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Examining Profitability, Viability, and Commercialization Level of Beef Cattle Production among Pastoralists in the Simanjiro District of the Manyara Region, Tanzania

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Authors' contributions

This work was carried out in collaboration between both authors. Author CAK managed the data curation, formal analysis, investigation, methodology, validation, writing-original draft and writing-review & editing. While author ZY managed conceptualization, funding acquisition, project administration, provision of resources, Software, Supervision and visualization. Both authors read and approved the final manuscript.

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ABSTRACT

Beef cattle production is significant in wealth creation and improving livelihoods of pastoralists, thus reducing poverty. Nevertheless, most pastoralists continue to live in poverty. This study, thus, sought to assess the profitability, viability, and commercialization level of beef cattle production, as well as the socioeconomic characteristics among pastoralists in the Simanjiro District of the Manyara Region, Tanzania. Cross-sectional data were collected from a sample of 398 pastoralists, using interviews and questionnaires. Descriptive statistics, gross margin (GM), Benefit-Cost Ratio (BCR), and household commercialization index (HCI) methods were used for data analysis. The

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results revealed that the average age of the pastoralists was 47.7 years with a family size of 10.9. On average, the pastoralists had about 26.4 years of farming experience. Most of the pastoralists (59.3%) had no formal education. Among the pastoralists, only 3% had access to farm credits. Further analysis showed that 98.7% of pastoralists marketed their beef cattle to primary auction markets of which 75.4% of price-setting methods were inappropriate (unprofitable). Among the pastoralists, only 3.8% added value to beef cattle before selling. The average cattle herd size was 119.7 heads, of which 98.4% of cattle herd sizes were local breed cattle. Gross margin and Benefit-Cost Ratio were 136.8 US$ and 2.9, respectively, while household commercialization index was 3.9%. Medication costs constituted 44% of the total variable costs involved in beef cattle production. This study, thus, concluded that beef cattle production is profitable and highly viable to run as a business. However**,** the commercialization level is low. Furthermore, keeping local breed cattle, inappropriate pricing methods, low-value addition, reliance on primary auction markets, limited access to credits, low level of education, and costs for medications; continue to be critical obstacles to improving profitability, viability, and commercialization level of beef cattle production among pastoralists**.**

Keywords: Pastoralists; beef cattle; profitability; gross margin analysis; benefit-cost ratio; better income; poverty reduction; Tanzania.

1. INTRODUCTION

Beef cattle production is significant in wealth creation and improving livelihoods of pastoralists, thus reducing poverty in pastoral communities in Sub-Saharan Africa, including Tanzania [1-2]. Moreover, beef cattle farming plays a crucial role in the etiquette and social status of pastoralists, thus, it is advantageous because of its high economic and social value [3]. In Tanzania, beef cattle production accounts for more than 50% of pastoralist's household income, 5.9% of the national GDP, source of employment, and export earnings [3-6]. Despite its potential for economic development, the beef cattle sector has been thinly developed, partly because of the limited commercialization (profitability and efficiency) of beef cattle production under pastoralists [7]. Pastoralists (traditional beef cattle farmers) practice traditional beef cattle production (subsistence-oriented) in the sem-arid and arid zones of Tanzania. Pastoralist's objectives in subsistence production are food self-sufficiency, serving as a store of wealth (informal banks), and a source of cash income, using mainly non traded and household generated inputs [8-9]. In addition, pastoralists are characterized by their migration behavior, as well as communal management of resources [4,10-11].

Tanzania is estimated to have a total of 34.5 million beef cattle, which ranks third (3^{rd}) in Africa and 11^{th} in the world [3,6]. Data indicate that 94% of total beef cattle heads are predominantly produced by pastoralists, whereas, only 6% are under commercial beef cattle ranching [3,6]. The commercial beef cattle ranching (commercial farmers) are more market-oriented than the traditional one (pastoralists). In a commercialized beef cattle production, profit maximization becomes the farm household's driving objective [9]. Pastoralists need to perceive beef cattle farming as a business to promote economic benefits and efficiency of beef cattle production.

Considering that in long-run, subsistence beef cattle farming may not be a viable activity to ensure sustainable household economy, food security and welfare of pastoralists in Tanzania; the government strives to commercialize beef cattle production under pastoralists, which account for 94% of beef cattle herds in Tanzania [3]. The efforts undertaken by the Ministry of Livestock and Fisheries Development-MLFD [4-5,11] included linking farmers to profitable markets, subsidizing inputs, enabling farmers' access to farm credits and veterinary services, and encouraging farmers to fatten beef cattle before selling (value addition). The efforts intended to ensure that the sector effectively promotes household food security and income to improve sustainable economy, thus reducing poverty among pastoralists. Commercialization of beef cattle production brings significant benefits to pastoralist households in Tanzania, which contributes to the efforts of the United Nations (UN) to eradicate poverty and hunger by 2030 [12]. Beef cattle commercialization (profitability and efficiency) typically leads to increased diversity of marketed commodities and specialization. This encourages farmers to produce high quality beef cattle, thereby increase their incomes [13].

Despite the government effort to commercialize beef cattle farming under pastoralists (traditional beef cattle sector), most pastoralists (traditional beef cattle farmers) continue to live in poverty [4,14]. For instance, according to a report by the Ministry of Livestock and Fisheries-MLF [14], the beef cattle industry contributes very little to the annual income of pastoralists, and the poverty rate among pastoralists is 22%. This is highly indicative that beef cattle production has little impact on the economy of pastoralists. This study, thus, sought to examine the economic benefits and efficiency of beef cattle production among pastoralists, specifically to examine the profitability (direct economic gains), viability (efficiency), and commercialization level of beef cattle production as well as the socioeconomic characteristics of pastoralists. Generally, this study aims to put forward an understanding of how beef cattle farming (business) ticks and what it contributes to the pastoralist's economy.

2. MATERIALS AND METHODS

2.1 Description of the Study Area

This study was conducted in the Simanjiro District of the Manyara Region, located in the northern part of Tanzania, in semi-arid and arid zones. The region covers an area of 44,522 square kilometers with a population of 1,425,131 people, and it is estimated to have a total of 2.3 million beef cattle herds. The region is one of the top ten regions with a high population of beef cattle, with a significant contribution to the national beef cattle herd stocks. The Simanjiro district has a population of 178,693 people, and it is estimated to have a total of 527,197 beef cattle. The district is dominated by Pastoralists (Maasai people) whose main economic activity is beef cattle production. The average rainfall in the Simanjiro district was 500 mm, and the temperature ranged from 130 0C to 30 0C. Most of the land is suitable for beef cattle production [3,15-16].

2.2 Sampling Procedures

The study applied a multi-stage stratified sampling technique to select respondents among pastoralists. The selection of respondents at different stages involved purposive and randomized sampling. Stratified random sampling creates stratification based on members who share similar attributes [17]. Strata in this study were made of four major beef cattle producing regions and their districts, dominated by pastoralists. One region (Manyara) was randomly selected from the four regions. Similarly, one district (Simanjiro) was purposely selected among the six districts because it is the leading beef cattle producing district in the region. In the study district, three villages; Emboreet, Terrat, and Endonyongijape were randomly selected. This study targeted pastoralists (N = 59,995) and applied Slovin's formula to determine a randomly selected sample size of 398 respondents [18] as follows;

$$n = \frac{N}{1 + Ne^2} = \frac{59{,}995}{1 + 59{,}995\ (0.05)^2} = 397.614 \approx 398 \quad (1)$$

Whereby, *N* is the targeted population size, *n* is the sample size, and *e* is the error tolerance level.

The percentage proportion was utilized to determine the number of respondents from each village (stratum) (see Table 1).

2.3 Data Collection

Structured questionnaires and interviews were used to collect cross-sectional data from February to July 2020. The questionnaires captured data on; (i) socioeconomic characteristics; (ii) beef cattle production costs and revenue, as well as the total number of beef cattle kept; (iii) beef cattle sales (marketing); specifically the selling channels (markets), quantity of beef cattle sold, and selling price; and (iv) beef cattle value addition.

2.4 Data Analysis Models

The economic benefits and efficiency of beef cattle production among pastoralists was evaluated based on three indicators, namely; (i) profitability (economic gain); (ii) viability (efficiency); and (iii) commercialization level of beef cattle production. Data collected from interviews and questionnaires were coded and analyzed using Excel and SPSS v. 22. The data analysis model for each indicator was as follows.

2.4.1 Commercialization level of beef cattle production

The household commercialization index (HCI) as used by Govereh et Al and Agwu et al. [19-20], was applied to examine the level of beef cattle commercialization among pastoralists.

Considering some early studies cited by Randolph [21], the proportion of sales from total beef cattle production is the most common approach used to determine the specific level of commercialization at the household level. The index measures the market-oriented level of beef cattle production. A zero value indicates a household that is completely subsistence-oriented (not commercialized), while the index close to 100% indicates higher level of commercialization (market-oriented) [20]. According to Muhammad-law et al. [22], the level of commercialization is as follows: a ratio of 30% indicates a low level of beef cattle commercialization, the ratio from 31% to 50% means moderately commercialized, and the ratio from 51% to 100% means fully commercialized (market-oriented). Therefore, the model is specifically expressed as:

$$Household\ Commercialization\ Index(HCI) = \frac{Gross\ value\ of\ beef\ cattle\ sales/year}{Gross\ value\ of\ all\ beef\ cattle/household} \times 100 \quad (2)$$

2.4.2 Profitability of beef cattle production

The profitability of beef cattle production was evaluated using a gross margin analysis (GMA) model. The gross margin (GM) was calculated as the total revenue (TR) of beef cattle production minus the total variable cost (TVC). This formula can be mathematically expressed as follows:

$$GM_i = TR_i - TVC_i \quad (3)$$

Here; GM_i is the gross margin of production per beef cattle in US$, TR_i is the total revenue of production per beef cattle in US$, and TVC_i is the total variable cost per beef cattle in US$. Furthermore, to detect the gross profit per beef cattle; the physical values and price per unit input and output factor were used to calculate the total production cost and total revenue. Therefore, the operational formula for the gross margin analysis (GMA) model was expressed as follows (see equation 4).

$$\mathrm{GM} = \sum_{i=1}^{n} Y_i Py_i - \sum_{j=1}^{m} X_j Px_j \quad (4)$$

Where; *GM* is the gross margin per beef cattle, $\sum_{i=1}^{n} Y_i Py_i$ is the total revenue (TR) of *n* beef cattle, Py_i is the market price of beef cattle, Y_i is the quantity of beef cattle sold, $\sum_{j=1}^{m} X_j Px_j$ is the total *m* variable input cost per beef cattle, X_j is the quantity of j[th] variable input (j = 1, 2, 3…*n, m* inputs), Px_j is the unit cost of inputs used /price per unit of a variable input, and ∑ is a summation sign.

Fixed costs were not involved in profit calculations because fixed costs are non-quantifiable due to traditional management system used by pastoralists. The total variable production costs (TVCs) were derived from the cost of labor for herding, drugs (medication), spraying or dipping, veterinary services (breeding services), and other costs such as marketing fees and transportation costs. The cost of feed (pasture) was not taken into account because beef cattle production under the pastoralist depends on the pasture from the communal grazing land. Most grazing land is owned by the government and is free.

2.4.3 Viability of beef cattle production

The viability of beef cattle production was determined using the Benefit-Cost Ratio (BCR). The BCR measures how the revenue generated covers the costs incurred from beef cattle production, and it also measures the economic efficiency of beef cattle production. Decision indicators for viability (efficiency) are described as follows: (i) if Benefit-Cost Ratio is equal to 1 (BCR = 1), it is break-even point, meaning that beef cattle production has neither loss nor profit; (ii) if Benefit-Cost Ratio is greater to 1 (BCR > 1), it means that beef cattle production is viable (efficient); (iii) if the Benefit-Cost Ratio is less to 1 (BCR < 1), it indicates that beef cattle production is not viable (inefficient); and (iv) if the Benefit-Cost Ratio is equal to zero (BCR = 0), it indicates that beef cattle production has no revenue (revenue = zero) [23-25]. The operational formula for the Benefit-Cost Ratio model is mathematically expressed as follows (see equation 5).

$$\mathrm{BCR} = \sum_{t=1}^{n} \frac{Bt}{(1+r)} \Big/ \sum_{t-1}^{n} \frac{Ct}{(1+r)} \quad (5)$$

Where; *BCR* is the Benefit-Cost Ratio for beef cattle production, B_t is the discounted value of benefits in period *t*, C_t is the discounted value of cost at period *t*, *n* is the number of years (t = 1, 2, 3 ……n), *r* is the discount rate, and ∑ is the summation sign.

2.5 Descriptive Statistics

Descriptive statistics, including frequencies, percentages, standard deviations, maximum,

minimum, and mean were used to analyze the socioeconomic characteristics of pastoralists, beef cattle ownership, market-related factors, and value addition. The socioeconomic characteristics of pastoralists included gender, age, education level, household size, farming experience, grazing land owned, access to farm credits and veterinary services, and involvement in cooperatives activities. Beef cattle ownership included beef cattle herd sizes and beef cattle breeds. Market-related factors included beef cattle selling channels (markets), quantity of beef cattle sold, an average selling price per beef cattle, and price-setting methods. Value addition focused on whether pastoralists do fatten beef cattle before sale. Beef cattle fattening is a new technology for traditional beef cattle farmers (pastoralists) in Tanzania, being practiced by the National Ranching Company (NARCO) farms and few private entrepreneurs [26]. Fattening (value) addition means feeding beef cattle with supplementary feed (to supplement limited grazing pasture) such as crop by-product (cotton seed cake, cotton halls, and sunflower seed cake) and local minerals for about two to three months to boost weight gain, after which they are sold for higher prices [27-28]. This has provided significant economic benefits to the entrepreneurs through sale of fattened beef cattle from accrued enterprises profits [29].

2.6 Theoretical Framework

This study was built on the theory of production economics written by Dorfman Robert [30], the theory explains the principles by which a business firm (beef cattle production) decides how much commodity (beef cattle-output) that it sells it will produce, and how much kind of labor, raw materials and services that it employs (variable inputs-factors of production) it will use. The theory also explains the relationship between the prices of commodities (beef cattle) and the prices of productive factors (variables costs) used to produce them.

According to Dorfman Robert [30], the decisions a business enterprise (beef cattle production) makes about its productive activities can be classified as; (i) cost minimization, and (ii) profit maximization. *In cost minimization*; the firm's (beef cattle production) task is to determine the cheapest combination of factors of production that can produce the desired output. This task is best understood in terms of what is called the production function, i.e., an equation that expresses the relationship between the quantities of factors employed and the amount of product (beef cattle) obtained. This relationship can be written mathematically as follows (see equation 6).

$$y = f\left(x_1, x_2, x_3 \ldots\ldots\ldots, x_n\right) \quad (6)$$

Here, y denotes the quantity of output (beef cattle produced), x_1, x_2, x_3 …., x_n are variable factors of production (labor, breeding and health services, drugs, feed supplements, and dipping or spraying). Therefore finding the cheapest of these (variables inputs) in beef cattle production is the problem of cost minimization. The cost of production (beef cattle production) is simply the sum of the costs of all of the variable factors. It can be written as (see equation 7):

$$C = p_1 x_1 + \ldots. + p_n x_n \quad (7)$$

Here, p_1 denotes the price of a unit of the first variable factor x_1.

In profit maximization; the determination of the most profitable level of output (beef cattle) to produce in a given beef cattle farm. The only additional datum needed is the market price of the product, say p_0. If the marginal cost of any given output (beef cattle) (y) is less than the market price, sales revenues will increase more than costs if output (beef cattle) is increased by one unit (or even a few more); and profits will rise. Contrariwise, if the marginal cost is greater than the market price, profits will be increased by cutting back output by at least one unit. It then follows that the output (beef cattle) that maximizes profits is the one for which the marginal cost equals that market price. It can be mathematically expressed as follows (see equation 8).

$$MC(Y) = P_0 \quad (8)$$

Here, *MC* is the marginal cost, *Y* is the output (beef cattle produced), and P_0 is the market price of beef cattle (output).Generally, in response to any market price the profit-maximizing firm (beef cattle production) will produce and offer the quantity for which the marginal cost equals that market price.

Thus, the economic benefits and efficiency (profitability, viability, and commercialization level) of beef cattle production among pastoralists will largely depend on costs minimization of production factors (variables factors of production) and profit maximization of quality beef cattle produced for sale.

Table 1. Distribution of sample size

Districts	Villages	Population	Percentage Proportion	Sample
Simanjiro	Emboreet	20,199	33.7	134
	Terrat	19,747	32.9	131
	Endonyongijape	20,049	33.4	133
Total		**59,995**	**100**	**398**

3. RESULTS AND DISCUSSION

3.1 Descriptive Statistical Analysis

3.1.1 Socioeconomic characteristics of pastoralists

Results in Table 2 revealed that beef cattle production among pastoralists was dominated by men. Among the 398 sampled pastoralists, about 94.5% were males, while 5.5% were females. Females should be encouraged to engage in beef cattle production to avoid gender disparity. Results further revealed that most pastoralists had low level of education. About 59.3% of pastoralists had no formal education, while 35.5% and 5.5% of pastoralists, had primary and college education, respectively. Education improves one's ability to improve beef cattle productivity and profitability [31]. Pastoralists should be provided with tailor-made training and education to promote the development of the beef cattle production among pastoralists. Furthermore, this study has shown that only 3% of pastoralists had access to farm credits. This indicates poor access to farm credits among pastoralists. Access to farm credits should be improved among pastoralists. Farm credit is important for investing in beef cattle production, thus boosting beef cattle productivity and profitability, which improves the economic sustainability of beef cattle production [32]. Regarding access to veterinary services, results show that 56.3% of pastoralists had access to veterinary services. Access to veterinary services should be improved through reducing the cost of acquiring consultations necessary for improved beef cattle production. Results in this study also revealed that only 2.5% of pastoralists were engaged in farmer's cooperatives. This indicates limited involvement in cooperative activities among pastoralists. Incentives should be set forth to attract pastoralists to join cooperatives. Cooperatives help pastoralists mobilize resources, share market information, improve their bargaining power and access to farm credits, promote their production and services, and reduce cost of production through economies of scale [32].

Analysis further revealed that the average age of pastoralists was 47.7 years. This indicates that pastoralists were in the active age of the labor force, which is important in the adoption of beef cattle production technologies, which enhances productivity and profitability for the economic sustainability of beef cattle production. The average household size among pastoralists was 10.9. This indicates a higher labor force potential for beef cattle production among pastoralists. Results in this study also show that pastoralists had 24.6 years of farming experience. Beef cattle farming experience increases beef cattle productivity through acquisition of skills and knowledge, thereby increasing the farmers' probability to increase profitability and efficiency [32-33]. The average grazing land owned by pastoralists was 10.9 ha. Grazing land availability is important in beef cattle productivity and profitability, which enhances the economic benefits and efficiency of beef cattle production [31].

3.1.2 Marketing behavior and value addition among pastoralists

The results in Table 3 reveal that 98.7% of the pastoralists sold beef cattle to primary auction markets (local markets) and 1.3% sold to middlemen or brokers, while none of the pastoralists sold beef cattle to secondary auction markets, abattoirs, and butcheries. Long distances, poor road conditions, and lack of accurate market information, associated with high transportation costs are the factors that prevent pastoralists from being able to channel their beef cattle into the secondary auction markets, abattoirs, and butcheries. These results indicate that pastoralists rely on the primary auction market to sell their beef cattle. The price of beef cattle in the primary auction market is always established through negotiations but not by weighing the live body weight. Beef cattle sold at the secondary auction markets get better prices than those sold at a primary auction markets due to the benefits of standardization. Marketing strategies should be set to encourage pastoralists to sell beef cattle at the secondary auction markets to benefit the profit margin taken

by middlemen and traders who normally buy beef cattle from primary auction markets at a lower price and transport them to secondary auction markets for better profit. Moreover, this study showed that most price setting methods were inappropriate. Among the pastoralists, 75.4% set the price by observing the physical appearance of beef cattle, 22% took the price set by buyers, and only a fraction of pastoralists (2%) set the price by measuring the live weight of beef cattle, and were found to channel their beef cattle through traders (middlemen and brokers). Furthermore, the findings revealed that none of the pastoralists considered the cost involved when setting the price of beef cattle for sale. Therefore, since beef cattle differ in live weight and costs involved in production, the price-setting should take into consideration the costs involved and the live weight of a particular beef cattle for better profit. Proper price-setting can potentially enhance profitability and viability (efficiency), consequently promoting the economic sustainability of beef cattle production.

Furthermore, fattening beef cattle before sale adds value by improving productivity and quality, thereby, boosting profitability, viability, and commercialization level of beef cattle production. In fattening, beef cattle are fed with cottonseed cakes and cotton husks or corn bran for 3-4 months before being sold at a premium price [27-28]. This further promotes the economic sustainability of beef cattle production among pastoralists. However, the findings of this study revealed that only 3.8% of pastoralists added value to beef cattle before selling, while 96.2% of pastoralists did not. Beef cattle value addition should be emphasized among pastoralists to ensure the economic sustainability of beef cattle production.

3.1.3 Beef cattle ownership among pastoralists

The results in Table 4 show that the average beef cattle herd size per household was 119.67 heads. Considering the large beef cattle population in Tanzania at the national level, the beef cattle herd size at the household (local) level is also large enough, to support stable and sufficient commercialization. Moreover, the beef cattle breeds kept by pastoralists included exotic breeds (*mean* = 0.2), local breeds (*mean* = 117.8), and crossbreeds *(mean* = 1.7). This implies that beef cattle production among pastoralists is dominated by local breed beef

Table 2. Socioeconomic characteristics of pastoralists

Categorical Variables (N = 398)				
Variables	**Frequency**		**Percentage**	
Gender				
Male	376		94.5	
Female	72		5.5	
Education Level				
No. education	236		59.3	
Primary educ.	140		35.2	
Secondary educ.	0		0.0	
College educ.	22		5.5	
Access to Credits				
Yes	12		3.0	
No	386		97.0	
Access to Veterinary Services				
Yes	224		56.3	
No	174		43.7	
Membership to Cooperatives				
Yes	10		2.5	
No	388		97.5	
Continuous Variables (N =398)				
Variables	**Mean**	**Max.**	**Min.**	**Std.Deviation**
Age of a pastoralist	47.7	105.0	20.0	15.7
Household Size	10.9	40.0	1.0	6.8
Farming Experience (years)	24.6	80.0	5.0	15.0
Grazing Land Owned (ha)	10.5	32.0	0.8	6.6

cattle. The local breed beef cattle are characterized by low market value and low productivity [1]. Low productivity and low market value hinder economic sustainability of beef cattle production among pastoralists. Pastoralists should be encouraged to keep crossbreeds beef cattle. Crossbreed is advantageous due to its superior heterosis to produce high-quality beef cattle. High-quality breeding stocks in-crease the productivity and market value of beef cattle. Consequently, this generates market incentives, which promote profitability, viability (efficiency), and commercialization of beef cattle production [1].

Moreover, this study also revealed that the classes of beef cattle kept by pastoralists included bulls, cows, steers-oxen, and heifers. On average, pastoralists had 53.23, 27.99, 24.45, and 17.83, cows, bulls, heifers, and steers-oxen, respectively. This indicates that beef cattle herd composition is dominated by cows followed by bulls and heifers. Cows, heifers, and bulls are concerned with the multiplication of beef cattle herd size through reproduction; that promote commercialization (market participation) among pastoralists.

Table 3. Marketing behavior and value addition among pastoralists

Variables	Frequency and percentage distribution among pastoralists (N = 398)	
	Frequency	**Percentage**
Beef cattle selling channels(markets)		
Primary auction market	393	98.7
Abattoir	0	0.0
Butchery	0	0.0
Middlemen/trader/broker	5	1.3
Secondary auction market	0	0.0
Total	**398**	**100.0**
Beef cattle price-setting methods		
Based on cost involved	0	0.0
Based on live weight	8	2.0
Based on age of beef cattle	0	0.0
Based on physical appearance	300	75.4
Took price set by buyers	90	22.0
Total	**398**	**100.0**
Value addition(fattening) before sale		
Yes	15	3.8
No	383	96.2
Total	**398**	**100.0**

Table 4. Beef cattle ownership among pastoralists

Variables	Beef cattle ownership status per household (N = 398)			
	Min	**Mean**	**Max**	**Std. Deviation**
Beef cattle herd size per household	5.0	119.7	2,130	311.2
Breeds of beef cattle per household				
Exotic breeds	0.0	0.2	25	2.2
Local breeds	5.0	117.8	2,130	311.5
Crossbreeds	0.0	1.7	100	10.2
Classes of beef cattle per household				
Bulls	2.0	28.0	550	69.5
Cows	3.0	53.2	1,000	131.2
Steers-oxen	0.0	17.8	600	79.4
Heifers	2.0	24.5	450	65.7

3.2 Economic Benefits and Efficiency of Beef Cattle Production among Pastoralists

3.2.1 The gross margin (gm), benefit-cost ratio (bcr), and household commercialization index (hci) of beef cattle production among pastoralists

Profit and viability are the main goals of any farm business, thus, the failure or success is measured by estimating the Benefit-Cost Ratio (BCR) and gross margin (GM) [34]. The results in Table 5 show that on average, pastoralists had a gross margin (GM) of 136.8 US$ per beef cattle. Although the gross margin was low, beef cattle production was profitable. The profit obtained was due to free pasture availability and not to farm intensification. Pasture is free or cheap available for the pastoralists, which makes beef cattle production among pastoralist a low cost, thus contributed to profit margin. This suggests that increase in production cost due to the scarcity of pasture would result in low profit.

Moreover, this study estimated the Benefit-Cost Ratio (BCR) for further rationalization of beef cattle viability. The BCR was 2.9, which implies that since the BCR is greater than 1 (*BCR = 2.9*), beef cattle production is highly beneficial and viable to run as a business. In addition, the BCR of 2.9 indicates that for every 1 US$ spent on beef cattle production, there is additional revenue of 2.9 US$.

The main variable costs considered in beef cattle production among the pastoralists as indicated in Table 5 include drugs (medications), supplements (mineral salts), labor for herding, spraying (dipping) for eradicating external parasites, marketing costs; and transportation costs. Among the variable cost, drugs or medications constitute 44% of the total variable cost, followed by spraying or dipping (28%), labor for herding (21.4%), and the least marketing and transportation (6.5%). The high cost accrued from medication or drugs is due to the prevalence of animal diseases in the study area. The presence of animal diseases is among the constraints which affect beef cattle production among pastoralists [4,14,35,36]. It is costly to treat beef cattle after an outbreak of the disease. Implementing beef cattle specific health programs to address potential health problems is the best way and is needed for achieving maximum profit. Generally, increasing turnover and decreasing costs lead to profit maximization [37]. Generally, beef cattle production is profitable and efficient; however, there is still a huge potential to strengthen more the economic sustainability of beef cattle farming among pastoralists. Beef cattle production should be more commercialized in order to sustain the economy of pastoralists and the nation at large. Commercial-oriented farming requires the development of their way of thinking, from production for family needs and the local market to profit-orientation [34,38].

Furthermore, the results in Table 5 showed that despite the large beef cattle herd size among pastoralists, the household commercialization index (HCI) was low (3.9%), which was mainly affected by the low volume of beef cattle sold (*mean=4.7*) per household per year. Pastoralists sold a small number of beef cattle per year and seemed to imply their reluctance to sell frequently even during a drought unless they needed money to meet the family's spending. According to the study by Wanyoike et al. [39], sales of beef cattle by pastoralists seems to coincide with the beginning of the school term, when household spending surged due to school fees, hence requiring the sale of a large volume of beef cattle. Such a sales strategy can leave pastoralists vulnerable to opportunistic traders because beef cattle may suddenly be needed for sale when they are not in good condition, consequently hinder profit maximization [39,40]. Similar results regarding low sales of beef cattle were reported previously by Bergevoet et al, Barret et al, and Gamba [41-43]. The HCI of 3.9% indicates less commercialization of beef cattle production among pastoralist (subsistence-oriented). According to Muhammad-law et al. [22], the ratio of 30% and below means low level of beef cattle commercialization, the ratio from 31% to 50% is moderately commercialized, and the ratio from 51% to 100% is fully commercialized (market-oriented). The low household commercialization index (HCI) among the pastoralists implies that the beef cattle production among pastoralists still has huge potential. If the sector is more commercialized, it can increase income of pastoralists as well as increase in the supply of beef cattle to both domestic and international markets, consequently reducing poverty.

Table 5. The gross margin, benefit-cost ratio, and household commercialization index of beef cattle production among pastoralists

Variables	Average value per beef cattle (USD)			
Variable costs for beef cattle production				
Medication and supplements*	31.68 (44.03)[1]			
Labor for herding*	15.43 (21.44)			
Spraying/dipping*	20.17 (28.03)			
Marketing and transportation fees	4.68 (6.50)			
Total variable cost (TVC)*	**71.96**			
Revenue and selling price				
Beef cattle selling price*	208.74			
Total revenue (TR)*	208.74			
Gross margin (GM) = (Total revenue - Total cost)*	**136.78**			
Benefit - Cost Ratio (BCR) = TR/TVC*	**2.90**			
Commercialization components per household in US$ (N = 398).				
Variables	**Mean**	**Max**	**Min**	**Std. Deviation**
Total beef cattle sold per household per year	4.7	100.0	0.0	11.8
Value of beef cattle sold per household per year**	981.1	20,874.1	0.0	2,463.1
Value of total beef cattle herd size per household**	24,965.3	444,616.2	0.0	64,949.7
Household commercialization index (HCI)	**3.9**	**4.7**	**0.0**	**3.8**

**Per average of 4 years old beef cattle at the time of selling. [1]The number in parentheses is the ratio of cost share to total variable costs. **The value obtained by multiplying the average beef cattle price (208.74US Dollar =484,296 Tanzanian shilling).*

4. CONCLUSION

The purpose of this study was to assess the economic impact of beef cattle production among pastoralists, particularly to determine the profitability, viability, and commercialization level of beef cattle production. This study concluded that beef cattle production among pastoralists is profitable and highly viable to run as a business. However, despite the large beef cattle herd size among pastoralists, the household commercialization index (HCI) was low. The low HCI indicates less commercialization of beef cattle production (subsistence-oriented), thus an unsustainable economy among pastoralist. Still, there is huge potential to improve the profitability and viability of beef cattle farming business among pastoralists. Furthermore, keeping local breed beef cattle, inappropriate beef cattle pricing-setting methods, low-value addition to beef cattle, reliance on primary auction markets, limited access to farm credits, low level of education, poor involvement in cooperatives activity, and higher costs for medications; continue to be critical obstacles to improving productivity, profitability, viability, and commercialization level of beef cattle production among pastoralists. Failure to improve productivity, profitability, and viability, as well as commercialization of beef cattle production, is what contributes to an unsustainable economy among the pastoralists.

This study recommend that government policymakers need to establish a balanced policies for pastoralists (traditional beef cattle farmers) and manage them in an appropriate way so that the development of the traditional beef cattle sector can be induced to reduce poverty, food security and contribute to economic development. These policies should place more emphasis on access to agricultural credits and profitable markets, as well as providing tailor-made education among pastoralists. In addition, the use of improved beef cattle breeds (hybrids) should be emphasized, and pastoralists should be encouraged to form and join farmers' cooperatives. Further research on the significant factors influencing the profitability and commercialization of beef cattle farming is recommended.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Dlamin SI, Huang WC. Towards Intensive Cooperated Agribusiness: A Gender-Based Comparative Borich Needs Assessment Model Analysis of Beef Cattle Farmers in Eswatini. Agriculture. 2020;10: 96.

DOI: 10.3390/agriculture10040096.

2. Shikuku KM, Valdivia RO, Paul BK, Mwongera C, Winowieck L, Läderach P, Silvestri S. Prioritizing climate-smart livestock technologies in rural Tanzania: A Minimum data Approach. Agricultural systems. 2017;151:204-216.
3. United Republic of Tanzania (URT). Economic Survey. Ministry of Finance and Planning Dodoma-Tanzania; 2018.
4. Ministry of Livestock and Fisheries Development (MLFD). Tanzania Livestock Modernization Initiative (TLMI). Government document; 2015. Available:https://livestocklivelihoodsandhealth.org/wpcontent/uploads/2015/07/Tanzania_Livestock_Modernization_Initiative_July_2015.pdf.
5. Ministry of Livestock and Fisheries Development (MLFD). Tanzania Livestock Sector. Development Strategy; 2010. Available:https://www.tanzania.go.tz/egov_uploads/documents/development_strategy-_Livestock_sw.pdf.
6. Food and Agriculture Organization of the United Nations Statistics (FAOSTAT). Regional FAO data groupings; 2019. Available:http://www.fao.org/faostat/en/#data/QL.
7. Ruhangawebare GK. Factors affecting the level of commercialization among cattle keepers in the pastoral areas of Uganda. Thesis for Award for PhD degree at Makerere University, Kampala, Uganda. 2010;116.
8. Kadigi RMJ, Kadigi IL, Laswai GH, Kashaigili JJ. The value chain of cattle and beef products in Ilemela and Magu Districts, Tanzania: Market access, opportunities and linkages. Academia Journal of Agricultural Research. 2013; 1(8):145-155.
9. Pingali LP, Rosegrant MW. Agricultural commercialization and diversification: Process and polices. Food Policy. 1995; 20(3):171–185.
10. Food and Agriculture Organization of the United Nations (FAO). Livestock Production Systems Spotlight: Cattle and Poultry Sectors in Kenya; FAO: Rome, Italy; 2018.
11. Ministry of Livestock Development (MLD). National Livestock Policy (NLP); 2006. Available: http://www.mifugo.go.tz.
12. United Nations (UN). World population, population by countries: Tanzania population; 2018. Available:http://www.worldometers.info/world-population/Tanzania population].
13. Pingali P. From subsistence to commercial production systems: The transformation of Asian agriculture. American Journal of agricultural Economics. 1997;79(2):628-634.
14. Ministry of Livestock and Fisheries (MLF). Tanzania Livestock Master Plan; 2018. Available:https://www.mifugouvuvi.go.tz/uploads/projects/1553601793TANZANIA%20LIVESTOCK%20MASTER%20PLAN.pdf.
15. United Republic of Tanzania (URT). Population and Housing Census. Population Dis-tribution by Administrative Areas. National Bureau of Statistics Ministry of Finance Dar es Salaam and Office of Chief Government Statistician President's Office, Finance, Economy and Development Planning, Zanzibar, Tanzania. 2012;264.
16. Pingo's forum. Socio-economic contributions of pastoralism as livelihood system in Tanzania: case of selected pastoral districts in arusha, manyara and dar es salaam re-gions. 2016;isbn:978-9976-89-624-4.
17. Sharma G. Pros and cons of different sampling techniques. International Journal of Ap-plied Research. 2017;3(7):749-52.
18. Singh, AS and Masuku, MB. Sampling techniques & determination of sample size in applied statistics research: An overview. Int. J. Econ. Commer. Manag. 2014; 2, 1–22.
19. Govereh J, Jayne TS, Nyoro J. Smallholder commercialization, interlinked markets and food crop productivity: Cross-country evidence in eastern and southern Africa; 1999. Available:http://www.aec.msu.edu/fs2/ag_transformation/atw_govereh.PDF.
20. Agwu NM, Anyanwu CI, Mendie EI. Socio-Economic Determinants of Commercialization among Small Holder Farmers in Abia State, Nigeria. Greener Journal of Agricultural Sciences. 2012;2(8):392-397, DOI.org/10.15580/GJAS.2012.8.110112200.
21. Randolph TF. The impact of agricultural commercialization on child nutrition. A case study of smallholder households in

Malawi. PhD dissertation. Cornell University, Ithaca, New York, USA; 1992.

22. Muhammad-Lawal A, Amolegbe KB, Lawal OM. Assessment of Commercialisation of Food Crops among Farming Households in Southwest Nigeria, Journal of Applied Business Research. 2014;7(5):520–531.
23. Ngulube RD, Adock DP. A cost-benefit analysis of document management strategies used at a financial institution in Zimbabwe: A case study". South Africa Journal of Information Management. 2013; 15(2):540 – 561.
24. Gurau MA. The Use of Profitability Index in Economic Evaluation of Industrial Investment Projects. Proceedings in Manufacturing Systems. 2012;7;1:55−58.
25. Sewell M, Marczak M. Using Cost Analysis in Evaluation: Alternative Methods for Collecting Evaluation Data. The University of Arizona, Institute for Children, Youth and Families; 1999.
26. Ministry of Livestock and Fisheries Development (MLFD). Tanzania budget speech; 2013.
Retrieved from http://www.mifugouvuvi.go .tz/.
27. Mlote SN, Mdoe NSY, Isinika AC, Mtenga LA. Value Addition of Beef Cattle Fattening in the Lake Zone in Tanzania: Challenges and Opportunities. Livestock Research for Rural Development. 2012;24(6)Article No 95.
28. Mlote SNY, Mdoe NS, Isinika AC, Mtenga LA. Factors Affecting Agro-Pastoralist and Pastoralists' Willingness to Adopt Beef Cattle Fattening in the Lake Zone in Tanzania. Journal of Agricultural Science. 2013;510.
DOI:10.5539/jas.v5n10p140.
29. Mlote SN, Mdoe NSY, Isinika AC, Mtenga LA. Profitability analysis of small scale beef cattle fattening in the Lake Zone in Tanzania. Journal of Agric. Economics and Development. 2013;2(5):203-216.
30. Dorfman R. The Price System. Prentice-Hall, New York, 1964;152+viii:16s.(paper); 32s. (cloth).
31. Kibona CA, Yuejie Z. Factors that influence market participation among traditional beef cattle farmers in the Meatu District of Simiyu Region, Tanzania. PLoS ONE. 2021;16(4):e0248576.
Available:https://doi.org/10.1371/journal.po ne.0248576.
32. Dlamin SI, Huang WC. A Double Hurdle Estimation of Sales Decisions by Smallholder Beef Cattle Farmers in Eswatini. Sustainability. 2019;11:5185. DOI: 10.3390/su11195185.
33. Kgosikoma K, Malope P. Determinants of market participation and the institutional constraints: Case study of Kweneng West, Botswana. J. Agric. Ext. Rural Dev. 2016; 8:178–186.
34. Dalie S, Wantasen E, Anis S, Pangemanan SP. Profit analysis of traditional beef cattle farm in Minahasa regency, Indonesia. Online J. Anim. Feed Res. 2015;5(3):90-94.
35. Carabine E, Simonet C. Value Chain Analysis for Resilience in Drylands (VC-ARID): Identification of Adaptation Options in Key Sectors; VC-ARID Synthesis Report; Pathways to Resilience in Semi-Arid Economies (PRISE): London, UK; 2018.
36. Makokha S, Witwer M. Analysis of Incentives and Disincentives for Live Cattle in Kenya; Technical Notes Series; Monitoring African Food and Agriculture Policies (MAFAP): Rome, Italy; 2013.
37. Meaker HJ. The profitability of beef production under semi-extensive conditi-ons. S.-Atr. Tydskr. Veek. 1986; 16(3).
38. Bart K, Mayer AC, Gomez CA, Muñoz E, Hess HD, Holmann F. Economic evaluation of the current and alternative dual-purpose cattle systems for smallholder farms in the Central Peruvian highlands. Agricultural Systems. 2010;101 (3):152-161.
39. Wanyoike F, Njiru N, Kutu A, Chuchu S, Wamwere-Njoroge G, Mtimet N. Analysis of Livestock and Fodder Value Chains in Arid and Semi-Arid Lands in Kenya; International Livestock Research Institute (ILRI): Nairobi, Kenya; 2018.
40. Veronica M, Samuel O, Boniface K, Markus G. Beef Production in the Rangelands: A Comparative Assessment between Pastoralism and Large-Scale Ranching in Laikipia County, Kenya. Agriculture. 2020;10:0399.
DOI:10.3390/ agriculture10090399.
41. Bergevoet RHM, Engelen A. The Kenyan Meat Sector; Opportunities for Dutch Agribusiness. LEI Report 2014-032; LEI Wageningen UR (University & Research Centre): Wageningen. The Netherlands; 2014.

42. Barrett CB, McPeak JG, Luseno W, Little PD, Osterloh SM, Mahmoud H, Gebru G. Pastoralist livestock marketing behavior in Northern Kenya and Southern Ethiopia: An analysis of constraints limiting off-take rates. SSRN J; 2004.

43. Gamba P. Beef and Dairy Cattle Improvement Services: A Policy Perspective;Tegemeo Working Paper 23/2006; Tegemeo Institute of Agricultural Policy and Development: Nairobi, Kenya; 2006.

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