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Socioeconomic determinants and production factors influencing beef fattening success in Bangladesh: A cross-sectional study using a multivariate approach

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Abstract

Beef fattening is an important livelihood strategy in Bangladesh, yet limited empirical evidence exists on how farmer's socioeconomic factors and management practices influence health outcomes and market value. This study applied multilevel statistical analyses to evaluate determinants of management procedures and high selling price of beef production. A cross-sectional survey was conducted among 60 farmers and 100 fattening cattle of North-East region of Bangladesh by a pre-structured questionnaire through face-to-face interview. Descriptive statistics with 95% confidence intervals (CI), Chi-square and Fisher's exact tests were used to assess associations between categorical variables. Logistic regression was used to identify predictors of high selling price. The maximum number of farmers involved in beef fattening is male (55%). About 50.82% farmers had taken training on beef fattening and rest of the portion did not have any training. All animals in the study were uncastrated males. Most of the farmers offered their beef cattle 1-5 kg green roughage (44%). Nobody used steroid drugs, but most of them used feed supplements such as multivitamins. Most of the fattened cattle (52%) sold between 100000 to 200000 takas. Training exhibited perfect association with vaccination (Fisher's exact p = 0.00059), with all trained farmers vaccinating their animals. Crossbred cattle were significantly more likely to be sold at ≥100,000 BDT than local breeds (p = <0.05). Feed additive use was inversely associated with high selling price, whereas final weight category strongly predicted high market value (p<0.05). Therefore, the beef fattening programme can be a profitable business in Bangladesh by adopting training and better management procedures.

Keywords: Beef Fattening; Market Price; Socioeconomic Status; Production Factors; Bangladesh

1. Introduction

Beef fattening plays a crucial role in the livestock economy of Bangladesh, contributing significantly to rural income generation, employment creation, and the national meat supply, particularly during the Eid-ul-Adha festival when demand rises sharply. The demand of meat in Bangladesh is 74.37 lakh metric ton and 120gm/day/head but production was 84.40 lakh metric ton and availability were 136.18 gm/day/head [1]. Beef cattle fattening helps to fulfill this protein demand. The livestock subsector contributes approximately 1.9% to national GDP and supports nearly 20% of the population through direct or indirect employment [2,3]. Therefore, Beef cattle fattening has emerged as an important income-generating enterprise among smallholder farmers, who typically purchase young, lightweight bulls from local markets and fatten them over short production cycles to capture favorable seasonal prices [4,5]. In Bangladesh huge number of farmers including small scale and large scale are started bull fattening just before 3 or 4 months of Eid-ul-

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Adha, when they sell the animals with profitable prices. Bull fattening could be an effective program for poverty alleviation and improving food security [6].

Beef fattening in Bangladesh is traditionally based on indigenous cattle which has been chosen for their affordability, disease resistance, and adaptability to low-input systems [7]. Though crossbred cattle are getting popular day by day due to consistently achieving higher final weights and superior market prices because of improved genetic potential for growth and feed efficiency. Feeding practices also remain highly variable across farms. Many smallholders rely heavily on green roughage, straw, and homemade concentrates, with limited adoption of commercial feeds, silage, or urea-molasses-based technologies [8,9]. These feeding strategies influence carcass yield and final body weight, which in turn determine market value.

The acute shortage of feeds and fodder has been identified a principal constraint to optimum livestock production in Bangladesh [10] . Farmers may not have available land to cultivate fodder for their beef cattle. The fodder production in Bangladesh is very deficient from the required amount [10]. Farmers mainly offered their cattle roadside grass and rice straw is basal feed for their beef cattle. Most of the farmers offered their beef cattle rice straw in different ways by mixing with other feed substances like as chopping the straw and mixing it with rice husk, chopping straw mixed with green grass, chopping straw mixed with wheat bran, and fresh water. They also use wheat and rice bran, molasses, and locally available resources such as vegetable by-products, rice gruel, boiled rice, oil cake etc. for cattle fattening.

Farmers also face many problems in selling beef cattle. Farmers are selling their beef cattle through different marketing channels. Farmers market their cattle in various ways like directly into the local market, online, and at large district market. Different stages through intermediaries who link the farmers of fattened cattle with the ultimate customer. Main intermediaries are “Dalal” whose main job is bringing the buyers and sellers together and helping in bargaining. Finally deal takes commissions from both buyer and seller. Due to this intermediate person, farmers are not getting enough payment. Nowadays, the online market is also getting popular to sell beef cattle.

Access to veterinary services, including vaccination, anthelmintic use, and basic treatments, plays an essential role in reducing mortality and improving productivity. Unfortunately, chemical hazards related to steroid misuse have been reported historically [11], although recent evidence suggests a declining trend due to stronger regulation and farmer awareness campaigns. Meanwhile, institutional support from the Department of Livestock Services (DLS), in the form of training or subsidized veterinary inputs, can significantly improve farm performance, but coverage remains inconsistent across regions [2].

Given these challenges, there is an urgent need for multivariate analytical approaches that capture the complexity of socioeconomic, management, and production interactions in beef fattening systems. Logistic regression can quantify key predictors of successful outcomes such as high selling price or effective vaccination practices, and this type of integrated analyses are now lacking in the Bangladeshi context.

Therefore, this study aimed to investigate the socioeconomic determinants and production factors influencing beef fattening outcomes in three major cattle-producing districts of Bangladesh. Specifically, we applied a multivariate approach using descriptive statistics and logistic regression to (i) characterize farmer socioeconomic profiles, (ii) describe feeding and management practices, (iii) evaluate health and management of beef cattle, and (iv) identify significant predictors of high market price and improved production performance. The findings provide evidence-based insight to support targeted extension programs, policy interventions, and improved fattening strategies for farmers in Bangladesh.

2. Materials and methods

The cross-sectional study was completed by using data collection with a pre-structured questionnaire based through face-to-face interview with respondents. The study was carried out for periods of 6 months from both large-scale farmers and household farmers in Saidpur Upazilla, Kishorgonj Upazilla and Nilphamari Sadar under the Nilphamari district and also data was collected from Madhukhali Upazilla, Faridpur Sadar under the district of Faridpur and last one Daulodia upazilla under the Rajbari district.

2.1. Statistical analysis

All data analyses were conducted in R (version 4.4.1). Descriptive statistics were calculated for all categorical variables and presented as frequency (%) with corresponding 95% confidence intervals (CI). Associations between categorical variables were assessed using Chi-square (χ^2) tests of independence, Fisher’s exact tests were applied where expected

cell counts were <5. Effect sizes for 2×2 tables were expressed as odds ratios (OR) with 95% CI. Logistic regression models were used to identify predictors of high market price (≥100,000 BDT vs <100,000 BDT), including final weight category, use of feed additives, UMS, and vaccination status. Odds ratios (OR) with 95% CI were reported.

3. Results

3.1. Socio-economic status and beef fattening experience of the farmer

The socio-economic status of the farmer, including age, sex, educational qualification, monthly income, and previous experience with beef fattening, is shown in Table 1. Table 1 illustrates that 55 % respondents were male (42.5–66.9%: 95%CI), the maximum number of farmers were in the age category between 36-40 years (26.67%), while the minimum number of farmers was in the age category between 46-50 years (6.67%). Among the farmers 60% were primary educated, whereas 1.67% were post-graduation. All respondents (100%) reported having previous experience with beef fattening (95% CI: 94.1–100%). Among the respondents, Half of the farmers (50.82%; 95% CI: 38.4–63.2%) reported receiving no training, though 14.75% (95% CI: 7.9–25.8%) reported long-duration training (>365 days). The majority of farmers (35.0%; 95% CI: 24.2–47.6%) earned between 21,000 and 30,000 Tk per month, while only 8.33% (95% CI: 3.6–18.1%) reported monthly earnings exceeding 100,000 Tk.

Table 1 Socio-economic status and beef fattening experience of the farmer (n=60)

Variables	Category	Frequency	Percentage	95% CI
Sex	Male	33	55	42.5–66.9%
	Female	27	45	33.1–57.5%
Age (Years)	25-30	6	10	4.7–20.1%
	31-35	14	23.3	14.4–35.4%
	36-40	16	26.7	17.1–39.0%
	41-45	15	25	15.8–37.2%
	46-50	4	6.7	2.6–15.9%
	51-65	5	8.3	3.6–18.1%
Education status	Primary School (level 1-5)	36	60	47.4–71.4%
	Secondary school (SSC) (level 6-10)	7	11.7	5.8–22.2%
	Higher Secondary School (HSC) (level 11-12)	7	11.7	5.8–22.2%
	Graduation	8	13.33	6.9–24.2%
	Post-graduation	1	1.7	0.3–8.9%
Monthly income (Tk/month)	10,000-20,000	9	15	8.1% – 26.1%
	21,000-30,000	21	35	24.2% – 47.6%
	31,000-40,000	11	18	10.6% – 29.9%
	41,000-50,000	6	10	4.7% – 20.1%
	51,000-60,000	4	6.67	2.6% – 15.9%
	61,000-70,000	1	1.67	0.3% – 8.9%
	71,000-80,000	3	5	1.7% – 13.7%
	1,00,000 - >100,000	5	8.33	3.6% – 18.1%
	Yes	61	100	94.1–100%

Previous experience of beef fattening	No	0	0	0%
Period of training (Days)	3	19	31.15	20.6% – 43.6%
	30	2	3.28	0.9% – 11.1%
	Above 365	9	14.75	7.9% – 25.8%
	No	31	50.82	38.4% – 63.2%

3.2. Information about breed, age, color, body weight and castration status of the beef cattle:

A total of 100 beef cattle were evaluated for breed type, age category, coat color, initial and final body weight, and castration status (Table 2). The population was dominated by local cattle (81.0%, 95% CI: 72.2–87.5%), while crossbred animals represented 19.0% (95% CI: 12.5–27.8%). Coat color distribution was highly variable, with reddish animals most common (47.0%, 95% CI: 37.5–56.7%), followed by black (19.0%) and gray/ash (15.0%). Age distribution revealed that nearly half the cattle were between 2.1–2.5 years (43.0%, 95% CI: 33.7–52.8%). Only 4.0% (95% CI: 1.6–9.8%) were older than 3 years. All animals in the study were uncastrated males (100%, 95% CI: 96.3–100%), reflecting cultural consumer preference for intact bulls during Eid-ul-Adha. Initial body weight with the highest proportion of animals in the 151–200 kg (38.0%, 95% CI: 29.1–47.8%). Final body weight increased substantially across the fattening period, with 42.0% (95% CI: 32.8–51.8%) reaching 150–250 kg and only a small proportion exceeded more than 1000-1500 kg.

Table 2 General information including breed, age, color, body weight, and castration status of the beef cattle (n=100)

Variables	**Category**	**Frequency**	**Percentage**	**95% CI**
Breed	Cross	19	19	12.5–27.8%
	Local	81	81	72.2–87.5%
Color	Reddish	47	47	37.5–56.7%
	Black	19	19	12.5–27.8%
	Gray/Ash	15	15	9.3–23.3%
	Black and White	14	14	8.5–22.1%
	White	3	3	1.0–8.5%
	Black and Red	1	1	0.2–5.4%
	Brown	1	1	0.2–5.4%
Age (Years)	1.5-2	23	23	15.8–32.2%
	2.1-2.5	43	43	33.7–52.8%
	2.6-3	30	30	21.9–39.6%
	3.1-3.5	4	4	1.6–9.8%
Castration status	Castrated	0	0	0.0–3.7%
	Uncastrated	100	100	96.3–100.0%
Initial weight (kg)	100-150	34	34	25.5–43.7%
	151-200	38	38	29.1–47.8%
	201-250	19	19	12.5–27.8%
	251-300	4	4	1.6–9.8%

	301-350	3	3	1.0–8.5%
	>500-1000	1	1	0.2–5.4%
	>1000-1500	1	1	0.2–5.4%
Final weight (kg)	150-250	42	42	32.8–51.8%
	251-350	32	32	23.7–41.7%
	351-450	20	20	13.3–28.9%
	451-550	3	3	1.0–8.5%
	551-1000	2	2	0.6–7.0%
	>1000-1500	1	1	0.2–5.4%

3.3. Farm management procedures for beef fattening

Table 3 shows the farm management practices adopted for beef fattening. Most farmers purchased cattle from the local market (78%, 95% CI: 69.0–85.0%), while only 22% (95% CI: 15.0–31.0%) selected animals from their own farms. The duration of the fattening period varied, with 4 months being the most common (31%, 95% CI: 22.4–40.8%), followed by 7 months (28%, 95% CI: 20.2–37.3%), while periods of ≥6 months were uncommon (1%; CI: 2.2–11.1%). Beef cattle were sold through a variety of marketing channels. Nearly one-third of farmers used both online and local markets (29%, CI: 20.8–38.8%), followed closely by online-only sales (28%, CI: 20.2–37.3%), whereas 20% (CI: 13.3–28.9%) relied solely on local markets. More than half of the cattle (52%, 95% CI: 42.5–61.2%) were sold at prices between 100,001 and 200,000 Tk, reflecting the premium value of fattened bulls before Eid-ul-Adha. Lower price categories (60,000–100,000 Tk) accounted for 12–13% of sales, whereas cattle achieving >300,000 Tk were uncommon (≤2%; CI: 0.6–7.0%). Housing practices varied among farms. Half of the cattle were kept in face-in housing systems (50%, CI: 40.4–59.6%), whereas 33% (CI: 24.6–43.3%) used a combination of face-in and face-out systems. Only 17% (CI: 10.7–25.8%) maintained cattle in non-stanchion single-row barns. All farms used concrete flooring (100%, CI: 96.3–100%), and none used soil or mud floors.

Table 3 Farm management procedures of the cattle for fattening

Variables	Category	Frequency	Percentage	95% CI
Source of the beef cattle purchase	Local market	78	78	69.0–85.0%
	Own farm	22	22	15.0–31.0%
Period of fattening (months)	4	31	31	22.4–40.8%
	7	28	28	20.2–37.3%
	3.5	12	12	7.1–19.7%
	3	9	9	4.8–16.3%
	5	9	9	4.8–16.3%
	4.5	5	5	2.2–11.1%
	8	5	5	2.2–11.1%
	6	1	1	0.2–5.4%
Places of selling beef cattle	Online and local market	29	29	20.8–38.8%
	Online	28	28	20.2–37.3%
	Local market, middleman,farm	23	23	15.8–32.5%
	Local market	20	20	13.3–28.9%
Selling price of the beef cattle (Tk/animal)	60,000-70,000	12	12	7.1–19.7%
	71,000-80,000	13	13	7.9–21.2%
	81,000-90,000	12	12	7.1–19.7%
	91,000-100,000	8	8	4.2–14.9%

	100,001-200,000	52	52	42.5–61.2%
	200,001-300,000	1	1	0.2–5.4%
	>300,000-800,000	2	2	0.6–7.0%
Housing	Face in	50	50	40.4–59.6%
	Face in and face out	33	33	24.6–43.3%
	No stanchion barn (singlerow)	17	17	10.7–25.8%
Floor of the house	Concrete	100	100	96.3–100.0%
	Soil and mud	0	0	0.0–3.7%

3.4. Feeding management of the beef cattle

Feeding practices for beef cattle are presented in Table 4. Nearly half of the cattle received 1–5 kg of green roughage per day (44%, 95% CI:34.4–54.1%), while 36% received 11–15 kg, indicating heavy reliance on moderate roughage supplementation. A minority of farms (5%) did not supply green roughage at all (5%). Feeding dry roughage (straw) was inconsistent; only 32% of animals received straw daily, whereas the majority (68%) did not receive any dry roughage. In case of readymade commercial feed feeding, about one-fifth of cattle received 0.5 kg/day (21%, 95% CI: 14.1–30.0%), while 49% were not given any commercial feed. In contrast, home-made concentrated feed was widely used. Around 4 kg/day (31%, 95% CI: 22.9–40.9%), and 22% received 3 kg/day, indicating that farmers relied mainly on self-formulated rations rather than pre-mixed commercial feed. Only 5% reported not using any homemade concentrate. The type of home-made feed ingredients also varied. The most frequently used combination was broken maize, wheat bran, and rice polish (35%, 95% CI: 26.4–44.7%), followed by wheat-based mixtures with broken maize and lentils (28%). Only a small percentage (2–8%) used single-ingredient or limited-ingredient rations, while 5% (95% CI: 2.2–11.1%) did not provide homemade feed at all. Use of silage was limited; only 20% (95% CI: 13.3–28.9%) supplied 10 kg/day, while 71% (61.5–79.0%) did not use silage. Similarly, adoption of UMS (urea–molasses–straw) was low, with only 29% (95% CI: 21.0–38.5%) of farmers providing it. No respondents reported using UMMB (Urea Molasses Multi-Nutrient Blocks), indicating low adoption of treated roughage technologies.

Table 4 Feeding management of the beef cattle

Variables	**Category**	**Frequency**	**Percentage**	**95% CI**
Green roughage(kg/day)	1-5	44	44	34.4–54.1%
	6-10	3	3	1.0–8.5%
	11-15	36	36	27.0–46.0%
	16-20	2	2	0.6–7.0%
	21-25	4	4	1.6–9.8%
	26-30	4	4	1.6–9.8%
	40	2	2	0.6–7.0%
	Not given	5	5	2.2–11.2%
Dry roughage (straw_kg/day)	12	32	32	23.4–41.7%
	Not given	68	68	23.4–41.7%
Readymade feed(kg/day)	0.5	21	21	14.1–30.0%
	1.5	3	3	1.0–8.5%
	1	7	7	3.4–13.7%
	2.5	1	1	0.2–5.4%
	2	19	19	12.5–27.8%
	Not given	49	49	39.5–58.5%

Home-made concentrated feed (kg/day)	1	30	30	21.9–39.6%
	3	22	22	15.0–31.0%
	4	31	31	22.9–40.9%
	5	4	4	1.6–9.8%
	>5-10	8	8	4.2–14.9%
	Not given	5	5	2.2–11.1%
Home-made feed ingredients	Broken maize, wheat bran, rice polish	35	35	26.4–44.7%
	Maize, Rice polish, Rice bran, Wheat bran, Mustard oil cake, soya bean meal, DCP, Molasses, Salt	15	15	9.3–23.3%
	Wheat, Wheat Bran, Broken Maize, Lentil powder	28	28	20.1–37.5%
	Wheat bran, Rice bran	8	8	4.1–15.0%
	Wheat Bran, Rice Bran, Mustard oil cake/lentil, chickpea	7	7	3.4–13.7%
	Wheat bran	2	2	0.6–7.0%
	Not given	5	5	2.2–11.1%
Silage (kg/day)	10	20	20	13.3–28.9%
	16	9	9	4.8–16.2%
	Not given	71	71	61.5–79.0%
UMS (Kg/day)	1	29	29	21.0–38.5%
	Not given	71	71	61.5–79.0%
UMMB (Kg/day)	Ye	0	0	0.0–3.7%
	Not given	100	100	96.3–100.0%

3.5. Health management of beef cattle

Table 5 represents the health management of beef cattle. Vaccination coverage among the surveyed beef cattle was high, with 55% of animals receiving FMD-only vaccines and an additional 34% receiving multi-component vaccination protocols that included Anthrax and Black Quarter (95% CI ranges 45.0–64.6% and 22.8–40.6%, respectively). Only 11% (95% CI: 6.3–18.6%) of cattle were not vaccinated. All farmers reported administering medication during the fattening period (100%; 95% CI: 96.3–100%), while none reported withholding treatment. The most commonly used supplements were Catophos, liver tonic, and DCP (44%, 95% CI: 34.7–53.8%). Smaller proportions used micronutrient combinations including zinc, multivitamins, AD3E, and amino acid preparations (1–8%). Approximately one-third of the farms (31%; 95% CI: 22.8–40.6%) did not provide any supplement. No farmers reported the use of steroid drugs, indicating an absence of unauthorized fattening agents in the surveyed population. In case of support received from the Department of Livestock Services (DLS), majority (38%) receiving no assistance (95% CI: 29.1–47.8%) while 33% receiving anthelmintics and primary treatment (95% CI: 24.6–42.7%). Overall, the results show strong adoption of basic veterinary care and vaccination, moderate use of nutritional supplements, and no evidence of steroid misuse within surveyed beef fattening operations.

Table 5 Health management of beef cattle

Variables	Category	Frequency	Percentage	95% CI
Vaccination	FMD	55	55	45.0–64.6%
	FMD, Anthrax	3	3	1.0–8.5%
	FMD, Anthrax, BQ	31	31	22.8–40.6%
	No	11	11	6.3–18.6%
Medication	Yes	100	100	96.3–100.0%
	Not given	0	0	0.0–3.7%
Feed supplements	Catophos, liver tonic, DCP	44	44	34.7–53.8%
	Catophos, Multivitamin, Zinc, Liver tonic	8	8	4.1–15.0%
	Zinc, Liver tonic	8	8	4.1–15.0%
	zinc, Burga vet	2	2	0.6–7.0%
	Zinc, Aminovit	2	2	0.6–7.0%
	Zinc, Liver tonic, AD3E	2	2	0.6–7.0%
	Zinc, AD3E	1	1	0.2–5.4%
	Zinc, Liver tonic, Catophos, Aminovit	1	1	0.2–5.4%
	Zinc, liver tonic, Catophos	1	1	0.2–5.4%
	Not given	31	31	22.8–40.6%
Steroid Drugs	No	100	100	96.3–100.0%
	Yes	0	0	0.0–3.7%
Incentive from DLS	Anthelmintic, Primary treatment	33	33	24.6–42.7%
	Anthelmintic, vaccine	29	29	21.0–38.5%
	No	38	38	29.1–47.8%

3.6. Determination of the association between key management practices

Table 6 Association between key management practices

Training	Not Vaccinated	Vaccinated	χ^2	df	p-value (Fisher's exact test)	Odds ratio (Fisher's exact)
Yes	11	41	9.35	1	0.00059*	∞
No	0	48				
Feed additive	**Selling price (<100k)**	**Selling price (≥100k)**				
No	2	29	24.76	1	0.000000065*	0.04*
Yes	43	26				
Breed	**Selling price (<100k)**	**Selling price (≥100k)**				
Local	45	36	17.01 (0.000037)	1	0.0000029*	∞
Crossbred	0	19				

UMS use	Selling price (<100k)	Selling price (≥100k)				
No	25	46	8.16	1	0.0036*	0.24
Yes	20	9				

χ^2 = chi-square test, df= degrees of freedom

Table 6 shows the association between different management practices of the beef fattening program. All cattle owned by trained farmers were vaccinated, which represents a strong association ($p<0.05$) between farmer training and vaccination. There has been a significant association between feed additives and beef selling prices. Cattle without feed additives are much more likely to be in the high-price group. There has also been a significant association ($p<0.05$) between breed and selling price and it showed all crossbred cattle were sold for ≥100,000 Tk. The UMS feeding and selling price also significantly associated ($p<0.05$) where UMS-fed cattle are less often in the ≥100k group compared to those not fed UMS.

Table 7 shows the association expressed as logistic regression among high selling price (≥100k) and final weight category, feed additives, UMS, Vaccination of the beef cattle. Final weight category is the dominant predictor and significantly associated ($p<0.05$) and showed heavier animals are far more likely to fetch high market prices. Feed additives (Yes/No) shows odds ratio (OR) 0.03 indicate animals receiving additives had lower odds of being in the high-price group after adjusting for final weight and other factors. UMS and vaccination are not statistically significant in this model once weight and additives are included, though vaccinated animals tend to more often be high-priced (OR ~7.9, but CI very wide and $p > 0.05$).

Table 7 Logistic regression among high selling price (≥100k) and Final weight category, feed additives, UMS, Vaccination

Predictor	OR	95% CI	p-value
Final weight category	85.23	13.25–548.38	0.000003*
Feed additives (Yes)	0.03	0.001–0.94	0.046*
UMS use (Yes)	1.51	0.19–12.23	0.697
Vaccinated (Yes)	7.90	0.59–106.29	0.119

4. Discussion

The socioeconomic of farmers who are involved in beef fattening program in Bangladesh (Table 1) illustrates that average age category of farmers between 36-40 years that is almost similar to [12] where he found that the averageage of the farmers 27 to 40 years. The maximum respondents are lies between 36-40 years becausein this stage of age people engaged in government or non- government service and some people have developed own business that's why they have money to develop farming. Under the age of 25 incontext of Bangladesh people are not enough money or financial support to build up farming. Among the respondents 60% are primary level educated that are nearly similar result with [7]. Currently in rural area, primary educated and secondary level educated people are becoming attracted in beef fattening, this result is differed from [13] reported that higher educated (graduation) people are attracting to beef fattening than before. Most of the farmers (55%) are male and female farmer participation is lower. Female respondents are mostly didn't complete their secondary education because of their early marriage. Ahmed et al. [14] reported that only 9–15% of rural cattle fatteners had ever received technical training, while the majority depended on informal knowledge and neighbor farmers. Similarly**,** Mamun et al. [15] found that lack of training and technical guidance was among the top constraints in small-scale fattening programs

The findings of Table 2 indicate a strong reliance on local cattle breeds for beef fattening in Bangladesh. This is consistent with earlier reports showing that smallholder farmers frequently prefer indigenous breeds due to their lower purchase cost, higher disease resistance, and better adaptability to low-input feeding systems [13,14**].** Local cattle dominate rural fattening enterprises, particularly in northern districts such as Nilphamari and Rangpur, where crossbred calves are less available and more expensive [7]. The high proportion of animals aged **2–3 years** aligns with typical marketing strategies aimed at maximizing weight gain while minimizing feeding duration. This age group is well recognized as ideal for rapid finishing due to active muscle deposition and efficient feed conversion [16]. The

distribution of coat colors particularly the predominance of reddish and black animals reflects the phenotypic variation typical of Bangladeshi indigenous zebu cattle. While coat color has limited metabolic or production relevance, previous studies have reported consumer preferences for certain coloration patterns, which may indirectly influence selection during purchase [5]. A notable finding is that 100% of cattle were uncastrated. This reflects cultural and religious practices, as consumers prefer intact bulls for sacrifice during Eid-ul-Adha and often consider castrated cattle less desirable for ceremonial slaughter [11] and they also treated the castrated bull as a deformed because lack of scrotum. The absence of castrated animals is also consistent with previous surveys in rural Bangladesh, where castration is rarely practiced due to cost, traditional beliefs, and the preference for natural growth-enhancing hormonal environment in intact bulls [9]. Initial weight categories indicate that most cattle originate from lightweight indigenous stocks, which farmers commonly purchase 3–5 months before Eid to capitalize on expected high price margins. This aligns with findings from Hasan et al. [4], who reported that smallholders frequently purchase underweight animals to reduce upfront investment while relying on low-cost feeding practices to achieve substantial weight gain within a short timeframe. Final weight outcomes in this study were consistent with expected gains under traditional fattening systems using homemade concentrates, rice straw, and limited green fodder. Similar weight ranges have been documented in northern Bangladesh under comparable feeding and management conditions [7,8].

Farm management practices (Table 3) in the present study reflect the typical structure of smallholder beef-fattening systems in Bangladesh, where most farmers rely on the local cattle market to purchase animals rather than raising them on their own farms. This finding aligns with earlier reports showing that 70–90% of fattening cattle originate from local village markets because smallholders lack the capital and land required for calf rearing [4,5]. The predominance of short fattening cycles (3–5 months) also matches previous studies, which noted that farmers typically fatten bulls only for the Eid-ul-Adha season to maximize profit from peak consumer demand [8]. The increasing use of online marketing platforms, alongside traditional live markets, reflects shifting marketing behavior in peri-urban regions. Similar trends have been documented in recent analyses indicating that digital livestock marketplaces are becoming more common, particularly during the COVID-19 pandemic, which accelerated the adoption of online cattle sales across Bangladesh (FAO, 2020). The majority of cattle selling prices in the range of 100,001–200,000 Tk is consistent with earlier economic assessments showing that well-fattened bulls especially before Eid command premium prices in high-demand districts such as Sirajganj, Pabna, and Rangpur [7]. Housing conditions reported in this study found mostly concrete floors represent relatively improved infrastructure compared to earlier decades when soil or mud flooring was common. Improved flooring and structured housing have been associated with better hygiene, reduced parasitic load, and improved animal handling efficiency [17].

The feeding practices (Table 4) observed in this study reflect the typical resource-limited conditions of smallholder beef fattening systems in Bangladesh. The heavy reliance on green roughage and home-mixed concentrate feeds**,** rather than commercial rations, is consistent with previous reports indicating that farmers prefer locally available ingredients such as broken maize, wheat bran, and rice polish due to affordability and accessibility [13, 14]. The widespread use of homemade concentrates particularly mixtures based on cereal by-products aligns with earlier findings that smallholders formulate rations using ingredients sourced from village markets rather than depending on industrial feeds [7]. The complete absence of UMMB use in this study is also consistent with earlier reports that block technology uptake remains poor in Bangladesh despite evidence of improved growth and feed efficiency when properly applied [18]. Farmers often perceive UMMB as costly or unfamiliar, leading to low adoption rates nationwide.

The health management practices (Table 5) observed that vaccination coverage was high, with the majority of cattle receiving either FMD-only or multi-component vaccines (Anthrax, BQ). Studies have similarly documented moderate to high vaccination uptake among organized and semi-organized fattening farms in Bangladesh, particularly where veterinary access is better established [7,13]. Universal use of medication in the present study aligns with earlier findings that smallholder fatteners routinely administer anthelmintics, antibiotics, and supportive treatments often as part of routine preparation for Eid markets [11]. The widespread use of nutritional supplements such as liver tonics, DCP, and mineral mixtures reflects increasing farmer awareness of the benefits of micronutrient support and growth enhancers, although one-third of respondents still did not provide any supplements. Previous studies indicate that supplement use is positively associated with better growth performance but is strongly influenced by economic capacity and feed availability [9]. Notably, no farmers reported using steroid drugs**,** which contrasts sharply with historical reports that identified anabolic steroid misuse as a major public health concern in Bangladesh [11,16]. This may indicate successful regulatory enforcement, increased awareness of food-safety risks, and shifting consumer preferences against chemically fattened cattle.

The association analysis (Table 6) revealed several key management factors significantly influencing production outcomes in beef fattening farms. Farmer training showed a strong relationship with vaccination uptake, as all trained farmers vaccinated their cattle. This finding supports earlier reports that training and extension participation

significantly improve disease-prevention practices and biosecurity compliance among smallholder livestock producers [13,14]. A significant association was also observed between feed additive use and selling price, where cattle not receiving additives were more likely to achieve a high selling price (≥100,000 Tk). Similar patterns have been documented previously, where farmers often administer additives to weaker or slower-growing cattle, and such compensatory supplementation does not always translate to improved market value [9,11]. Breed was another critical determinant, with all crossbred cattle being sold in the higher price category. This is consistent with earlier findings showing that crossbred bulls achieve superior growth and command premium prices in Bangladeshi markets due to better conformation and consumer preference [5,7]. Finally, UMS use was significantly associated with selling price, whereby UMS-fed animals were less frequently found in the ≥100k group. UMS improves roughage digestibility; its effect on growth is moderate unless combined with adequate concentrates and quality forage [16,17].

Table 7 shows that the final body weight category as the strongest predictor of achieving a high selling price (≥100,000 Tk). The odds of receiving a premium market price increased more than 85-fold for heavier animals compared to lighter ones. This finding is consistent with multiple previous studies showing that live weight, dressing percentage, and visual body conformation are the most influential attributes affecting cattle pricing in South Asian livestock markets [4,5]. Furthermore, indigenous market analyses indicate that buyers during Eid-ul-Adha strongly prioritize heavier and visually larger bulls, which aligns with the extremely high effect size observed here [8]. There has been negative association between feed additive use and high selling price (OR = 0.03), which contradicts to the theory that nutritional supplementation is generally expected to enhance growth performance. However, this result may occur due to farmers administer additive products to cattle that are initially smaller, weaker, or slower-growing, rather than to high-performing animals. This interpretation is supported by previous studies showing that low-income or high-risk farmers disproportionately use multiple feed additives or even illegal chemical agents in attempts to accelerate weight gain in otherwise underperforming cattle [9,11]. Although vaccination status showed a positive but non-significant association with high selling price (OR ≈ 7.9). This reflects the fact that vaccination primarily contributes to preventing disease outbreaks and reducing mortality factors that indirectly support production but does not directly influence growth rate or market conformation in the short term. Prior work confirms that vaccination and preventive healthcare reduce morbidity risks in fattening units [8,2]. Therefore, the logistic regression results emphasize that final live weight is the central economic driver in beef fattening enterprises in Bangladesh, overshadowing the effects of feed additives, UMS, or vaccination once animals reach market size. These findings reinforce the need for extension programs to prioritize genetic improvement**,** balanced ration formulation, and growth-oriented feeding strategies rather than reliance on multiple additive products. Strengthening farmer training and improving access to high-quality feed resources may help farmers achieve heavier final weights, resulting in substantially higher market returns.

5. Conclusion

This study provides a comprehensive assessment of the socioeconomic characteristics, management practices, feeding strategies, health interventions, and price determinants among beef fattening farmers in three major cattle-producing districts of Bangladesh. The findings demonstrate that beef fattening remains a viable and profitable enterprise for smallholder households, with more than half of the fattened cattle achieving a selling price of ≥100,000 BDT. Breed selection and final body weight emerged as the strongest determinants of market value, with crossbred animals consistently achieving higher prices. Training played a crucial role in improving farmer practices, particularly in ensuring complete vaccination coverage among trained respondents. Strengthening training programs, improving access to quality breeds, promoting efficient feeding technologies, and ensuring transparent marketing channels will be essential to improving productivity, profitability, and livelihood outcomes. Overall, the study reinforces the potential of beef fattening to contribute meaningfully to rural income generation, food security, and poverty reduction in Bangladesh.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors didn't have any conflict of interest.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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