An Economic Analysis of Small-Scale Cattle Fattening in Kushtia District, Bangladesh

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ABSTRACT

The study analyzed the economics of cattle fattening in Kushtia district, Bangladesh, using a Cobb–Douglas type profit function. Primary data were collected from 107 small-scale cattle fatteners through face-to-face structured interviews, covering socioeconomic characteristics, cost–benefit details, and marketing practices. The results indicate that cattle fattening was a profitable and flexible source of income, with an average profit of BDT 8,268.50 per farm in a season. Salt cost, fixed cost, and medicine cost were found to be significant at the 1% level, while purchase cost was significant at the 5% level and negatively associated with profit, as expected**.** Farm size showed a positive and significant association with profit at the 1% level, suggesting that larger farms tend to achieve higher profitability. Based on the findings, the policy suggestions are that the government should implement subsidies or price-control measures for veterinary medicines to reduce production costs and enhance profitability. In addition, the government might help farmers expand their farms by providing access to credit, encouraging cooperative farming, and supporting land use, making cattle fattening more sustainable and profitable in the long run in Bangladesh.

INTRODUCTION

The fattening of cattle is a crucial and essential aspect of the agricultural and agribusiness framework in Bangladesh (Ahmed, et al. 2010). The fattening of cattle is a thriving enterprise that offers job and cash to disadvantaged rural populations. Agriculture, particularly the rearing of cattle, poultry, and aquaculture, is essential to the economy of Bangladesh. The cultivation of livestock is an essential sub-sector of agriculture, significantly impacting human health and the national economy. The technique of cattle fattening directly enhances local meat output and indirectly diminishes the necessity for illicit livestock imports. The cattle sector contributes 1.85% to the national GDP (DLS, 2023). Data from DLS in 2004 indicates a substantial disparity between the required daily animal protein intake of 120 grams per person and the actual availability of just 12.51 grams. Total meat output is 1.279 million tons, as reported by DLS in 2011. According to the Department of Livestock Services (DLS) in 2011, the cow population in Bangladesh is 2.3122 million. Nevertheless, cattle fattening for beef production has become an essential source of revenue for small-scale farmers in Bangladesh. Cattle ranching is integral to the rural economy of Bangladesh, functioning as a significant complement to agriculture (Hashem et al. 1999). A small-scale commercial cattle fattening initiative has been launched in specific locations of Bangladesh. Small-scale cattle fattening is essential for revenue generation among subsistence farmers in Kushtia District. Microcredit initiatives are frequently employed for the purpose of livestock fattening. The advancement of this nation is intricately linked to the development of rural areas. The density of cattle per unit area is elevated relative to industrialized nations; nonetheless, their productivity is significantly low due to reasons like suboptimal genetic composition, insufficient feed availability, and a deficiency in scientific understanding of housing and management practices. Their growth performance is significantly inadequate due to the aforementioned cause. Beef cow production techniques are hardly implemented in Bangladesh. Numerous folks residing in poor or extreme poverty participate in livestock fattening around four to five months before Eid-Ul-Azha. Seasonal demand for beef cattle arises during Eid-Ul-

Azha. Muslims customarily engage in Kurbani, the ritual slaughter of livestock, during the sacred holiday of Eid-Ul-Azha. Cattle are slaughtered during the festivity. Sujan et al. (2001) estimate that almost 10 million animals are slaughtered during this event. This study is to examine the economic factors associated with cattle fattening in the Kushtia district.

The paper is split into five sections. Section 2 provides a comprehensive assessment of the relevant literature. Section 3 delineates the technique pertinent to this investigation. Section 4 contains the empirical results and discussion. Section 5 presents conclusions and policy implications.

LETARETURE REVIEW

Several studies have been conducted to evaluate the profitability of cattle fattening in Bangladesh, including those by Kamal et al. (2019), Sarma and Raha (2015), and Sarma and Raha(2014). Kamal et al. (2019) examined the cattle fattening method in a particular location of the nation. It was shown that farmers engage in both dairy and beef cattle fattening. A majority of farmers, around 86%, choose to rear uncastrated males for fattening rather than steers. It was shown that farmers reared beef cattle for fattening without any scientific understanding. Pamukova and Momchilov (2017) performed a study of the income and production expenses of a dairy sheep farm in northeastern Bulgaria. Revenues and manufacturing expenses were examined by statistical and comparative methodologies. It was shown that farmers achieved greater money from milk sales. The cost of feed was identified as the most exorbitant. Mekuria (2016) discovered that livestock and meat products are undergoing substantial increase within the global agricultural and food sector. The observed rise may be ascribed to the escalating demand for meat resulting from expanding worldwide incomes, with innovations in production, processing, and transportation that have enhanced efficiency. Moreover, decreasing actual feed prices have contributed to this expansion. Ahmed and Egwuma (2015) emphasized the considerable influence of cattle on human welfare and the prevailing research. Sarma and Raha (2015) evaluated the tactics of beef cattle development enterprises in selected regions of Bangladesh. They assessed the existing characteristics of the farmer about beef cattle production. A total of 180 cattle fatteners were recruited from these regions. The Quantitative Strategic Programming Matrix (QSPM) and SWOT matrix approach were employed to evaluate the feasibility of a beef cattle development firm. The analysis indicated that the prospects and strengths of beef cattle agriculture surpassed the risks and limitations. Sarma and Raha (2014) performed a comprehensive analysis of the economics of beef cattle fattening in the northern char region of Bangladesh. A random sample of 150 cattle fatteners was selected from two districts with the largest proportion of fatteners in the char region. Information on socioeconomic aspects and beef fattening was gathered from residents of Pabna and Sirajgonj districts. Demircan et al. (2007) conducted an economic analysis of 100 beef cattle ranches in Turkey. The beef cattle ranches were categorized into three classes. Production expenses per animal were determined to range from 1.647 to 1.658 US$. Despite the profitability of beef cattle raising in agribusiness, numerous farmers continue to adhere to the conventional beef fattening technique. This is mostly undertaken to satisfy the demand for livestock during the Muslim celebration of Eid-ul-Azha. A considerable body of research has been undertaken on this problem; however, regression analysis has not been employed to explain the data. In addition, there is a deficiency of research pertaining to this topic field. A substantial vacuum exists in the literature about the availability of information on the socioeconomic factors of cattle fattening.

METHODOLOGY OF THE STUDY

The study area, sampling technique and data

Kushtia district, located in the southwestern part of Bangladesh, comprises six sub-districts (upazilas), namely Kushtia Sadar. Kumarkhali, Khoksa, Daulatpur, Bheramara, and Mirpur. For this study, Kushtia Sadar (sub-district) was selected as the research area due to its high concentration of cattle fattening activities, making it representative of small-scale cattle production in the region. The field survey was conducted in three villages—Abdalpur, Gopalpur, and Sahapur—within the Sadar sub-district, where small-scale cattle fattening is a prominent livelihood activity in this study area. The study targeted all beef cattle fatteners actively engaged in cattle fattening operations, and the sample frame was developed from records obtained from the sub-district livestock office. A total population of 150 cattle fatteners was identified, from which a random sample of 107

respondents was drawn, following the random sampling procedure established by Arkin and Cotton (1963). The sampling approach ensured that every eligible cattle fattener had an equal chance of being selected, minimizing selection bias and improving the representativeness of the sample. Data collection was carried out through face-to-face interviews using a structured interview guide. The questionnaire captured information on socioeconomic characteristics, farm practices, input costs, production outputs, and income from cattle fattening. The survey was administered between June and August 2023, during which the researchers directly observed farm practices to verify reported data and ensure accuracy. In addition to primary data, secondary data sources were utilized to enrich the analysis and provide contextual understanding. These included published articles, books, peer-reviewed journals, Bangladesh Economic Review, Bangladesh Agriculture Census, Directorate of Livestock Services and Statistical Yearbook of Bangladesh. The combination of primary and secondary data allowed for a robust examination of the economic dynamics of cattle fattening, including cost structures, profitability, and factors affecting farm performance. This methodological approach ensures a comprehensive and reliable assessment of the economics of small-scale cattle fattening in Kushtia Sadar, providing insights that are relevant for both local development planning and broader policy formulation in Bangladesh's livestock sector.

Empirical model

Profitability of small-scale beef cattle fattening

The economic theory of farm emphasizes the significance of profit in advancing agricultural enhancement, since it predominantly concentrates on financial elements. The information shown provides a more accurate representation of sales income relative to gross revenue. The concepts of profit entails determining the difference between total revenue and total cost (Prasetyo et al. 2012; Sarma and Ahmed 2011; Beattie and Taylor 1994; Jones 2000; Teegerstrom and Tronstad 2000). The total return represents the aggregate benefits derived from investing in an asset, whereas the total cost includes both fixed and variable expenses. Production levels do not influence fixed costs, which stay unchanged. Variable costs vary with output levels. In this study, profit was calculated as the difference between gross return and total gross costs paid in cash by farmers (Cherchye et al. 2010). To perform the economic analysis an activity budget was made to assess the profitability of small scale beef cattle fattening. In doing so, the gross return, net return, and per cattle profit were calculated. The gross return of cattle fattening was derived from the sells revenue of cattle. The per farm profit is considered to be net return divided by total number of farms. Thus, Total variable cost (TVC), Gross return (GR) = Q×P [Where, Q = cattle and P = Price of per cattle], Gross margin(CM) = (GR-TVC), Net return(NR) = (GR–GC), Per-farm profit = (Net profit ÷ N) [Where, N = Total number of farm]. The formula for profit is delineated in Eq (1).

Determinants of revenue of small scale beef cattle fattening

The Cobb-Douglas type profit function is used to identify the determinants of revenue of small scale beef cattle fattening in the study area. The regression model is presented as follows:

$\ln \pi_i = \beta_0 + \beta_1 \ln X_{1i} + \beta_2 \ln X_{2i} + \beta_3 \ln X_{3i} + \beta_4 \ln X_{4i} + \beta_5 \ln X_{5i} + \beta_6 \ln X_{6i} + \beta_7 \ln X_{7i} + \beta_8 \ln X_{8i} + \mu_i$ where, $\ln \pi_i =$ profit of ith cattle fattening farm.

$\ln X_1 =$ fixed cost

$\ln X_2 =$ purchase cost

$\ln X_3 =$ feed cost

$\ln X_4 =$ medicine cost

$\ln X_5 =$ salt cost

$\ln X_6 =$ years of education

$\ln X_7 = \text{farm size}$

$\mu_i = \text{error term}$

β_0 is the intercept term and the coefficients $\beta_2 ... \beta_7$ are called the partial regression coefficients. The error term (μ) is assumed to be normally distributed with mean zero and variance σ_u^2. The coefficient of the variables is estimated by the ordinary least squares (OLS) method. Diagnostic tests namely; multicollinearity, is checked using tolerance and VIF, and autocorrelation is detected by the Durbin-Watson d test. According to Greene (2012) and Gujarati and Porter (2009), a Variance Inflation Factor (VIF) greater than 10 and a tolerance value less than 0.1 are indicative of serious multicollinearity among explanatory variables. The Durbin-Watson (DW) statistic value around 2 indicates that there is no first-order autocorrelation in the residuals of the regression model (Gujarati & Porter, 2009; Greene, 2012).

RESULTS AND DISCUSSION

Results of profitability of small scale beef cattle fattening

Table1shows that the gross margin of the small-scale cattle fattening is BDT 50,49,400 per season. Again, the net return or profit is BDT 16,58,390 per season.

Table 1: Profitability of small-scale beef cattle fattening

Item	Total cost and return (BDT)	Per farm profit (BDT)
A.Gross return	50,49,400	8,268.50
B.Total variable cost	30,07,010	
C.Gross margin(A-B)	20,42,390	
D.Total fixed cost	3,84,000	
E.Total gross cost(B+D)	33,91,010	
F. Net return or profit(A-E)	16,58,390	

It is also found that the per-farm profit of the small-scale cattle fattening is BDT 8,268.50 per season. Since the average net profit is positive, the small-scale cattle fattening farm is profitable in the study area.

Results of the correlation matrix among the study variables

A correlation matrix that shows the strength and direction of relationships between pairs of variables. A value of 0 indicates no linear correlation, while values range from -1 (perfect negative correlation) to +1 (perfect positive correlation). Negative values show that one variable tends to rise when the other falls, whereas positive values suggest that variables tend to rise or fall together. The correlation results (Table 2) indicate that Y is positively and significantly associated with X_7 $(r = 0.524, p < 0.01)$ and negatively and significantly associated with X_1 $(r = -0.344, p < 0.01)$, $X_2 (r = -0.243, p < 0.05)$, and $X_4 (r = -0.241, p < 0.05$. No significant relationships are found between Y and X_3, X_5, or X_6. Among the independent variables, X_1 and X_2 are strongly correlated, while X_1, X_2, and X_4 show several negative interrelationships. A strong positive relationship is also observed between X_4 and X_5.

Table 2: Correlation matrix among the study variables

	Y		X_1		X_2		X_3		X_4		X_5	X_6	X_7
Y	1												
X_1	-0.344	**	1										
X_2	-0.243	*	0.619	**	1								
X_3	-0.090		-0.365	**	-0.417	**	1						
X_4	-0.241	*	-0.318	**	-0.361	**	0.343	**	1				
X_5	0.006		-0.027		-0.157		0.170		0.398	**	1		
X_6	0.140		0.130		0.032		-0.199	*	-0.033		0.119	1	
X_7	0.524	**	-0.257	**	-0.247	*	-0.015		-0.044		-0.072	-0.099	1

** indicates significant at 1% level and * indicates significant at 5% level

The analysis indicates that fixed cost has a significant negative relationship with profit at the 1% level**.** Likewise, purchase cost shows a negative correlation with profit at the 5% level**.** Furthermore, medicine cost is also negatively associated with profit, significant at the 5% level**.**

Results of factor affecting determinants for small-scale beef cattle fattening

An ANOVA test was performed before regression analysis to assess the overall significance of the model. This test is crucial as it partitions the variance in the dependent variable into explained and unexplained components and provides the F-test, which determines whether the predictors jointly contribute to explaining variation in the dependent variable. In a regression analysis**,** the ANOVA (Analysis of Variance) Table 3 is used to test whether the regression model as a whole is statistically significant.

Table 3: ANOVA table for regression analysis

Source of variation (SV)	**SS**	**df**	**MS**	**F**	**p-value**
Regression	4.116	7	0.588	11.752	0.000
Residual	4.953	99	0.050		
Total	9.069	106			

The ANOVA results indicate that the overall regression model is statistically significant, $F(7, 106) = 11.752$, $p < 0.001$. This suggests that the set of independent variables jointly explains a significant proportion of variance in the dependent variable. Specifically, the model accounted for a substantial proportion of the variability, suggesting that it provides a good fit to the data. Thus, we reject the null hypothesis that all regression coefficients are equal to zero, confirming the overall usefulness of the model in predicting the outcome variable.

Regression results for beef cattle fattening

The Cobb-Douglas type profit function is employed to assess the impact of these factors on the revenue generated by small-scale cattle fattening in the study. Table 4 presents the parameters, tolerance and Variance Inflation Factor (VIF), R^2, $\bar{R}^2$, and Durbin-Watson d statistic of the variables in the regression model. The coefficient of

fixed cost ($\ln X_1$) is significant at 1% level and the coefficient of fixed cost of cattle fattener is -0.335. The results indicate that 1% increase of this input, keeping other factor constant, would result in a decrease of net return by 0.335%. The tolerance and VIF of fixed cost of cattle fattener ($\ln X_1$) are 0.531 and 1.884 respectively, so there is no multicollinearity problem in case of cattle fattener fixed cost variable.

The coefficient of purchased cost of cattle $(\ln X_2)$ is significant at 1% level and the coefficient of purchased cost of cattle fattener is -1.293.The results indicate that 1% increase of this input, keeping other factor constant, would result in a decrease of net return by 1.293%. The toralance and VIF of fixed cost of cattle fattener ($\ln X_2$) is 0.493 and 2.027 respectively, so there is no multicollinearity problem in case of the cattle purchased cost variable.

The coefficient of feed cost of cattle is insignificant and coefficient of feed cost of cattle -0.177.The results indicate that 1% increase of this input, keeping other factor constant, would result in an decrease of net return by 0.177%.The Variance Inflation Factor (VIF) for feed cost in the cattle fattening model is 1.366, indicating that this variable does not exhibit multicollinearity**.**

The coefficient of medicine cost of cattle $\ln X_3$ is -1.434.The results indicate that 1% increase of this input, keeping other factor constant, would result in an decrease of net return by 75% in Table 6.2.The tolerance and VIF of the variable of cattle fattening $\ln X_3$ is 0.659 and 1.517 respectively , so there is no multicollinearity problem in case of cattle fattening medicine cost variable ($\ln X_4$) which is desirable.

Table 4: Empirical results for beef cattle fattening

Variable	Coefficient	Std. error	t-value	p-value	Tolerance	VIF
Constant	32.337	6.882	4.699	0.000		
Fixed cost ($\ln X_1$)	-0.335	0.109	-3.070	0.003	0.531	1.884
Purchase cost ($\ln X_2$)	-1.293	0.634	-2.039	0.044	0.493	2.027
Feed cost ($\ln X_3$)	-0.177	0.118	-1.493	0.139	0.732	1.366
Medicine cost ($\ln X_4$)	-1.434	0.305	-4.700	0.000	0.659	1.517
Salt cost($\ln X_5$)	0.401	0.240	1.671	0.098	0.776	1.289
Years of schooling ($\ln X_6$)	0.075	0.032	2.335	0.022	0.892	1.121
Farm size ($\ln X_7$)	0.294	0.076	3.849	0.000	0.862	1.161
R^2		0.454		DW = 1.953		
Adjusted R^2		0.415				

The coefficient of salt cost $(\ln X_5)$ of cattle fattening is also exactly significant at p< 0.10 and the coefficient of salt cost of cattle ($\ln X_5$) is 0.401.The results indicate that 1% increase of this input, keeping other factor constant, would result in an increase of net return by 0.401%. Now salt is a most potential variable which is not used in previous days fattening program. The VIF of the salt cost variable for cattle fattening ($\ln X_5$) is 1.289 which is less than 5%, so there is no multicollinearity problem in case of cattle fattening salt cost variable.

The coefficient of years of schooling $(\ln X_6)$ of cattle fattening is also significant at p<0.05 and the coefficient of years of schooling for cattle fattener is 0.075.The results indicate that 1% increase of this input, keeping other factor constant, would result in an increase of net return by 0.075%. The tolerance and VIF for the years of schooling variable in the cattle fattening profit model are 0.892 and 1.121, respectively, indicating that there is no multicollinearity problem, which is desirable.

The coefficient of farm size $(\ln X_7)$ for cattle fattening is also significant at p<0.01 and the coefficient of farm size of cattle is 0.294.The results indicate that 1% increase of this variable keeping other factor constant, would result in an increase of net return by 0.294%. The tolerance and VIF of the variable $(\ln X_7)$ of cattle fattening are 0.862 and 1.161 respectively, so there is no multicollinearity problem in case of farm size variable $(\ln X_7)$ which is desirable. The coefficient of determination R^2 for cattle fattening is 0.454, which indicates that 45.4 % of the dependent variable of small-scale cattle fattening is explained by the independent variables included in the model. The selected revenue function has a sufficient degree of freedom for testing statistically significant and stable with respect to the sign of their regression. The Durbin–Watson statistic (DW = 1.953) is close to the benchmark value of 2, indicating the absence of autocorrelation in the residuals. This suggests that the error terms are independently and randomly distributed, thereby satisfying a key assumption of the regression model.

CONCLUSIONS AND POLICY IMPLICATIONS

This study provides an economic analysis of small-scale cattle fattening in Bangladesh using a Cobb–Douglas type profit function, based on data from 107 small-scale cow fatteners. The correlation matrix indicates that fixed cost has a significant negative relationship with profit at the 1% level**,** while purchase cost and medicine cost are also negatively associated with profit, both significant at the 5% level. The findings reveal that higher fixed costs, purchase costs, and medicine costs are significantly associated with reduced profitability, underscoring the importance of effective cost management in small-scale livestock operations. The ANOVA results show that the set of independent variables jointly explains a significant proportion of variance in the dependent variable. The regression results demonstrate that the years of schooling and profit is positively and statistically significant at 5% level. Evidence indicates that persons with higher educational attainment are more likely to generate more income from cattle fattening operations. The similar findings are found in the study of Sarma and Ahmed (2011). The medicine costs and fattening income adversely affect the profitability of small-scale cattle fattening in this study area. Based on the findings, several policy implications emerge. First, the government should implement subsidies or price-control measures for veterinary medicines to reduce production costs and improve farm profitability. Second, policies that promote farm expansion through access to credit, cooperative farming models, and land-use support could enhance the sustainability and long-term viability of cattle fattening farms. By addressing cost constraints and supporting farm growth, these interventions can help farmers adopt improved management practices, increase efficiency, and achieve higher and more stable incomes from cattle fattening operations.

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