of the variance in the data. These factors were investment constraints, productivity constraints, climatic and environmental conditions, veterinary and social security services, and marketing constraints, which explained 21.32%, 13.01%, 11.97%, 11.03%, and 10.097% of the variance after rotation, respectively. The factors hypothesized to influence the profitability of dairy enterprises were; daily milk yield per lactating cow, the prevalence rate of diseases, percentage of lactating cows to those raised on the enterprise, attendance of animal production training, the unit production cost of milk, and enterprise size according to the number of animals raised. Regression analysis results of these factors revealed that the unit production cost of milk, enterprise size, and daily milk yield per lactating cow were statistically significant. The estimated model had an R-squared value of 0.92. The recommendations emphasized in this study were reducing milk production costs, rational use of production resources, adopting improved cattle breeds, improving feeding by supplementing animal diets with concentrate feeds to increase milk yield, and general improvement in dairy herd management practices, including disease control strategies.

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Introduction

The dairy industry plays a significant role in Uganda's economic development by creating employment opportunities, improving livelihoods, and rural poverty alleviation (Herrero et al., 2013; FAO, 2019). Following its liberalization in 1993, Uganda's dairy industry has registered significant levels of growth (Balikowa, 2011; Mwebaze and Kjaer, 2013). One of the key developments registered by the industry is the increase in export levels and reduction in the level of reliance and expenditure on imported dairy products. Uganda exported 0.16 million tons of cattle dairy products worth over US$120.74 million in 2019, while only 412 tons of cattle dairy products worth US$1.69 million were imported in the same year (FAO, 2022). This is attributed to improved compliance of Uganda's milk and milk products to regional and international market standards, increased adoption of dairy cattle farming as a business by the private sector, and the annual increase in dairy processing capacities (DDA 2019, 2020).

Uganda's current milk production stands at 2.04 million tons placing Uganda in third place in terms of milk production within the East African region after Kenya and Tanzania (UBOS, 2019; UBOS, 2020; FAO, 2022). The country comprises six cattle milk-producing regions: the southwest, central, eastern, mid-west, northern, and Karamoja regions. These regions contribute 25%, 24%, 21%, 12%, 11%, and 7% to total national milk production, respectively. In addition to their differences in milk production, these regions also differ in terms of the number of cattle kept on farms, the market situation of milk and dairy products, and infrastructure on the dairy farms (Balikowa, 2011; DDA, 2021).

Uganda's dairy production systems are categorized into intensive and extensive systems, which are further divided into the small scale and medium-sized extensive and intensive systems, large scale intensive systems, agro-pastoralist, and nomadic pastoralist systems depending on the size of herds, breeds of animals raised, grazing systems, annual milk production, and level of investment (Ndambi et al., 2008; FAO, 2019). Under the intensive production systems, farmers keep herds consisting of majorly exotic dairy cattle breeds, milk production per cow ranges from 2.4 to 2.7 tons per lactation and animal diets are usually supplemented with concentrate feeds. While under the extensive production systems, farmers keep herds consisting of majorly local cattle breeds with a few crosses, milk production per lactation ranges from 0.44 to 1.14 tons per lactation, and animals are grazed on natural pastures with minimal or no supplementation with concentrate feeds (Ndambi et al., 2008).

Despite registering significant levels of growth, Uganda's dairy industry continues to experience several challenges. Among these challenges are seasonality of milk production and consumption, unregulated informal milk markets and unreliable formal markets, high production costs, animal breeding challenges, climatic factors, and livestock diseases (Dobson and Combs, 2005; Ekou, 2014; Waiswa et al., 2021). These challenges limit the industry's potential to; alleviate poverty, improve household livelihoods, and contribute to food security and nutrition.

Additionally, dairy cattle enterprises experience low-profit levels because of the high production costs, low milk yields, and low milk prices. Profit being the criterion used for evaluating the economic viability, managerial efficiency, and social goals of any business, failure to generate profits has driven farmers and dairy cattle enterprises out of the industry, prompting them to replace dairy herds with beef herds because the latter are considered more profitable (Tumushabe, 2020). In light of the above, this study was conducted with two objectives: to provide detailed information about the significant challenges experienced by dairy cattle enterprises, and examine the factors that influence the profitability of these enterprises, and thereby generate policy implications to improve farm economic sustainability.

Materials and Methods

This study used both primary and secondary data. Primary data was collected from January to April 2021 using data compilation forms from 100 randomly sampled dairy cattle enterprises in Mbarara, Kiruhura, Lyantonde, Isingiro, and Ibanda districts, located in Southwestern Uganda. Secondary data were obtained from field reports compiled by Dairy Development Executives of Pearl Dairy Farms Limited during their farmer training activities in the study area. Data compilation forms covered a one-year production period (2019 to 2020). The data were recorded in Microsoft Excel 2019 and transferred to STATA 15.0 statistical software for analysis. The enterprises were divided into three categories according to the number of animals raised, i.e., the first group had enterprises that raised from 1 to 100 animals, the second group had those that raised 101 to 200 animals, and those that raised above 200 animals constituted the third group.

Exploratory factor analysis was used to group and summarize the challenges faced by dairy enterprises in the study area. Factor analysis is a statistical technique used to group and summarize a large number of variables that may be related to one another because they are all associated with the same underlying factor into a smaller number of factors or latent variables (Topcu et al., 2010). To increase the accuracy of factor analysis results, in addition to the 100 randomly sampled dairy cattle enterprises, data on 100 more dairy cattle enterprises was obtained from field reports compiled by Dairy Development Executives of Pearl Dairy Farms Limited in the study area to make 200 dairy cattle enterprises. These field reports presented sufficient information about the challenges experienced by the enterprises; however, information about the economic performance of the enterprises was not sufficient enough which is why the information obtained therein was not used for any other analyses except for factor analysis. The principal components analysis (PCA) method was used to extract the factors from the variables. Factors were extracted based on eigenvalues greater than 1. The Kaiser-Meyer-Olkin (KMO) test of sampling adequacy and Bartlett's test of sphericity were used to test whether the sample size was sufficient and had enough correlations between the variables for factor analysis. The varimax method was used for rotation because the factors were thought to be independent.

The model for the profitability of the enterprises was estimated using multiple regression. Multiple regression is a statistical technique used to analyze the relationship between a dependent variable and a set of independent variables. It is often used to accomplish three objectives; to find the best prediction equation for a group of variables, to control for confounding factors to assess the contribution of a specific variable or set of variables, that is, identifying independent relationships and finding structural relationships, and provide explanations for seemingly complex multivariate relationships (Ho, 2013). The model for the profitability was specified as given below:

$$y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \varepsilon$$

Where;

y = Profits per liter of milk produced (US$/liter)

$\beta_{(1,2,3,...,6)}$= Regression coefficients of the independent variables, 1, 2, 3,..., 6 are values for the respective independent or x variables

ε = Error term

x_1 = Unit production cost of milk (US$/liter)

x_2 = Enterprise size (1-100: 1, 101-200: 2, and >200: 3)

x_3 = Prevalence rate of diseases (%) (Number of sick cattle/Total number of cattle)

x_4 = Daily milk yield per lactating cow (liter/head/day)

x_5 = Percentage of lactating cows to those raised on the enterprise (%)

x_6 = Attendance of animal production training (Dummy, No: 0, Yes: 1)

The estimated model was tested for autocorrelation, heteroscedasticity, and multicollinearity using the Durbin-Watson statistic, Breusch-Pagan or Cook-Weisberg test, and Variance Inflation Factors (VIF), respectively.

Table 1. Socio-demographic and economic characteristics of dairy cattle producers

Variable	Number	%
Address		
• Kiruhura	30	30.0
• Mbarara	14	14.0
• Isingiro	13	13.0
• Ibanda	14	14.0
• Lyantonde	29	29.0
Age of dairy producers		
• 30.00 – 44.00	30	30.0
• 45.00 – 59.00	53	53.0
• 60.00 – 74.00	16	16.0
• 75.00 – 89.00	1	1.0
Education level of dairy producers		
• Primary Education	41	41.0
• Secondary Education	21	21.0
• Tertiary/Vocational institution	24	24.0
• University Education	10	10.0
• No Formal Education	4	4.0
Main economic activity of dairy producers		
• Animal Farming	88	88.0
• Crop Farming	4	4.0
• Civil Servant	5	5.0
• NGO worker	1	1.0
• Trader	1	1.0
• Others	1	1.0
Secondary economic activity		
• Animal Farming	12	12.0
• Crop Farming	43	43.0
• NGO worker	2	2.0
• Retired	6	6.0
• Trader	9	9.0
• Others	6	6.0
• No secondary activity	22	22.0
Size of land owned		
• 20.00 – 119.00	46	46.0
• 120.00 – 219.00	34	34.0
• 220.00 – 319.00	8	8.0
• ≥320.00	12	12.0
Total number of cattle raised		
• 15.00 – 64.00	39	39.0
• 65.00 – 114.00	50	50.0
• 115.00 – 164.00	7	7.0
• ≥165.00	4	4.0
Number of lactating cows		
• 5.00 – 14.00	30	30.0
• 15.00 – 24.00	39	39.0
• 25.00 – 34.00	15	15.0
• 35.00 – 44.00	8	8.0
• ≥45.00	8	8.0
Daily milk production (liters)		
• 30 – 129	71	71.0
• 130 – 229	23	23.0
• ≥230	6	6.0

Results

Face to face interviews were conducted on 30, 29, 14, 14, and 13 dairy farms in Kiruhura, Lyantonde, Mbarara, Ibanda, and Isingiro districts. The ages of the dairy producers ranged from 30 to 78 years, with the most significant percentage (53%) being between 45 and 59 years old. The average age of dairy producers in the study area was 49 years. The largest share of dairy producers (41%) in the study area had acquired primary education as the highest level of education. Only 10% had attained a university education, and 4% had never acquired any formal education. A significant portion of dairy producers (88%) practiced animal farming as their main economic activity. The most significant share of dairy producers (46%) reported owning between 20 and 119 acres of land. The average land size of dairy cattle producers in the study area was 177 acres. The maximum and minimum land sizes were 680 and 20 acres, respectively. A significant percentage of enterprises (50%) had 65 to 114 heads of cattle. The average number of cattle raised on enterprises in the study area was 78 heads. Regarding the number of cows milked, the largest portion of enterprises (39%) had 15 to 24 lactating cows, followed by 30% that had 5 to 14 lactating cows. On average, there were 22 lactating cows on each enterprise in the study area. The ratio of lactating cows to the total number of cattle raised on the enterprises was determined as 28.2%. Looking at milk production on the enterprises, 71% produced between 30 to 129 liters of milk per day. On average, 109.2 liters of milk were produced per enterprise per day, and an average of 6 liters per day were produced per lactating cow.

Challenges Experienced by the Enterprises

Moderate correlations existed in the data according to the correlation matrix, i.e., plenty of variables had correlations above 0.3, while none of them had correlations exceeding 0.9, which suggests that there was no multicollinearity and the analysis was appropriate. Eighteen questions relating to the challenges experienced by dairy producers in the study area were factor analyzed using principal components analysis with varimax rotation. Kaiser-Meyer-Olkin measure of sampling adequacy was 0.643, above the commonly recommended value of 0.6, and Bartlett's test of sphericity was significant (χ^2 (153) = 1670.13, P<0.001). Using both the scree plot and eigenvalues greater than 1 to determine the underlying components, the analysis yielded five factors explaining a total of 67.42% of the variance in the data, as shown in Table 2.

Table 2. Eigenvalues of the factors after extraction and rotation

Factors	Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	3.852	21.398	21.398	3.837	21.315	21.315
2	2.619	14.549	35.947	2.342	13.013	34.327
3	2.366	13.146	49.094	2.155	11.974	46.301
4	1.921	10.672	59.766	1.985	11.026	57.327
5	1.378	7.658	67.424	1.817	10.097	67.424

Table 3. Challenges experienced by enterprises and their corresponding variable loadings

Factors (Variables)	Loading of Variables
Investment constraints (Factor 1)	
Insufficient farmers' training opportunities	-0.897
Inadequate profits for expansion of the enterprise	0.773
Insufficient resources to plant pastures	0.771
Scarcity of pastures during some periods of the year	-0.734
Inadequate capital to expand the enterprise	0.708
Low levels of milk production	0.536
Productivity constraints (Factor 2)	
Low pregnancy rates	0.813
Limited access to quality breeding bulls	0.764
Insufficient support and financing opportunities	-0.573
High milk production costs	-0.499
Occurrence of repeated heat after mating or insemination	0.486
Climatic and environmental conditions (Factor 3)	
Production is greatly affected by the prevalence of animal diseases	0.925
Production is greatly affected by climatic conditions	0.904
Veterinary and social security services (Factor 4)	
Limited access to veterinary services	0.787
Insufficient social security system	0.771
Marketing constraints (Factor 5)	
Inadequate infrastructure and facilities	0.871
Limited market for milk	0.684
Low milk prices	0.459

Kaiser-Meyer-Olkin measure of sampling adequacy = 0.643. Bartlett's test of sphericity: Approx. Chi-Square = 1670.133, df = 153 (P<0.001)

Table 4. Major diseases affecting enterprises and their frequency of occurrence

Disease	Affected Enterprises (%)	Unaffected Enterprises (%)	Frequency of occurrence (%)			Number of Animals Affected (%)			Dead Animals (%)		
			1 to 2	3 to 5	Often	1 to 5	6 to 10	>10	No Deaths	1 to 5	6 to 10
Stillbirths	13	87	10	3	0	13	0	0	13	0	0
Foot diseases	4	96	1	3	0	4	0	0	4	0	0
Septicemia	1	99	1	0	0	1	0	0	1	0	0
Mastitis	17	83	14	1	2	15	2	0	17	0	0
Theileriosis	88	12	6	28	54	34	46	8	21	65	2
Rickettsiosis	1	99	1	0	0	1	0	0	1	0	0
Hypocalcemia	19	81	18	1	0	19	0	0	17	2	0
Anaplasmosis	71	29	33	31	7	65	6	0	7	60	4
Brucellosis	6	94	5	1	0	6	0	0	3	3	0
Heartwater	22	78	20	2	0	22	0	0	5	17	0
Babesiosis	21	79	15	6	0	21	0	0	5	16	0
Other infections	24	76	16	3	5	19	3	2	11	12	1

Table 5. Regression analysis results of the factors influencing the profitability of the enterprises

Independent Variables		Coef.	Std. Err.	t	P>t	[95% Conf. Interval]		VIF	1/VIF
Unit production cost of milk (US$/liter)	X_1	-1.04361	0.03477	-30.02	0.000	-1.1127	-0.9746	1.16	0.861
Enterprise size	X_2	-0.01933	0.00542	-3.56	0.001	-0.0301	-0.0086	1.08	0.927
Prevalence rate of diseases (%)	X_3	-0.00019	0.00013	-1.45	0.149	-0.0005	0.0001	1.06	0.945
Daily milk yield per lactating cow (liter/head/day)	X_4	0.00456	0.00120	3.81	0.000	0.0022	0.0069	1.28	0.781
Percentage of lactating cows to those raised on the enterprise (%)	X_5	0.00002	0.00014	0.17	0.863	-0.0003	0.0003	1.37	0.728
Attendance of animal production training	X_6	0.00564	0.00394	1.43	0.156	-0.0022	0.0135	1.20	0.833
Constant		0.23876	0.01455	16.41	0.000	0.2099	0.2677	Mean VIF = 1.19	

F (6, 93) = 174.80, Prob > F = 0.0000; R-squared = 0.9185, Adj R-squared = 0.9133

As shown in Table 3., Factor 1 was labeled 'Investment constraints' because of the high loadings by the following items: insufficient farmers' training opportunities, inadequate profits for the expansion of the enterprise, insufficient resources to plant pastures, scarcity of pastures during some periods of the year, inadequate capital to expand the enterprise and low levels of milk production. This factor explained 21.32% of the variance after rotation. Factor 2 explained 13.01% of the variance after rotation and was labeled 'Productivity constraints' because of the high loadings by low pregnancy rates, limited access to quality breeding bulls, the occurrence of repeated heat after mating or insemination, high milk production costs, and insufficient support and financing opportunities. Factor 3 explained 11.97% of the variance after rotation and was labeled 'Climatic and environmental conditions' because of the high loadings by the following items: production is greatly affected by climatic conditions and the prevalence of animal diseases. Factor 4 was labeled 'Veterinary and social security services' because of the high loadings by limited access to veterinary services and insufficient social security system. This factor explained 11.03% of the variance after rotation. Factor 5 was labeled 'Marketing constraints' and represented the following items: inadequate infrastructure and facilities, limited market for milk, and low milk prices. This factor explained 10.097% of the variance after rotation.

Factor 3 represented items "production is greatly affected by the prevalence of animal diseases and climatic conditions." Among the diseases encountered on the enterprises, Theileriosis and Anaplasmosis were of the greatest economic importance. They contributed the highest to the number of infections and animal deaths, as shown in Table 4. These affected 88% and 71% of the enterprises in the study area, respectively, during the 2019-2020 production period. Theileriosis frequently occurred in 54%, 3 to 5 times in 28%, and 1 to 2 times in 6% of the enterprises, while Anaplasmosis was frequently encountered in 7%, 3 to 5 times in 31%, and 1 to 2 times in 33% of the enterprises interviewed during the production year. Furthermore, 34%, 46%, and 8% of interviewed dairy producers recorded 1 to 5, 6 to 10, and above 10 cases of Theileriosis, respectively, with 65%, and 2% of them recording between 1 to 5 and 6 to 10 animal deaths due to the infection, respectively. While 65% and 6% of interviewed dairy producers recorded 1 to 5 and 6 to 10 cases of Anaplasmosis, respectively, with 60% and 4% of them recording between 1 to 5 and 6 to 10 deaths due to the infection, respectively.

Factors Influencing the Profitability of the Enterprises

The factors hypothesized to influence the profitability of dairy enterprises in the study area were; daily milk yield per lactating cow, the prevalence rate of diseases, percentage of lactating cows to those raised on the enterprise, attendance of animal production training, the unit production cost of milk, and enterprise size according to the number of animals raised. The regression results of the profitability model are shown in Table 5. The model had an R-squared value of 0.92. In the model, daily milk yield per lactating cow, percentage of lactating cows to those raised on the enterprise, and attendance of animal production training positively influenced the profitability, while the unit production cost of milk, enterprise size, and the prevalence rate of diseases negatively affected the

profitability of the enterprises in the study area. The unit production cost of milk, enterprise size, and daily milk yield per lactating cow were statistically significant ($p<0.001$). The Durbin Watson statistic, the p-value for the Breusch-Pagan / Cook-Weisberg test for heteroscedasticity and the mean of Variance Inflation Factors (VIF) were 1.264, 0.075 ($P>0.05$), and 1.190, respectively, an implication that the model showed neither autocorrelation, heteroscedasticity, nor multicollinearity, respectively. The estimated model is presented below (figures in parentheses are t values).

$$Y = 0.23876 - 1.04361X_1 - 0.01933X_2 - 0.00019X_3 + 0.00456X_4 + 0.00002X_5 + 0.00564X_6$$

(16.410) (-30.020) (-3.560) (-1.450) (3.810) (0.170) (1.430)

Discussion of Results

The challenges experienced by dairy enterprises in the study area were grouped into five factors, i.e., investment constraints, productivity constraints, climatic and environmental conditions, veterinary and social security services, and marketing constraints. These represented the following items: insufficient farmers' training opportunities, inadequate profits for the expansion of the enterprise, insufficient resources to plant pastures, scarcity of pastures during some periods of the year, inadequate capital to expand the enterprise, low levels of milk production, low pregnancy rates, limited access to quality breeding bulls, the occurrence of repeated heat after mating or insemination, high milk production costs, insufficient support and financing opportunities, climatic conditions, the prevalence of animal diseases, limited access to veterinary services, insufficient social security system, inadequate infrastructure and facilities, limited market for milk, and low milk prices. Several of these challenges were also reported by different authors from several studies, reports, and reviews. Among these are Balikowa (2011); Sikawa and Mugisha (2011); Ekou (2014); Rutaro (2015); Tijjani and Yetişemiyen (2015); Tibezinda et al. (2016); Vudriko et al. (2016); Wangalwa et al. (2016); Vudriko et al. (2018); Byaruhanga et al. (2020) and Waiswa et al. (2021). In terms of infrastructure and facilities, the poor road network and inadequate milk cooling and transportation equipment made it challenging to transport milk to market centers and the irregularities in electricity supply always interfered with the processing and storage of milk.

The insufficient support and financial opportunities in terms of credit sources limited the ability of dairy producers to expand their enterprises, afford modern equipment, and establish cattle structures on the enterprises. Climatic conditions have been reported to affect dairy production in Uganda in several ways. They influence the availability of natural pastures in terms of quality and quantity, which are the primary source of fodder for dairy producers in the study area (Balikowa, 2011; Ekou, 2014; Tibezinda et al., 2016). Dry seasons are known for the scarcity of quality pastures, leading to drastic reductions in milk yield during such seasons of the year. Climatic conditions also influence milk prices, with wet seasons having low milk prices because of surplus milk production and the dry seasons having high milk prices because of the low milk production (Dobson and Combs, 2005; DDA, 2019; DDA, 2020). Among the veterinary services, dairy producers lacked access to artificial insemination services. All interviewed dairy producers relied on the natural mating system of using bulls for breeding purposes because artificial insemination services were expensive and not readily available. While the provision of these services may be driven by the level of demand to a greater extent, increased dairy cattle productivity in the long run, may require interventions to increase their availability and access.

The prevalence of diseases, especially tick-borne diseases such as Theileriosis and Anaplasmosis, were highly reported among the challenges, which corroborates well with Vudriko et al. (2016); Byaruhanga et al. (2020)'s studies where it was reported that tick-borne diseases, mainly Theileriosis are the major diseases of economic importance in Southwestern Uganda. These infections cause significant losses to dairy producers in several ways. These include financial losses from cattle morbidity and mortality, production losses due to the infected animals' reduced production potential, and expenses incurred in the measures taken to control ticks and treat the diseases (Gachohi et al., 2012). The prevalence of tick-borne infections further prevents the adoption of highly productive exotic cattle breeds that are more susceptible to the infections, thus considerably hindering the development of the dairy industry in Uganda (Gachohi et al., 2012).

Tick-borne infections can be controlled by three methods: control of ticks, immunization of cattle, and integrated control, which is a combination of the two. Ticks in Uganda are controlled by directly applying acaricides using dip tanks, spray races, hand sprays, and pour-ons (Gachohi et al., 2012). Almost all dairy farmers in the study area relied solely on controlling ticks by spraying or dipping animals as the only way to prevent tick-borne infections. A negligible number of farmers vaccinated their herds against Theileriosis. These measures increase the production costs of enterprises. In economic terms, the application of acaricides as the primary means of controlling ticks is estimated to cost between US$6 and US$36 per adult animal in Uganda (Gachohi et al., 2012).

There are reports about high tick acaricide resistance in Southwestern Uganda, which increases the costs of controlling tick-borne infections (Vudriko et al., 2016; Vudriko et al., 2018; Byaruhanga et al., 2020). The same was also reported on several enterprises during data collection. Farmers in the study area reported complete failure of acaricides to control ticks despite increasing concentrations of the acaricide and increasing the number of times animals were sprayed or dipped against ticks. Under such a situation, using the integrated tick-borne disease control system is the best option that can be recommended to dairy producers, that is, both immunizing their animals against infections like Theileriosis and applying acaricides to control ticks. However, more drastic and structural measures such as training dairy producers on the use and handling of acaricides, zoning of the acaricides used in the country, and advanced scientific support and research are needed to eradicate tick-borne infections.

The limited market for milk can be attributed to the worsening relations between Uganda and its neighbors, Kenya and Rwanda. In February 2019, Rwanda closed the Gatuna border post, restricting entry from both Uganda and Rwanda (Africannews, 2022), while in December of the same year, Kenya, which is a major importer of more than 80% of Uganda's dairy products, banned milk imports from Uganda (Waiswa et al., 2021). Creating lasting solutions to these issues will be vital in creating the right atmosphere for trade between the countries and improving the export market for Uganda's dairy products.

Among the factors hypothesized to influence the profitability of dairy enterprises in the study area, daily milk yield per lactating cow, percentage of lactating cows to those raised on the enterprise, and attendance of animal production training positively influenced the profitability. On the other hand, the unit production cost of milk, enterprise size, and the prevalence rate of diseases negatively affected the profitability of the enterprises in the study area. High milk yield per lactating cow increases the profitability of the enterprise. As the ratio of the number of lactating cows to the total number of cattle on the enterprise increased, profitability increased because most of the expenses in terms of treatment, feeding, disease prevention and control, and general management are compensated by the revenue from the high amounts of milk produced by the lactating cows. A low number of lactating cows compared to the total of animals raised on the enterprises means that the revenue generated from the milk produced is not enough to compensate for the management costs of the non-lactating animals on the enterprises, thus low profitability.

Attendance of animal production training influences the rate of adoption and implementation of improved production systems to increase milk yield on the enterprise, thereby positively influencing profitability. The prevalence rate of diseases negatively affected the profitability of the enterprises because high rates of disease prevalence result in more expenses for treatment and preventive measures of the disease and a reduction in the productivity of the animals in terms of milk yield. Enterprises with large herds generated lower profits than those with small herds. This could be attributed to managerial incompetence, irrational use of resources such as land, and a lower number of lactating cows compared to the enterprise's total herd. Additionally, large herd sizes mean more production costs in managing and taking care of the herds, feeding, controlling, and preventing diseases, reducing the enterprise's profit margin in milk production. This, however, does not mean that dairy producers should not own large herds. Instead, emphasis should be laid on the rational use of the resources on the enterprise to ensure sustainable production.

The unit production cost of milk, enterprise size, and daily milk yield per lactating cow were statistically significant ($P<0.001$). Results of the model predicted that a dollar increase in the unit production cost of milk and a unit increase in the enterprise size decreased profits of the enterprise by US$1.044 and US$0.019 per liter of milk produced, respectively. On the other hand, a liter increase in the daily milk yield per lactating cow increased profits of the enterprise by US$0.0046 per liter of milk produced. This suggests that all efforts to improve the profitability of the enterprises should be directed more towards reducing the production costs, increasing the daily milk yield of each lactating cow, and rational use of the enterprise's active capital elements to ensure the sustainability of the enterprises. Daily milk yield can be increased through strategies such as adopting improved cattle breeds, improved feeding and concentrate supplementation to increase the quality and quantity of animal diets, and general improvements in dairy herd management practices, including strategies to control diseases.

Conclusion

As responsible authorities continue to lay strategies necessary to transform Uganda from a predominantly peasant and low-income country to a competitive upper middle-income country, the dairy industry's role in achieving this should not be underestimated. However, to ensure that the abundant opportunities presented by this industry are exploited, the challenges experienced by the different actors along the production and value chain need to be taken into account and necessary strategies to overcome them, need to be established. This study attempted to establish the challenges faced by dairy enterprises in Southwestern Uganda and analyze the factors that influence the profitability of these enterprises. The findings and information presented herein are intended to demonstrate the rationale for formulating and implementing structural policies to improve dairy sector production in the country. This study revealed that the unit production cost of milk, enterprise size and daily milk yield per lactating cow were significant in influencing the profitability of the enterprises. In light of this, recommendations that need to be emphasized are reducing milk production costs, rational use of resources such as land, increasing the daily milk yield per lactating cow through strategies such as adopting improved cattle breeds, improving feeding by supplementing animal diets with concentrate feeds and general improvement in dairy herd management practices, including disease control strategies.

Conflicts of Interest

The authors declare no conflicts of interest.

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