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Advancing Safe Broiler Farming in Bangladesh: An Investigation of Management Practices, Financial Profitability, and Consumer Perceptions

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Abstract: This study examined the rearing and management methods, financial profitability, and consumer perceptions towards safe broiler production in Bangladesh. Employing stratified random sampling, 60 participants (30 farmers and 30 consumers) from two sub-districts in Mymensingh district were interviewed. A mix of descriptive, mathematical, and statistical approaches was used for data analysis and representation. This study identified key components of safe broiler management, including brooding, housing, feed and water management, lighting, litter maintenance, medication and vaccination, and biosecurity and hygiene control. A benefit–cost of 1.40 obtained from profitability analysis indicated the profitability of safe broiler farming. Consumer awareness of safe broiler meat was assessed using the Likert scale, highlighting the significance of nutrition, packaging, freshness, taste, and natural ingredients in purchasing decisions. The Logit model revealed that factors such as meat size, freshness, taste, and family income significantly impacted consumer purchasing choices. The main challenges faced by safe broiler producers included high prices and limited availability of feed, day-old chicks, medicine and vaccines, and lack of knowledge. To ensure efficient safe broiler production in Bangladesh, this study recommends the implementation of stable input supplies, accessible credit, skill development, and infrastructure enhancement.

Keywords: safe broiler; rearing methods; financial profitability; consumer perceptions; Bangladesh

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Citation: Akter, M.S.; Uddin, M.T.; Dhar, A.R. Advancing Safe Broiler Farming in Bangladesh: An Investigation of Management Practices, Financial Profitability, and Consumer Perceptions. *Commodities* **2023**, *2*, 312–328. https://doi.org/10.3390/commodities2030018

Academic Editor: Jungho Baek

Received: 15 June 2023
Revised: 22 August 2023
Accepted: 5 September 2023
Published: 8 September 2023

1. Introduction

Poultry farming in Bangladesh has traditionally been a backyard culture venture, with indigenous chicken being kept under semi-natural conditions for domestic consumption, and very little commercial motive. However, with the domestic demand for both meat and eggs increasing rapidly, poultry farming (broilers for meat and layers for the egg) has been promoted as a solution to meet the shortfall in the production of these two commodities [1].

Poultry meat contributes approximately 37% of the total animal protein in Bangladesh, with broilers being the breed of choice for meat production [2]. Broiler farming requires similar housing and equipment as that for layer birds, with one square foot of farmhouse being required for each bird. Young chicks are brought from hatcheries and reared in brooders until they reach maturity. As they are meat-producing birds, they grow quite quickly and require a high vitamin, mineral, and trace element-rich diet [3]. The use of antibiotics is common in broiler farming, not only for the prevention and treatment of diseases but also for body growth [4]. However, overuse and misuse of antibiotics in animals can lead to the development of drug-resistant bacteria in both poultry and humans, posing a global public health threat [5]. Therefore, producing antibiotic-free broiler meat is becoming increasingly popular worldwide, but suitable strategies must be adopted to ensure food safety and chicken welfare [6].

To tackle the issue of adulteration, a new concept of "safe broiler" has been introduced in Bangladesh, operating according to specific and precise standards of production [7]. The safe broiler production system focuses on animal health and welfare, good environmental practices, and product quality, resulting in higher yields and returns for farmers [8]. The Department of Livestock Services (DLS) of Bangladesh has launched a village-safe broiler production program in the Gazipur District [9], with antibiotic residues being absent in safe broiler meat certified by the Institute of Food Science and Technology (IFST) laboratory of the Bangladesh Council of Science and Industrial Research (BCSIR) [10]. The production of safe broiler meat is also being conducted in other areas of Bangladesh.

In Bangladesh, the practice of poultry farming was previously confined to backyard culture, but it has now evolved into a crucial industry for meat and egg production [11]. Given the surge in demand for these items, there is a pressing need for collaboration between the government and private organizations to improve the current production levels of meat and eggs. Broiler farming is a feasible solution to address the meat shortage, but the excessive use of antibiotics must be monitored to avoid the emergence of antibiotic-resistant bacteria [12]. The implementation of the safe broiler production system is a positive step towards guaranteeing food safety, animal welfare, and greater profitability for farmers [13].

Modalities of poultry farming have been identified by a handful of studies in Bangladesh as presented in Table 1. While a number of research efforts have been undertaken in the poultry industry of Bangladesh, such as analyzing profitability, studying antibiotic usage, comparing different poultry breeds, etc., only a few studies have focused on consumers' perceptions of poultry chicken consumption. However, no research was found concerning the financial profitability and consumers' attitudes towards safe broilers in Bangladesh. This study has been carried out to minimize this research gap by achieving the following objectives: (i) to investigate the rearing practices for safe broiler production; (ii) to estimate the financial profitability of safe broiler production; and (iii) to examine the consumers' perceptions towards purchasing safe broiler. The results of this study are expected to provide significant information that can contribute to enhancing the productivity and sustainability of the safe broiler industry. By filling the research gap, this study can help to ensure that the industry meets the standards of safe broiler production in Bangladesh.

Table 1. Review of related literature.

Research Focus	Study Areas	Major Findings	References
Antibiotic usage in commercial chicken production	Gazipur, Chattogram, Cumilla, Joypurhat and Bogura	▪ Almost all farms had used antibiotics since the start of their production cycle ▪ Antibiotics were used for both treatment and prophylactic purposes ▪ Antibiotic usage was mainly advised by veterinary practitioners, followed by feed dealers and farmers	Chowdhury et al. (2022) [14]
Consumers' willingness to pay for safe broiler chicken	Mymensingh	▪ Lower- and middle-income groups are the main consumers of conventional broiler meat ▪ Consumers' health and environmental perceptions of safe broiler meat were found to be high ▪ Consumers unanimously demand safe broiler meat and would consume 36% more if it were available locally	Saha et al. (2022) [15]
Financial and factor demand analysis of broiler production	Dhaka, Rajshahi, Mymensingh and Chattogram	▪ Feed was the primary operating input expense for broiler farming ▪ Broiler farming was profitable, with no significant differences in variable costs and net returns observed among the study areas ▪ The elasticity values indicated that feed, chick price, and labor price had a complementary relationship, while day-old chicks and labor were substitutes ▪ Changes in input prices did not significantly affect the quantity of other inputs demanded for broiler farming	Kamruzzaman et al. (2021) [16]
Production and profitability of broiler farming	Dinajpur	▪ Involvement in broiler production was profitable for the small-scale broiler farmers ▪ The net return was estimated as Tk. 6681 with a benefit–cost ratio (BCR) greater than one ▪ Feed, medicines, human labor, and training had a significant positive effect on the production of broilers whereas rental costs had a negative effect	Rabbani and Ahmad (2021) [17]
Consumers' perceptions toward duck meat consumption	Mymensingh	▪ Most consumers had a negative attitude toward duck meat consumption ▪ The main reasons for this negative attitude were allergies, asthma, and a seasonal pattern of consumption	T. Haque et al. (2020) [18]
Presence and source of heavy metal in broiler chicken	Rajshahi	▪ Heavy metals can accumulate in broiler chicken tissue and organs from their feed ▪ The feed tested was safe for broiler chicken consumption, and the level of heavy metal accumulation in broiler chicken remained within acceptable limits ▪ Consequently, broiler chicken was considered safe for human consumption	Mondol et al. (2020) [19]
Farmers' socioeconomic condition and indigenous poultry production status	Mymensingh	▪ Most of the farmers (54.84%) were of middle age (31–50 years) and were landless (41.58%), having an average annual income of Tk. 61,260 where agriculture was found as a primary occupation (49.10%) ▪ Average egg production per clutch in chicken and duck was identified as 13 and 17 eggs with 76.78 and 69.61% hatchability, respectively ▪ Natural and uncontrolled breeding was observed for indigenous poultry	Shahjahan and Bhuiyan (2016) [20]

Table 1. *Cont.*

Research Focus	Study Areas	Major Findings	References
Technical, economic, and social performance of *Sonali* birds	Joypurhat, Mymensingh/Gazipur, Bogra and Naogaon	• *Sonali*-intensive farms had larger flock sizes than commercial farms, and *Sonali* semi-scavenging farms were larger than those with local non-descript chickens • The highest BCR per batch and bird was observed in local non-descript chickens, followed by *Sonali* semi-scavenging • Rearing *Sonali* birds, especially for intensive meat production, offers great potential for rural households to supply meat nationwide, boost incomes, and generate employment opportunities	Uddin et al. (2015) [21]
Profitability and resource use efficiency for *Sonali* chicken	Gazipur	• The average net return for 1000 birds was calculated at Tk. 52,059 with a BCR of 1.40 • Labor, veterinary and medicine, and electricity cost had a positive and significant impact on *Sonali* chicken production • Inequal ratios of marginal value products and marginal factor costs indicated farmers' inefficiency in using all resources to produce *Sonali* chicken	Uddin et al. (2014) [22]
Profitability of broiler farming	Mymensingh	• Broiler production was found as a profitable enterprise • The net return was calculated at nearly Tk. 242,111 farm^{-1} year^{-1} • Feed cost, cost of day-old chick, labor cost, and litter cost had a significant positive impact on the net return	Rana et al. (2013) [23]
Farmers' income from native poultry production and resource use efficiency	Noakhali, Patuakhali and Satkhira	• A BCR of 5.57 indicated native poultry production as a highly profitable business • The contribution from poultry rearing to farmers' total income was 8.25% • Increasing returns to scale was found, suggesting greater potential earnings by utilizing more inputs in production	Uddin et al. (2013) [24]

2. Results and Discussion

2.1. Rearing and Management Systems of Safe Broiler

Safe broiler management practices generally involve the techniques and innovations that managers employ to enhance the efficiency of safe broiler production. In the study areas, these practices encompass brooding, housing, feed and water management, lighting, litter maintenance, medication, and vaccination, as well as biosecurity and hygiene control.

Brooding was found as the crucial period right after hatching when chicks required special care and attention to ensure their health and survival. This process helped acclimate the chicks to the ambient temperature, as their thermoregulatory systems were not fully developed for the first few weeks. During the initial seven days of brooding, old newspapers covered the floor, providing adequate feeding and drinking spaces for all birds. Fresh and dried rice husks were used as bedding materials. In the first week, the broiler house temperature was maintained at 35 °C with 60% humidity. The brooding period lasted 7 days in summer and 10 days in winter. The thermal environment's impact on birds is determined by various factors such as species, age, body weight, sex, physical activity, and food intake [25]. Dawkins et al. (2004) [26] highlighted that addressing indoor housing environmental conditions is more vital for animal welfare than flock density. This suggests that broiler chicken productivity is likely to improve in an environment that closely aligns with the thermal neutral zone in terms of temperature and relative humidity. Salgado et al. (2007) [27] asserted that extremely cold conditions early in the grow-out period, and predominantly excessive heat after the 5th week of growth, can decrease broiler productivity. Such circumstances not only hinder their growth and health but can also escalate to severe outcomes such as increased flock mortality.

Tin shed open-sided, east-west oriented houses were constructed for housing, with cast floors. Houses and equipment were cleaned, washed, and disinfected, with a 35-foot distance between sheds. Each shed measured 2880 square feet. However, a study by Ghanima et al. (2020) [28] in the context of Egypt found cage-rearing systems and litter-rearing systems to positively influence growth performance and carcass traits of heat-stressed broilers. High-quality starter feed was provided for the first 10 days to ensure a strong start for the birds. Feeders and waterers were cleaned daily before the morning feed supply, and clean water was available around four times a day. Compound starter and grower feeds, as shown in Figure 1, were provided four times daily according to requirements, with grower feed given from 11–35 days of age.

The optimal water temperature ranged from 15 °C to 21 °C. In summer, drinker lines were regularly flushed to ensure cool water. Lighting was used for 23–24 h during the first 7 days, with a light intensity of 30–40 lux to promote feed and water consumption. A high light intensity of 5 watts/m^2 was maintained in the brooding area. Litters were disinfected and checked frequently to maintain dryness. Phytogenic preparations were used at various broiler ages, along with lemon juice and glucose for stress reduction. Birds were vaccinated according to the breeder company's schedule, and no antibiotics or drugs were administered since the broilers were organically raised.

Strict biosecurity and hygienic controls were implemented to maintain a healthy broiler environment. Farm staff access to each shed was limited, with footbaths placed at the main gate and each shed entrance. Potassium permanganate was used as a regular disinfectant. Before entering the shed, it was compulsory for everyone to dip their feet in a footbath containing disinfectant. The shed and all equipment, including hovers, feeders, waterers, and more, were thoroughly cleaned, washed, and disinfected. These practices align with some points discussed by Ahmed et al. (2021) [29], who noted that growers' management skills can substantially influence broiler growth rates and mortality. Limbergen et al. (2020) [30] identified several risk factors related to poor health and performance in European broiler production systems including floor quality, ventilation type, light intensity adaptations, type of feed, and daily check of feed and water system. Technological innovations promise to facilitate labor efficiency, economic viability, and environmental sustainability within a robust broiler management system. By doing so, these advances will not only elevate the standards of animal welfare but also optimize production efficiencies, thus creating a more resilient and humane poultry industry [31].

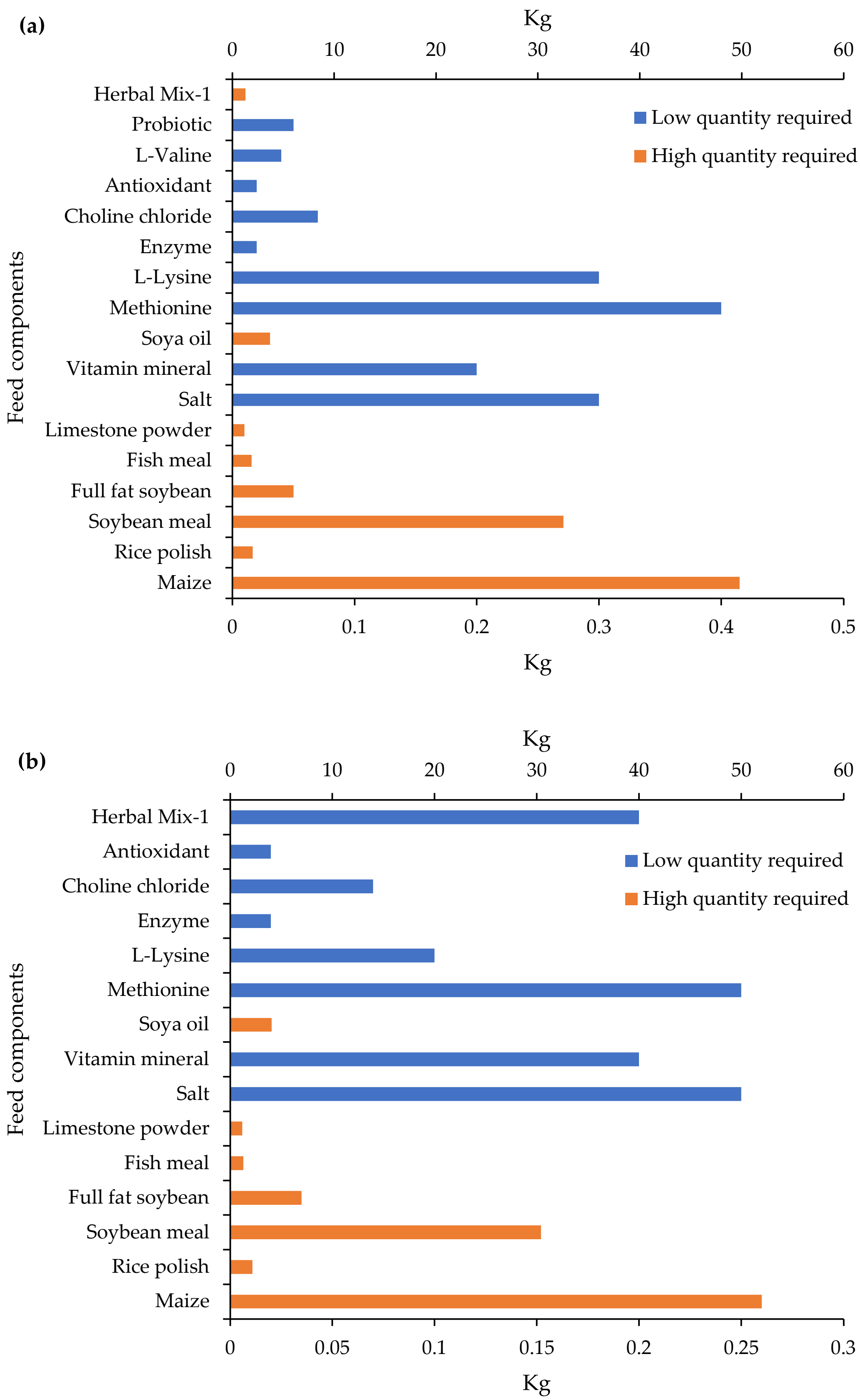

Figure 1. Compound (**a**) starter and (**b**) grower feed formulation for safe broilers.

2.2. Financial Profitability of Safe Broiler Production

The profitability of safe broiler farming was assessed by analyzing gross return, gross margin, net return, and benefit–cost ratio. To determine the total production cost, both variable and fixed costs were taken into consideration (Table 2). The variable costs included expenses such as day-old chick, labor, veterinary and medicine, electricity, litter, transportation, repairing, cleaning, and interest on operating capital. On the other hand, fixed costs included depreciation of housing, and tools and equipment.

Table 2. Financial profitability of safe broiler production.

Cost of Safe Broiler Production		
Particulars	**Tk./Batch**	**Percentage (%) of Total Cost**
Variable Costs		
Feed (Packed) (Handmade)	140,666 (137,666) (3000)	67.7 (66.3) (1.4)
Day-old chick	36,000	17.4
Labour	8333	4.0
Veterinary and medicine	7000	3.3
Electricity	2000	0.9
Litter	4000	1.9
Transportation	2500	1.2
Repairing	1500	0.7
Cleaning	1000	0.5
Interest on operating capital	1560	0.8
i. Total variable cost	204,559	98.6
Fixed costs		
Depreciation of housing	2033	0.9
Depreciation of tools and equipment	833	0.4
ii. Total fixed cost	2866	1.4
iii. Total cost	207,425	100.0
Return from safe broiler production		
Particulars	**Amount of return (Tk./batch)**	
iv. Gross return (Birds) (Litter and bird excreta)	282,212 (279,300) (2912)	
v. Gross margin (iv − i)	77,653	
vi. Net return (iv − iii)	74,787	
vii. Benefit–cost ratio (BCR) (iv ÷ iii)	1.40	

The study estimated that the total variable cost of safe broiler farming was Tk. 204,559 per batch, and the total fixed cost was Tk. 2866 per batch, resulting in a total cost of Tk. 207,425 per batch. Among the total cost, 67.7% was spent on feed preparation, 17.4% on purchasing day-old chicks, and 4.0% on hiring human labor. After conducting a profitability analysis, the study estimated the gross return, gross margin, and net return of safe broiler production at Tk. 282,212, Tk. 77,653, and Tk. 74,787 per batch, respectively. The benefit–cost ratio for safe broiler farming was found to be 1.40, indicating that for every Tk. 100 spent on safe broiler production, the growers earned Tk. 140 in return (Table 2). In contrast, a case study on conventional broiler production in Mymensingh by

Rana et al. (2013) [23] estimated the benefit–cost ratio at 1.32. The authors found that the highest expenditures in conventional broiler farms were associated with feed preparation and the acquisition of day-old chicks, followed by veterinary services, labor, and transportation. However, the authors reported no expenditure towards repairing and cleaning. Karaman et al. (2023) [32] found that despite being heavily influenced by the mortality rate and feed conversion ratio, contract broiler production in Turkey remained profitable. Nevertheless, the authors noted that heating cost had the largest share of the total cost, with litter cost following closely behind.

It was found that safe broiler farming was marginally more profitable than conventional broiler farming due to several reasons. Firstly, the mortality rate of safe broilers was significantly lower than that of conventional broilers, resulting in lower production costs [33]. Secondly, the use of antibiotics and other harmful chemicals was prohibited in safe broiler farming, which ensured better quality of meat and reduced health risks for consumers [6]. This also led to higher market prices for safe broiler meat compared to conventionally raised broilers. Moreover, safe broiler farming involved a more sustainable approach that emphasized animal welfare, environmental protection, and social responsibility [34]. This not only aligned with the values of consumers who preferred safe and ethical food products but also contributed to the long-term profitability of the business.

2.3. Consumers' Perceptions toward Safe Broilers

The attitudes and perceptions of consumers regarding the purchase of safe broiler meat were evaluated using a 5-point Likert scale, which consisted of eight statements. The scores of the Likert scale indicated the level of consumers' agreement with the statements (Table 3). The first statement received the highest "strongly agree" response at 43.33%, indicating that a significant portion of consumers believe that safe broiler meat is a good source of protein. This demonstrates the importance of emphasizing the nutritional benefits of broiler meat and could be a potential area for marketing campaigns to focus on, as it may encourage more consumers to purchase safe broiler products [35]. The fourth statement obtained the highest "agree" response at 46.67%, signifying that 46.67% of respondents consider good packaging methods to be an essential aspect of safe broiler meat. The significance of good packaging methods suggests that the appearance and presentation of broiler meat products should be prioritized by manufacturers. Providing visually appealing packaging that conveys the safety and quality of the product may help to build consumer trust and increase sales [36].

Table 3. Likert scale for assessing consumers' perceptions toward safe broiler meat.

	Statements	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total Responses	Total Score
1.	Rich in protein content	13 (43.33)	11 (36.67)	5 (16.67)	1 (3.33)	0 (0.00)	30 (100.00)	128
2.	More tasty than other poultry meats	8 (26.67)	11 (36.67)	11 (36.67)	1 (3.33)	0 (0.00)	30 (100.00)	119
3.	High level of freshness	10 (33.33)	6 (20.00)	8 (26.67)	0 (0.00)	2 (6.67)	30 (100.00)	100
4.	Effective packaging techniques	7 (23.33)	14 (46.67)	6 (20.00)	2 (6.67)	1 (3.33)	30 (100.00)	114
5.	Free from synthetic additives	6 (20.00)	8 (26.67)	7 (23.33)	6 (20.00)	3 (10.00)	30 (100.00)	98
6.	Limited availability in some locations	1 (3.33)	6 (20.00)	6 (20.00)	12 (40.00)	5 (16.67)	30 (100.00)	76
7.	Priced higher than alternatives	3 (10.00)	10 (33.33)	11 (36.67)	6 (20.00)	0 (0.00)	30 (100.00)	100
8.	Possesses an unpleasant odor	0 (0.00)	1 (3.33)	1 (3.33)	14 (46.67)	14 (46.67)	30 (100.00)	49

Note: Figures in the parentheses indicate percentages of responses.

On the other hand, the eighth statement had the highest "disagree" response, also at 46.67%. This means that 46.67% of the respondents disagreed with the notion that safe broiler meat has a bad smell, while another 46.67% strongly disagreed with this statement. The fact that a large proportion of respondents disagreed with the statement that safe broiler meat has a bad smell indicates that consumers generally perceive broiler meat as being fresh and odor-free [37]. This positive perception should be maintained and reinforced through proper handling, storage, and transportation practices within the industry. Taste is another crucial factor for consumers, as evidenced by 36.67% of respondents agreeing that safe broiler meat is tastier than other poultry meats. Poultry producers should strive to develop and maintain high-quality taste profiles that differentiate their broiler products from the competition [38].

Lastly, 26.67% of respondents agreed with the statement that safe broiler meat does not contain any artificial ingredients, showcasing the importance of natural components in consumer preferences. The preference for natural ingredients suggests that consumers are increasingly concerned about the presence of artificial additives in their food [39]. To address this concern, poultry producers could consider adopting more transparent labeling practices, highlighting the absence of artificial ingredients and emphasizing the use of natural, wholesome components in their broiler meat products [40]. Therefore, understanding and addressing consumer preferences and concerns are crucial for the poultry industry to thrive. A case study by Bukachi et al. (2021) [41] in Nairobi found consumer perceptions of food safety to be determined by concerns about food production, processing, handling, storage, and the health risks associated with food consumption. Therefore, by focusing on nutrition, packaging, freshness, taste, and natural ingredients, producers can better meet consumer expectations and ultimately contribute to the growth and success of the broiler meat market.

2.4. Factors Affecting Consumers' Decision to Purchase Safe Broiler Meat

The logit model employed to identify the factors affecting consumers' decision to buy safe broiler meat in the study areas is displayed in Table 4. Among the eight primary determinants examined in the model, four had a positive and significant impact on consumers' choice to purchase safe broiler meat. These factors included: the size of the safe broiler, the freshness of the meat, the taste of the meat, and family income. The estimated Equation (1) was as follows:

$$Z = -4.274 - 0.013X_1 + 0.019X_2 + 2.970X_3 + 20809X_4 + 1.136X_5 + 0.553X_6 + 2.210X_7 - 0.029X_8 \quad (1)$$

The Logit model's findings presented in Table 4 reveal that the size of the safe broiler was found to have a significant and positive influence on consumer preferences for safe broiler meat at a 1% level of significance. A one-unit (kg) increase in broiler size would raise the likelihood of consumers preferring safe broiler meat by 0.031 times. This implies that a larger safe broiler size is more likely to meet consumers' demands. Furthermore, the study identified a significant and positive relationship between the freshness of the meat and the consumption of safe broiler meat. The estimated marginal effect of meat freshness was 0.034, significant at a 10% level of significance. This demonstrates that consumers are more likely to consume fresh safe broiler meat, with preference levels expected to increase by 0.034 times. The taste of the meat was found to have a significant and positive impact on the probability of preferring safe broiler meat. The estimated marginal effect of meat taste was 0.059, significant at a 10% level of significance. This suggests that consumers were 0.059 times more likely to prefer safe broiler meat over other poultry types. Family income was identified as a significant factor influencing the consumption of safe broiler meat, with a positive effect at the 1% level of significance. As family income increases by one unit, the likelihood of preferring safe broiler meat rises by 0.236 times. This implies that consumers with higher incomes are more likely to allocate a larger portion of their income to purchasing safe broiler meat.

Table 4. Estimates of the Logit model.

	Explanatory Variables	Co-Efficient (β)	Standard Error	*p*-Value	Marginal Effect (dY/dX)
	Constant	−4.274	11.52	0.711	0.878
(X_1)	Price of safe broiler	−0.013	0.030	0.643	−0.001
(X_2)	Average price of other poultry meats	0.019	1.076	0.804	0.002
(X_3)	Size of safe broiler	2.970 ***	1.020	0.004	0.031
(X_4)	Freshness of meat	2.809 *	0.096	0.078	0.034
(X_5)	Color of meat	1.136	1.209	0.348	0.096
(X_6)	Taste of meat	0.553 *	0.998	0.058	0.059
(X_7)	Family income	2.210 ***	0.620	0.002	0.236
(X_8)	Family size	−0.029	0.011	0.302	−0.961
	Model Summary				
	Log-likelihood		14.50		
	chi^2		32.08		
	Prob > Chi^2		0.000		
	Pseudo R^2		0.725		

Note: *** and * indicate significance at 1 and 10 percent levels of significance ($p < 0.01$ and $p < 0.10$), respectively.

The price of safe broiler and family size had insignificant and negative impacts on consumer preferences for safe broiler meat. The average price of other poultry and meat color were found to have insignificant but positive effects on the probability of preferring safe broiler meat.

The findings align with existing literature on consumer preferences and purchasing behavior for safe broiler meat. Previous studies, such as Grunert (2006) and Verbeke et al. (2010) [42,43], had similarly identified the negative relationship between the price of safe broiler meat and consumer preferences, emphasizing that consumers were price-sensitive and more likely to purchase safe broiler meat at lower prices. The positive effect of other poultry prices on the preference for safe broiler meat also corroborates existing literature [44], suggesting that consumers tend to shift their preferences based on relative prices. The significance of size, freshness, and taste of the meat in influencing consumer preferences is consistent with the reports of Font-i-Furnols and Guerrero (2014) and Napolitano et al. (2010) [45,46], where the authors highlighted the importance of product quality attributes in driving consumer choices. The authors also emphasized that consumers prioritized larger, fresher, and better-tasting poultry products when making purchasing decisions.

The positive influence of family income on safe broiler meat consumption aligns with prior research [47], which demonstrated that consumers with higher incomes were more likely to spend a larger portion of their income on safe and higher-quality meat products. This relationship reflected the general trend that consumers' purchasing behavior tends to change as their income levels increase [48]. Lastly, the negative impact of family size on safe broiler meat consumption is also in line with existing literature [49], which has indicated that larger families might have greater financial constraints and, therefore, allocate fewer resources toward purchasing safe broiler meat.

2.5. Constraints Faced by the Safe Broiler Producers

Safe broiler producers in the study area face a number of challenges, including high feed prices, non-availability of day-old chicks, medicine, and vaccines, disease outbreaks, lack of credit, inadequate training facilities, and electricity shortages as depicted in Figure 2. Some of these challenges mirror those encountered by traditional broiler farmers in Bangladesh [50]. Issues such as high feed prices and non-availability of feed were reported by 83% of farmers, while 73% experienced a shortage of day-old chicks.

Furthermore, 60% of safe broiler producers mentioned difficulties in obtaining necessary medicines and vaccines in a timely manner and at reasonable prices. A lack of credit for capital-intensive poultry farming deterred 50% of farmers from pursuing the business. Disease outbreaks, affecting 53% of farmers, posed a notable threat to safe broiler farm development. Limited knowledge and modern information hindered 66% of producers from increasing safe broiler production. Additionally, electricity shortages, identified by 46% of sample farmers, impeded safe broiler production due to the reliance on electricity for lighting and heating during chick rearing.

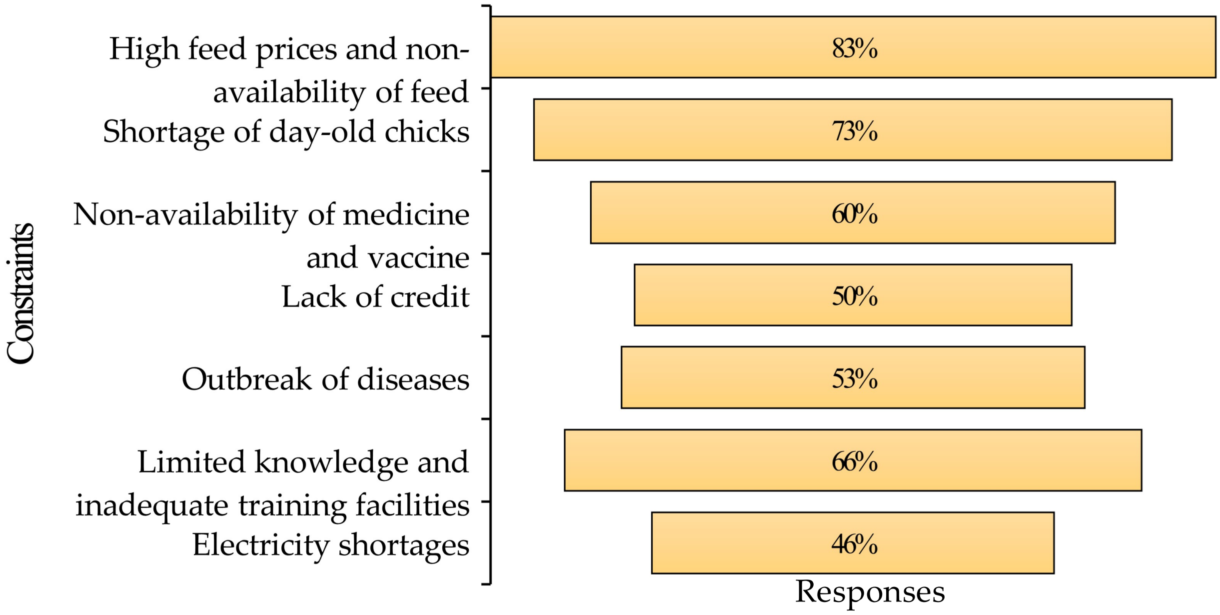

Figure 2. Constraints related to safe broiler production.

In order to better understand the constraints faced by safe broiler producers, it is important to discuss each of these challenges in greater detail. Feed typically accounts for 60–70% of poultry production costs [51]. Fluctuations in the prices of feed ingredients like corn, soybean meal, and other protein sources were found to have a direct impact on the profitability of broiler production [52]. Factors contributing to high feed prices and non-availability included climate change, global market dynamics, and competition for resources with other sectors (e.g., biofuels) [53]. A consistent supply of healthy day-old chicks is crucial for maintaining and expanding broiler production [16]. Factors leading to shortages included limited hatchery capacity, disease outbreaks, and logistical challenges in transporting chicks to remote areas [54]. The timely administration of medicines and vaccines is essential to prevent disease outbreaks and maintain flock health [55]. Determinants influencing the availability of medicines and vaccines included inadequate supply chain infrastructure, counterfeit products, and import restrictions [56,57].

Limited access to credit resulted from high interest rates, strict collateral requirements, and a lack of financial institutions catering to the needs of poultry farmers [58]. The adoption of best practices and modern technology could potentially improve productivity and efficiency in safe broiler production [59]. The reasons behind limited knowledge included lack of extension services, inadequate access to information through media and the internet, and low education levels among farmers. A shortage of training facilities was observed to hinder the transfer of knowledge and skills to poultry farmers. Such facilities should be provided for practical and hands-on training in poultry management, disease control, and biosecurity measures [60]. Reliable electricity is essential for maintaining optimal temperatures, lighting, and ventilation in broiler production facilities. Insufficient power generation, aging power infrastructure, and limited grid coverage augmented the electricity shortages in the study areas [61].

2.6. Towards Overcoming the Challenges of Safe Broiler Production

To address the challenges faced by safe broiler producers, a number of safe and critical steps can be followed as depicted in Figure 3. For instance, establishing partnerships with feed suppliers can guarantee a steady supply of feed at fair prices. At the same time, promoting local production of feed ingredients and researching alternative sources can help reduce dependency on imports and maintain stable prices [62]. Educating farmers on efficient feed management practices can minimize waste and lower overall costs [63]. Increasing the number of hatcheries and improving their distribution will ensure the adequate availability of day-old chicks. Encouraging private investment in hatcheries and providing incentives to existing ones can help meet the growing demand for chicks [64]. Expanding local pharmaceutical production of poultry vaccines and medicines can reduce dependence on imports and ensure their timely availability. Strengthening distribution networks and training farmers on the proper storage and administration of vaccines and medicines will further improve access [65].

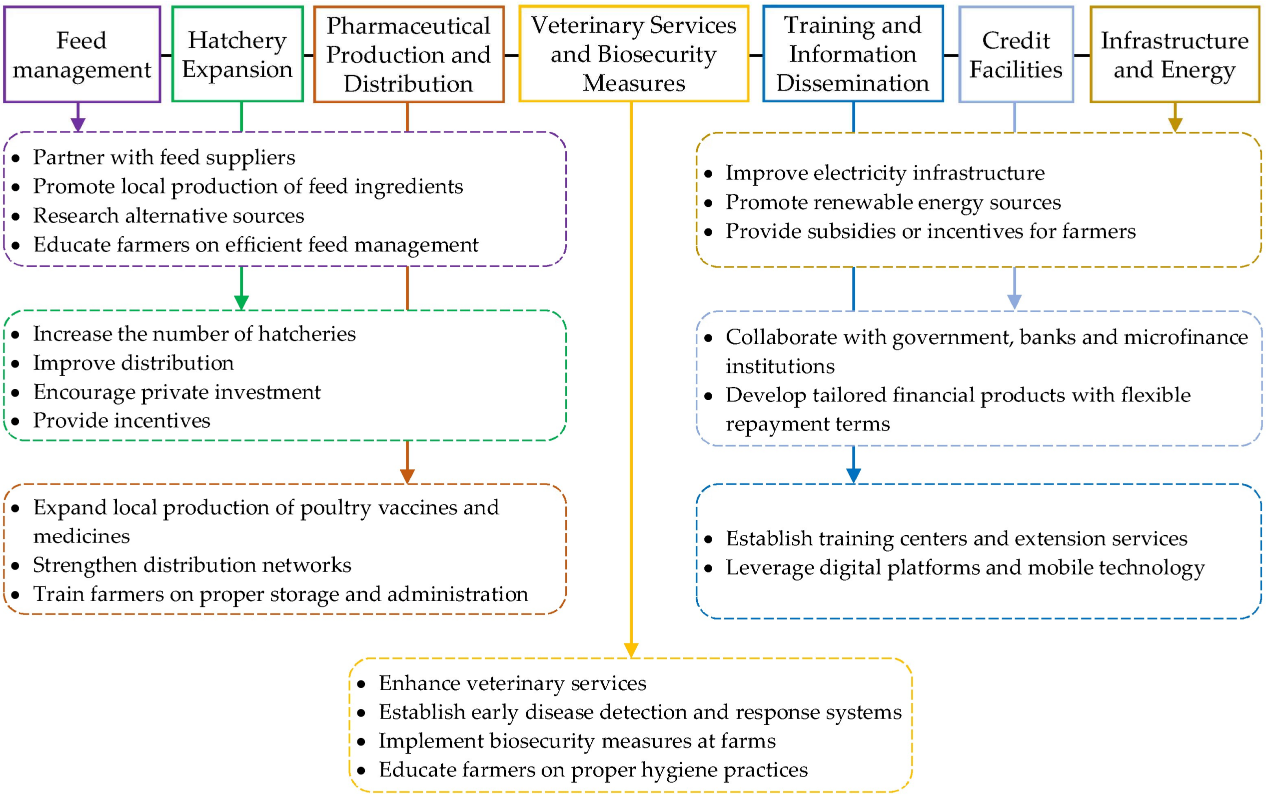

Figure 3. Steps towards improving safe broiler production.

Collaboration between the government, banks, and microfinance institutions can provide affordable credit facilities to farmers, boosting safe broiler farming businesses. Tailored financial products for safe broiler producers with flexible repayment terms can help overcome capital constraints [66]. Enhancing veterinary services, early disease detection, and rapid response systems can help mitigate the impact of disease outbreaks. Implementing biosecurity measures at safe broiler farms and educating farmers on proper hygiene practices can also prevent the spread of diseases [67,68]. Establishing training centers and extension services to provide farmers with access to modern information, best practices, and innovative techniques can improve safe broiler productivity [69]. Leveraging digital platforms and mobile technology can help disseminate information to farmers in remote areas. Improving electricity infrastructure and promoting the use of renewable energy sources, such as solar panels, can help ensure a consistent power supply for safe broiler farms [70]. Providing subsidies or incentives for farmers to invest in alternative energy sources can contribute to a more reliable electricity supply. By implementing these solutions, safe broiler producers can overcome the challenges they face and contribute to the sustainable development of the poultry industry in Bangladesh.

3. Materials and Methods

3.1. Study Area Selection and Sample Size Determination

The study was carried out at two sub-districts of Mymensingh district, namely Mymensingh Sadar (at Kamal-Ranjit market, locally known as K.R. market) and Trishal (at Dewaniabari and Kazirshimla villages). These areas were selected for the study based on the availability of a comfortable number of safe broiler farmers and consumers. A total of 60 respondents (30 farmers and 30 consumers from a population of nearly 100 for both) were interviewed through the formula following the stratified random sampling technique (2) [71]:

$$n = \frac{NZ^2P(1 - P)}{ND^2 + Z^2P(1 - P)}, \quad (2)$$

where n = Sample size; N = Population size; Z = Confidence level (at 95% level, Z = 1.96); P = Estimated population proportion (0.5 which maximizes the sample size); and D = Error limit of 10% (i.e., 0.1).

3.2. Collection of Data and Information

The data were collected between November and December 2021 through a structured questionnaire survey aimed at achieving the study objectives, with data collected from both farmers and consumers. To ensure the questionnaire's validity and reliability, a draft was prepared and pre-tested on a small sample of respondents. During this process, efforts were made to identify and categorize any information that was missing from the initial draft questionnaire. Based on these pre-test results, the questionnaire was improved, rearranged, and modified to reflect the field experiences. Ultimately, a final version of the questionnaire was developed (Supplementary Material), which was structured to ensure that even the most hesitant informant would be comfortable providing the necessary information. Secondary data and information were sourced from various government annual reports, official statistical abstracts, and other published and unpublished research studies. Furthermore, data from different books, handouts, publications, policy documents about agricultural development, and national and international journals published by various organizations and agencies of the Government of Bangladesh (GoB) were also considered to complete the research.

3.3. Analytical Techniques

Once all necessary data and information had been gathered, they were classified, edited, and coded to facilitate analysis. A combination of descriptive, mathematical, and statistical techniques was employed to extract meaningful insights and achieve the study objectives.

To document the rearing and management systems of commercial safe broilers, descriptive statistics were used. In order to calculate the cost of and benefit from safe broiler production (per batch that contains 1000 birds), profitability analysis was done from the viewpoint of individual farmers as follows (3) [72]:

$$GR = X_{mp}P_{mp} + X_{bp}P_{bp};\ GM = GR - \Sigma C_v;\ NR = GR - \Sigma C_v - \Sigma C_f;\ BCR = GR \div GC, \quad (3)$$

where GR = Gross return; GM = Gross margin; NR = Net return; BCR = Benefit–cost ratio; X_{mp} = Yield of main product; P_{mp} = Price of main product; X_{bp} = Yield of by-product; P_{bp} = Price of by-product; ΣC_v = Total variable cost; ΣC_f = Total fixed cost; and GC = Gross cost.

Consumers' perceptions regarding safe broilers were examined using a 5-point Likert scale [73]. Each respondent was asked to express their level of agreement or disagreement against eight (8) statements. The respondents had the option to indicate each statement as 'strongly agree', 'agree', 'neutral', 'disagree', or 'strongly disagree', which were assigned scores of 5, 4, 3, 2, and 1, respectively. To calculate the Likert scale score for each statement, the following formula (4) was used:

$$\text{Likert scale score} = (5 \times SA + 4 \times A + 3 \times N + 2 \times DA + 1 \times SDA) \div \text{Total respondents}, \quad (4)$$

where SA = Count of 'strongly agree' responses; A = Count of 'agree' responses; N = Count of 'neutral' responses; DA = Count of 'disagree' responses; and SDA = Count of 'strongly disagree' responses.

In order to identify the factors influencing consumers' decision to purchase safe broilers, the following logistic regression analysis (i.e., Logit model) (5) was used [74]:

$$Z_i = \ln[Pi/(1 - Pi)] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + U_i, \quad (5)$$

where P_i is the probability of preference and non-preference for safe broiler, $P_i = 0$ indicates non-preference and $P_i = 1$ indicates preference; Dependent variable: Z_i = Consumers' preference for safe broiler (Preference = 1, 0 otherwise); Independent variables: X_1 = Price of safe broiler (Tk./kg); X_2 = Average price of other poultry meats (Tk./kg); X_3 = Size of safe broiler (kg); X_4 = Freshness of meat ($P_i = 1$ for the presence of freshness in meat, 0 otherwise); X_5 = Color of meat ($P_i = 1$ for regular color of meat, 0 otherwise); X_6 = Taste of meat ($P_i = 1$ for tasty compared to other meat, 0 otherwise); X_7 = Family income (Tk./year); X_8 = Family size (no. of person); and U_i = Error term.

4. Conclusions

In conclusion, the transition of poultry farming in Bangladesh from a backyard culture to a vital industry has led to the development of the "safe broiler" production system. This study aims to investigate safe broiler rearing practices, financial profitability, and consumer perceptions, contributing to the industry's productivity, sustainability, and adherence to safe production standards. Effective broiler management practices encompass various aspects, including brooding, housing, feed, and water management, all of which contribute to the health and survival of the birds. Safe broiler farming demonstrates greater profitability than conventional methods. This approach promotes better meat quality and reduces health risks for consumers, leading to higher market prices. Furthermore, the focus on animal welfare, environmental protection, and social responsibility contributes to the long-term profitability and sustainability of safe broiler farming. Factors such as broiler size, meat freshness, taste, and family income positively impact consumers' decisions to purchase safe broiler meat. Safe broiler producers face numerous challenges, including input and resource, financial, knowledge and skill, and infrastructure constraints. Addressing these constraints requires a multifaceted approach that includes stable input supplies, accessible credit, skill development, and infrastructure improvement. By implementing these solutions, farmers can ensure the sustainable development and growth of the safe broiler industry in Bangladesh.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/commodities2030018/s1, Questionnaire.

Author Contributions: Conceptualization, M.S.A., M.T.U. and A.R.D.; methodology, M.S.A.; software, M.S.A.; validation, M.T.U. and A.R.D.; formal analysis, M.S.A.; investigation, M.S.A.; resources, M.T.U.; data curation, M.S.A. and M.T.U.; writing—original draft preparation, M.S.A. and A.R.D.; writing—review and editing, M.T.U. and A.R.D.; visualization, M.S.A. and A.R.D.; supervision, M.T.U.; project administration, M.S.A. and M.T.U.; funding acquisition, M.S.A. and M.T.U. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Ministry of Science and Technology, Government of the People's Republic of Bangladesh through the National Science and Technology (NST) fellowship.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Informed consent was obtained from all respondents involved in the study.

Data Availability Statement: Data may be provided upon reasonable request.

Conflicts of Interest: The authors declare no conflict of interest.

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