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Economic analysis of dairy production in Uganda, a case study on the performance of dairy cattle enterprises in Southwestern Uganda

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Abstract. *Waiswa D, Günlü A. 2022. Economic analysis of dairy production in Uganda, a case study on the performance of dairy cattle enterprises in Southwestern Uganda. Asian J Agric 6: 61-67.* The economic performance of dairy cattle enterprises in Southwestern Uganda was analyzed in this study. A survey was conducted on 100 dairy cattle enterprises in Mbarara, Kiruhura, Lyantonde, Ibanda, and Isingiro Districts using data compilation forms covering the 2019/20 production year. The unit production cost of milk was determined as US$0.19L^{-1}. Veterinary expenses had the largest share of the production costs at 24.94%, followed by labor costs, depreciation of the inventory value, other expenses, and feed costs, which contributed 14.11%, 12.46%, 11.96%, and 11.41%, respectively. Additional costs included the depreciation of animals, electricity and water, buildings, equipment and machinery, maintenance-repair, and general administrative expenses, which contributed 9.95%, 7.86%, 2.54%, 2.29%, and 2.48% to the total production costs, respectively. As a result, while the net profit of the enterprises was determined as US$1435.29, their financial profitability was 0.59, the profitability factor was 12.20, and the output-input ratio was 1.06. The overall profitability of the enterprises was affected mainly by the high veterinary expenses due to the high prevalence rates of tick-borne infections and the irrational distribution of capital elements. Therefore, measures to reduce the occurrence of tick-borne diseases are considered vital in lowering milk production costs, thereby increasing the profitability of enterprises.

Keywords: Dairy cattle enterprises, dairy production, economic analysis, economic performance

INTRODUCTION

Uganda's economy is estimated to have grown by 2.9% during the 2019/2020 fiscal year, with real Gross Domestic Product (GDP) standing at US$35 billion (at 2016/2017 prices) (UBOS 2020). As among the largest foreign exchange earners, contributing to Uganda's export earnings through exports valued at more than US$120.74 million as of 2019 (FAOSTAT 2021), the dairy industry contributes significantly to this GDP value. Furthermore, dairy production has significant potential to reduce hunger, malnutrition, and rural poverty, improve rural livelihoods, promote food security and nutrition, create employment opportunities, promote gender equality, and support the overall development of Uganda's economy (Herrero et al. 2014; FAO 2019; Waiswa and Akullo 2021).

Available statistics reveal that Uganda's annual milk production stands at 2.04 million tons (UBOS 2020), obtained from an estimated 4.14 million heads of milked cows. Each cow was estimated to produce 492.8 liters of milk per lactation (FAOSTAT 2021). Out of the total milk produced, 80.2% is marketed for an estimated US$835.9 million (2019), and the remaining 19.8% is consumed at farms and household levels. Of the marketed milk, 34% is processed into a wide range of products such as powdered milk, butter, UHT milk, yogurt, cream, ice cream, and cheese, while the remaining 66% is sold in raw form (DDA 2020).

Regarding dairy products' export and import, Uganda exported 0.16 million tons of dairy products worth over US$120.74 million in 2019, while 412 tons worth US$1.69 million were imported in the same year (FAOSTAT 2021). The high level of dairy exports over imports implies low reliance and expenditure on imported dairy products, indicating the industry's growth. The increase in Uganda's dairy export value is attributed to improved compliance of Uganda's dairy products to regional and international market standards and the annual increase in dairy processing capacities (DDA 2020).

Despite these developments, studies analyzing the economic performance of dairy cattle enterprises in Uganda are still scanty. Therefore, this study was conducted to determine the profitability of dairy cattle enterprises while calculating the costs involved in the production and establishing the unit cost of milk production. The information generated is intended to draw the attention of dairy producers, international and voluntary organizations, government agencies, and other private stakeholders to implement technical, economic, and structural policies to improve dairy cattle production. These improvements will be essential in rural development and in alleviating poverty and malnutrition in the country.

MATERIALS AND METHODS

Face-to-face interviews were conducted with the enterprise owners on 100 randomly sampled dairy cattle in Southwestern Uganda. The interviews are from January to April 2021, located in Mbarara, Kiruhura, Lyantonde, Isingiro, and Ibanda Districts. The data was collected using data compilation forms covering 2019 to 2020. Production costs on the enterprises included feed, labor, veterinary, maintenance and repair, general administrative costs, depreciation in the capital elements (machinery, equipment, and animals), and other expenses.

Feed costs included the production and purchase of roughage and concentrate feeds. Labor costs were divided into family and hired labor. For hired labor, the labor cost was calculated using the amount of money directly paid to workers. While for unpaid family labor, the labor cost was calculated by multiplying the number of family workers by the average amount of money paid to a hired worker to perform the same task in the same region. Veterinary expenses covered veterinary examination fees, treatment and vaccination costs, and acaricides and disinfectants. Artificial insemination costs were not included in the veterinary expenses because any interviewed farmers didn't use it. Instead, they relied on the natural breeding system. Maintenance and repair costs covered expenses incurred in maintaining and repairing fixed capital investments (animal shelter, equipment, and machinery) used in production. Finally, general administrative expenses were calculated as 3% of the total costs of dairy enterprises (Mat and Cevger, 2020).

The straight-line method was used to calculate the depreciation values of buildings, machinery, and equipment because of its simplicity and the assumptions that the assets were expected to render uniform service throughout their estimated economic life and the amount of depreciation was a function of time only. These were calculated by subtracting the item's scrap value from its new value or value at initial purchasing and dividing the result by the item's economic life. For example, the depreciation value of animals used in milk production (lactating cows) was arrived at by subtracting its value at slaughter from the breeding value and dividing the resultant figure by the economic life of the animals (Mat and Cevger, 2020). The average economic life of cattle was taken to be six years. Since depreciation was calculated for lactating cows, the change in inventory was calculated using the values of heifers, calves older than seven months, and bulls on the enterprise. Calves less than seven months old were considered under calf income. A negative value indicates a depreciation in the inventory. Therefore, the resultant value was considered as a production cost. In contrast, a positive value indicated an increase in the inventory, and the consequent value was regarded as a secondary income of the enterprise (Mat and Cevger 2020).

Income from products other than milk, considered the main product in dairy farming, was considered secondary income. These included the sum of income from the sale of calves and manure and the positive value of the change in inventory (Günlü 1997; Mat and Cevger 2020). The total costs of the enterprises were obtained by subtracting the total secondary incomes from the total general expenses. For example, income from milk sales was obtained by multiplying the amount of milk produced at the end of the production period by its selling price, while the production cost of 1 Liter of milk was obtained by dividing the total cost by the total amount of milk received at the end of the production period (Mat and Cevger 2020).

Financial profitability or profitability of equity capital is an important criterion used to measure how efficiently the enterprise uses its capital and, therefore, its success. It was obtained as a percentage of net profit and equity capital quotient. While economic profitability, an indicator of how effectively all the economic resources involved in the dairy production activities of the enterprise are utilized, was obtained by dividing the sum of net profit and passive capital by the value of active capital. The profitability factor obtained a percentage of the quotient of the net product of the enterprise and the gross product (Günlü 1997). The elements included in the calculation of the gross product were the values of all products obtained from the enterprise and inventory value increases. The value of the products given out by the enterprise in kind, while the net product was obtained by subtracting the total costs (variable + fixed costs) from the value of the gross product (Gül and Gürbüz 2016; Göçoğlu and Gül 2019). The Output-Input ratio was obtained by dividing the enterprises' total revenue by the total expenses (Cicek and Tandogan 2008). All expenses and revenues were converted to United States dollars at the 2019/20 financial year-end period's average exchange rate of US$1 = 3730.14 UGX (BoU 2021).

RESULTS AND DISCUSSION

This study was conducted on 30, 29, 14, 14, and 13 randomly selected dairy cattle enterprises in Kiruhura, Lyantonde, Mbarara, Ibanda, and Isingiro districts, respectively, as presented in Table 1. The most significant proportion of dairy producers (41%) had attained primary education at the highest level, followed by 24% with tertiary or vocational training and 21% with secondary education. The ages of the interviewed dairy producers ranged from 30 to 78 years, and the average age was 49 years. A significant portion of dairy producers (88%) practiced animal farming as their main economic activity.

These findings corroborate well with Sikawa and Mugisha (2011), Rutaro (2015), Tibezinda et al. (2016), Wangalwa et al. (2016), and Byaruhanga et al. (2020) 's findings from their studies conducted in Southwestern Uganda. These studies revealed that the average age of dairy producers in the region ranged from 47 to 54 years, more than 50% of the dairy producers had attained above the primary level of education, and the largest percentage of the population in this region is engaged in livestock farming as the main economic activity. Therefore, the education level of farmers may have a significant influence on several factors as far as dairy production is concerned, such as managerial competencies, successful implementation of improved production, processing, and

milk marketing, and the rate of adoption of innovations in dairy production, which could enhance increased milk production and the profitability of the enterprises (Sikawa and Mugisha 2011; Sisay et al. 2018).

Dairy producers in the study area owned large pieces of land for dairy activities such as grazing and growing fodder; none hired land for any dairy farming activities. The land is a great requirement for dairy producers in the study area because they practice extensive dairy farming. The size of land owned ranged from 20 to 680 acres, with the average land size being 177 acres. The results further revealed that, on average, 2.3 acres of land were used by each grazing animal. That exceeds the recommended 1.5 to 2.0 acres of land per cow (Virginia 2020), indicating that land is not a problem for dairy producers in the study area. However, despite the availability of enough land, only 11% of the interviewed dairy producers planted pastures, mainly Napier grass, for their animals moreover on small pieces of land (4 acres on average). That shows a high level of reliance on rain-fed natural pastures as fodder, which explains why dairy producers are significantly affected during dry seasons. During such seasons, dairy producers are constrained by pasture scarcity, leading to drastic milk yield reductions (Balikowa 2011; Waiswa et al. 2021).

Considering that there is enough land on which to establish pastures, the low levels of planting pastures reported could be attributed to factors such as lack of planting materials (pasture seeds), high costs of the available planting materials, insufficient farmer training opportunities about pasture establishment and conservation and/or the bad attitude of farmers towards planting pastures. Therefore, this calls for efforts to be invested in encouraging and training farmers on pasture establishment and conservation and providing the necessary planting materials (either freely or at subsidized costs) to ensure the availability of animal feeds throughout the year.

The average number of cattle raised was 78 heads, with some enterprises having as low as 19 heads while others had as high as 450 heads of cattle (Table 2). Most cattle raised in the study area were crossbreeds between Ankole cattle and exotic dairy breeds, the most common being the Holstein Friesian breed; 84% of the respondents raised only crosses, while 16% raised both crosses and local Ankole breeds. The number of cows milked ranged from 5 to 85, with 22 heads as the average number. The ratio of lactating cows to the total number of cattle raised in the enterprises was 28.2%. Each milked cow produced an average of 6 liters per day. On average, 109.2 liters of milk were produced per enterprise per day, 6.8 liters were consumed per day, and 97 liters of milk were sold majorly to dairy cooperatives at an average selling price of US$0.23L^{-1}.

These results are comparable with other studies conducted in Southwestern Uganda. Their studies revealed that the majority of dairy producers in the region kept crossbreeds of cattle for dairy production. The average herd size ranged from 81 to 96 heads of cattle, which is higher than this study's finding, and the average daily milk production per cow ranged from 5.4 to 7.4 liters depending on the breed, values that are closer to this study's finding (Sikawa and Mugisha 2011; Rutaro 2015; Tibezinda et al. 2016; Vudriko et al. 2016; Wangalwa et al. 2016; Vudriko et al. 2018; Byaruhanga et al. 2020). This study's daily milk yield (6 L) is higher than that obtained from studies in Rwanda, which obtained a daily milk yield of 4.6 liters from Ankole and Friesian crosses (50% Friesian) under similar management conditions, i.e., extensive grazing on natural pasture with minimal supplementation (Manzi et al. 2020). The average selling price was higher than the national average farmgate price of US$0.20L^{-1} but lower than the national average retail price of US$0.39L^{-1}, reported by the Dairy Development Authority (DDA) (DDA 2020).

The number of cows milked differed from other studies as well. While this study revealed that each farmer milked 22 heads of cattle on average, which makes 28.2% of the total number of animals owned. Tibezinda et al. (2016)'s study revealed that the average number of milked cows was 25 (30.9% of the entire herd), while Byaruhanga et al. (2020)'s study showed that the percentage of milked cows was 19.8% of the total herd. The study's differences may be attributed to the different years in which the studies were conducted and the method of selecting the study area and samples. The average daily milk production per milked cow found in this study is higher than estimates from FAO (FAOSTAT 2021; Ndambi et al. 2008). That is attributed to the fact that this study's results were from Uganda's highest milk-producing region, unlike FAO and Ndambi et al.'s findings, which are estimates of the total national milk production.

Table 1. Socio-demographic characteristics of enterprises

Variable	Number	%
Address		
Kiruhura	30	30.0
Mbarara	14	14.0
Isingiro	13	13.0
Ibanda	14	14.0
Lyantonde	29	29.0
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
Others	3	3.0
Breeds of cattle raised		
Crosses (Ankole x Exotic breeds)	84	84.0
Both crosses and Ankole breeds	16	16.0
Age of dairy producers		
Mean	49.17	
Std. Deviation	10.64	
Minimum Value	30	
Maximum Value	78	

Table 2. Production characteristics of enterprises

Variable	Mean	Std. Deviation	Minimum value	Maximum value
Size of land (Acres)	176.74	164.62	20	680
Total number of cattle (heads)	78.38	56.79	19	450
Number of milked cows (heads)	22.32	15.40	5	85
Daily milk production (liters)	109.25	76.21	30	561
Daily milk consumption (liters)	6.83	5.4	1.5	30
Daily milk sales (liters)	97.05	67.67	26	556
Selling price of milk (US$)	0.23	0.02	0.16	0.26
Milk production per milked cow per day (liters)	6.27	1.67	1.83	9.82

Calculation of milk production costs on enterprises

The cost elements and their proportional distributions that makeup milk production cost in dairy cattle enterprises examined are presented in Table 3.

While the average selling price of milk was determined as US$0.23L^{-1}, the unit cost of one liter of milk was calculated as US$0.19. The most significant proportion (24.94%) of this was veterinary expenses. This production cost is lower than the average production cost of US$0.26L^{-1}, which was reported by Mugambi et al. (2015). Some studies note that the cost of milk production in Uganda ranges from US$0.13 to US$0.16L^{-1} (Waiswa et al. 2021). Others show that the average cost of milk production in Uganda varies according to the size of the herd. Large-scale enterprises cost less than US$0.20L^{-1}, and small-scale enterprises have values ranging from US$0.2 to US$0.35L^{-1} (Ndambi and Hemme 2009).

Studies conducted in other Sub-Saharan African countries show variations in milk selling prices, production costs, and profits obtained. For example, studies in Kenya reveal that while the average selling price of milk ranges from US$0.25 to US$0.39L^{-1}, the average production cost ranges from US$0.25 to US$0.38L^{-1} of milk depending on the production system (Mugambi et al. 2015; TIAPD et al. 2016). In Zambia, the average milk production cost was reported to be US$0.18L^{-1}, while the average selling price was US$0.43L^{-1} of milk (Mumba et al. 2011). Compared to this study's results in other countries, it clearly shows that dairy cattle farming has significant potential to achieve rural development and solve food security and nutritional problems in Uganda, as long as economic, political, and infrastructural improvements are considered.

On the contrary, studies conducted in other countries show that feed costs cover the largest share of the expenses in milk production (Hemme et al. 2014; Semerci et al. 2014; Rashid et al. 2015; Yilmaz et al. 2016; Oğuz and Yener 2017, 2018a,b; Mat et al. 2021; Mat and Cevger 2022). In this study, veterinary expenses had the largest share of production costs at 24.94%. Feed expenses constituted 11.41% of the total production costs. That owes to the fact that dairy producers in the study area rely on the extensive grazing system, which involves grazing cattle on large tracts of land with natural pastures. Under such a system, low feed costs are an advantage because dairy producers spend on feeds only when they supplement animals' diets with concentrate feeds and silage (Hanson et al. 1998; White et al. 2002; Waghorn and Hegarty 2011). However, the biggest challenge in this system is the high levels of infestation of animals with ticks while grazing, which increases the risk of tick-borne infections in enterprises (Hezron et al. 2012; Kasaija et al. 2021). Prevention and control of these diseases require extra costs in implementing preventive measures such as acaricide spraying, vaccination, and treatment costs, resulting in high veterinary expenses.

Therefore, measures to reduce the occurrence of tick-borne diseases should be vital in lowering milk production costs. Among these measures can be the use of an integrated tick-borne disease control system, which includes vaccinating cattle against infections such as Theileriosis and applying acaricides to control ticks (Ginsberg and Stafford III, 2005; Gachohi et al. 2012; Vudriko et al. 2018). In addition, training programs for dairy producers need to include good practices such as acaricide rotation, mixing the right acaricide concentrations, using the right equipment to spray cattle, applying adequate amounts of acaricide on cattle while spraying, and establishing appropriate cattle health management programs (Vudriko et al. 2016; Vudriko et al. 2018). Additionally, offering veterinary drugs and services at subsidized costs can be a good strategy for reducing production expenses.

Technical and economic analysis of enterprises

The results obtained from the calculation of the technical and economic analyses of the enterprises are presented in Table 4.

The gross product value of enterprises was contributed mainly by revenue from the sale of milk (76.69%). That was followed by income from calves sales (14.06%), an increase in inventory value (6.87%), and income from the sale of manure (2.38%). The active capital of enterprises was contributed mainly by real estate capital (88.99%), livestock capital (7.76%), and lastly, working capital (3.25%). The largest share of real estate capital was land (87.97%), while buildings contributed 12.03%. The distribution of active capital elements is essential in the effective management of enterprises. In a rational working enterprise, it is recommended that capital be distributed so that 50% is real estate capital, 25% is livestock capital, and 25% is working capital (Oğuz and Yener 2017). This study indicated that capital elements in the enterprises were irrationally distributed, suggesting an area that requires improvement.

Table 3. Proportional distribution of cost elements that make up milk production costs on enterprises

	Production cost elements	Value (US$)	%
1	Feed costs	1178.27	11.41
2	Labor costs	1457.97	14.11
3	Veterinarian, drugs, acaricides, and vaccination costs	2576.21	24.94
4	Electricity and water costs	812.46	7.86
5	Inventory Depreciation	1287.39	12.46
6	Other expenses	1235.22	11.96
A	Total of Costs	8547.52	
7	Livestock depreciation	1027.66	9.95
8	Buildings, equipment, and machinery depreciation costs	262.25	2.54
9	Buildings, equipment, and machinery maintenance-repair costs	237.05	2.29
10	General administrative expenses (A × 3%)	256.43	2.48
B	Overall Total Costs	10330.91	100.00
C	Total Secondary Income	2742.41	
i	Income from the sale of calves	1654.36	
ii	Income from the sale of manure	280.05	
iii	Inventory Value Increase	808.00	
D	Total cost (B - C)	7588.50	
	Total Produced Milk (Liters)	39600	
	Milk Price Paid to Producer	0.23	
E	1-liter milk cost (D ÷ Total milk produced)	0.19	
F	Milk Sales Revenue	9023.79	
G	Net Profit or Loss (US$) (F - D)	1435.29	

Note: * Average exchange rate of 2019/20 financial year: US$1 = 3730.14 UGX (BoU 2021)

Table 4. Findings from technical and economic analysis of enterprises

Element	Value (US$)
Overall total costs	10330.91
Income from the sale of calves	1654.36
Income from the sale of manure	280.05
Milk sales revenue	9023.79
Total Revenue	10958.20
Real estate capital	215771.47
Livestock capital	18819.67
Working capital	7884.12
Active capital	242475.26
Passive capital	0.00
Equity capital	242475.26
Gross Product (GP)	11766.20
Net Product (NP)	1435.29
Net profit	1435.29
Financial Profitability	0.59
Profitability factor	12.20
Output-Input ratio	1.06

Note: * Average exchange rate of 2019/20 financial year: US$1 = 3730.14 UGX (BoU 2021)

In conclusion, dairy cattle farming is essential in transforming Uganda's economy, creating employment opportunities, alleviating poverty, and improving livelihoods. This paper presents an outlook on the economic viability of dairy cattle enterprises in the study region. It also revealed a generally low level of profitability of the enterprises. That was mostly attributed to the high production costs, especially the veterinary expenses, and the irrational distribution of capital elements. Implementing strategies to reduce the prevalence of tick-borne infections will be key to reducing production costs. Among these strategies are using an integrated tick-borne disease control system, incorporating good practices such as acaricide rotation, mixing the right acaricide concentrations, using the right equipment to spray cattle, and applying adequate amounts of acaricide on cattle while spraying into dairy producers' training programs. Subsidizing veterinary drugs and services for farmers can also play a role in reducing production costs.

Furthermore, the irrational distribution of capital elements can be improved by increasing the number of lactating cows in a production period, reducing the number of unproductive animals by replacing them with high-yielding animals and integrating extensive grazing with the intensive production system to reduce the amount of land required for grazing and increase the overall efficiency of the enterprises. Therefore, implementing the recommendations presented in this paper will not only aid in improving overall profitability at the farm level but will also aid in improving the overall productivity of the dairy industry nationwide. Furthermore, improvements in the productivity of the dairy industry come with a wide range of benefits, such as contribution to growth in national income, reduction of dependency on imported dairy products, creation of employment opportunities, improved livelihoods, and poverty reduction.

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