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An economic and Profitability Comparative Analysis among Different Poultry systems: A Case of Poultry Farmers in Hathazari, Bangladesh

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Authors' contributions

This work was carried out in collaboration among all authors. Author SI conducted the field survey, collected and organized the *data and prepared visual and tabular representations of the results. Author NH conducted the field survey, collected the data, performed statistical analyses including Duncan's multiple range test and chi-square test. Author FA drafted the manuscript. Author MR conducted the field survey and collected the data. Author HPH conceived and designed the study, supervised the research activities, coordinated logistics, reviewed the literature, ensured the consistency and accuracy of the methodology, and critically revised the manuscript for intellectual content, and ensured adherence to ethical research practices. All authors read and approved the final manuscript.*

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ABSTRACT

This study investigated the socio-economic profile of poultry farmers, farm management practices, and the economic profitability of broiler, layer, and sonali chicken production systems in Hathazari, Bangladesh. A total of 30 farms (10 each of broiler, layer, and sonali) were surveyed using a structured questionnaire. Duncan's multiple range test and the chi-square test were carried out for data analysis.

The analysis revealed that poultry farming was dominated by relatively affluent individuals (80% self-funded) who were primarily over 40 years old (73.3%). Farm size and vaccination status varied significantly (P=.00, P=.02) between production systems. Farms with robust biosecurity practices (60%) reported lower post-vaccination disease incidence (33.3%). Recognizing potential nutritional imbalances, most farmers (83.3%) preferred pre-formulated feed. Economic analysis revealed that layer farming offered the highest profitability, with an average annual cost per bird of 1280 BDT (Bangladeshi taka), net return of 909 BDT, and a cost-benefit ratio of 1:1.71. Broiler production yielded a cost per bird of 1376 BDT, net return of 617.2 BDT, and a cost-benefit ratio of 1:1.44. Sonali chicken farming resulted in the lowest profitability, with a cost per bird of 1019 BDT, net return of 79 BDT, and a cost-benefit ratio of 1:1.07.

These findings suggest that layer farming offers significantly greater profitability compared to broiler and sonali chicken production in Hathazari, Bangladesh.

Keywords: Poultry farmers; Hathazari; socio-economic scenario; profitability; economic analysis.

1. INTRODUCTION

1.1 Background of the Study

Bangladesh, a densely populated developing nation, relies heavily on agriculture for its economy. Poultry farming is an integral component of its agricultural sector [1]**.** Poultry farms are establishments dedicated to the raising of various avian species such as chickens, ducks, turkeys, and others, primarily for the purpose of meat or egg production. Today, the poultry farming industry has evolved into a vast enterprise encompassing various operations such as hatcheries, pullet farms dedicated to meat production, and facilities specialized in egg production [2]. Since the turn of the 21st century, the poultry sector in Bangladesh has emerged as an unmatched avenue for rapid financial gains, local job creation, and the provision of affordable animal protein [3]**.** Due to its low startup costs, minimal skill requirements, and high prolificacy, chicken rearing presents itself as a highly feasible option for widespread adoption. Additionally, it offers the advantage of seamless integration with existing household routines. This industry has significant potential to improve livelihoods, promote dietary shifts, and boost the country's GDP [4]**.**

Despite experiencing significant expansion, the poultry industry encounters various challenges, including the absence of an effective marketing infrastructure, limited technical expertise, insufficient laboratory testing capabilities, shortcomings in quality control and disease management practices, restricted access to credit, stiff competition from foreign markets, and elevated taxes on imported poultry seeds [5]**.**

Regardless of facing all these obstacles, Bangladesh has experienced a significant surge in the production of both chicken meat and eggs over the span of the last decade. During the period from 2009 to 2019, the nation witnessed a remarkable growth in its chicken population by over 30%, accompanied by an impressive rise of more than 200% in egg production. This growth trajectory culminated in a per capita consumption rate of 10.4 kg of chicken meat and 113 eggs by the year 2020 [6]**.** The burgeoning demand for meat, eggs, and their derived products has experienced a remarkable surge, driven by factors such as increasing income levels, population expansion, urbanization trends, and evolving dietary preferences. The government is actively engaging with the sector, encouraging participation from both urban and rural populations to bolster capacity and foster growth [7]**.** Prior to 2000, reliance on imported parent stocks was ubiquitous among commercial broiler and layer farms. However, the dawn of the new millennium saw the emergence of numerous local and multinational industry titans establishing domestic operations for parent and grandparent stocks to cater to Bangladesh's burgeoning demand.

Presently, Bangladesh's poultry sector boasts globally acclaimed broiler and layer strains,

spanning from grandparent stock to commercial hybrids. While industrial farms are undergoing modernization, a significant shift is also taking place in backyard poultry production. While egg production is relatively balanced between industrial and backyard systems (approximately 50:50), meat production leans towards industrial dominance (around 60:40). This suggests a growing importance of both sectors in the country's overall poultry output [3]. Poultry production has also skyrocketed from 91 million to a staggering 365.85 million between 1990 and the 2020-2021 fiscal year, driven by rising demand of poultry meat and eggs [8].

1.2 Justification of the study

Hathazari upazila boasts a rich diversity of poultry species and a well-established infrastructure for poultry farming. Despite this favorable environment, a critical gap exists in the research on the economic viability of various poultry farming practices within the region. So, this statistical study was aimed to conduct a comparative analysis of different poultry farming practices within Hathazari upazila. The analysis focused on three poultry types: broilers, layers, and sonali chicken. Evaluations were conducted across a range of aspects to figure out which one is the most profitable farming practice for poultry farmers within the region.

2. MATERIALS AND METHODS

2.1 Study Area and Study Period

The study was conducted from 8th March, 2024 to 30th June, 2024 in Hathazari upazila, Chattogram district, Bangladesh. Hathazari **u**pazila lies at 22.5°N 91.8°E in DMS (Degrees Minutes Seconds) and covers a land area of 246.32 square kilometers in total (WIKIPEDIA) (Fig. 1).

Fig. 1. Location of the study area

2.2 Sources of Data

Hathazari upazila comprises fourteen unions. Ten of these unions were chosen purposively, and one village from each of the selected unions was also chosen (using purposive sampling method). In these selected villages, three farms of each category were also chosen (using purposive sampling method). Farms having a minimum of 1000 birds were included in the study. Data for this study were collected from poultry farmers through a structured questionnaire during on-site visits to their farms.

2.3 Population and Sample Size

All poultry farms involved in poultry production within the Hathazari upazila were treated as the population, and a sample of 30 poultry farms (comprising 10 broiler, 10 layer, and 10 sonali farms) was chosen for study.

2.4 Collection of Data

The data were obtained via direct face to face interview using the structured questionnaire. The interview schedule and questionnaire were developed to align with the study's objectives, ensuring their relevance. Prior to the commencement of the survey, the questionnaire underwent pretesting and subsequent refinement. Data encompassing farm type, rearing system, bird population, vaccination protocols, and biosecurity measures etc. were collected during the visit.

2.5 Analytical Techniques

The information was entered into the main Excel sheet in a tabular format. The collected data were then imported into SPSS software for analysis, and comparisons of variables with various categories were conducted. Duncan's multiple range test and the chi-square test were carried out for data analysis.

3. RESULTS AND DISCUSSION

3.1 Socio-economic Status of the Farmers

Different variables and categories used to describe socio-economic status of the farmers are presented in Table 1. This study revealed a significant difference *(P*=.00) in farm size among surveyed poultry farmers. The majority (53.3%) farms with less than 2,000 birds, followed by farms with 2,000-4,000 birds (30%) and those exceeding 4,000 birds (16.7%). No statistically significant differences were observed in terms of age, education, or gender. Notably, 73.3% of farmers were over 40 years old, this age group is often characterized by sustained activity, productivity, and a heightened openness to adopting new innovations. Compared to farmers in other age brackets, middle-aged individuals may demonstrate a greater propensity for embracing advancements in the agricultural field. This study shares similarities with Tasie et al [9]**.** About 63.3% possessed a secondary education. Interestingly, nearly 90% of poultry farmers were male. Only 30% of farmers reported receiving formal training in poultry farming compared to 70% who had not. However, the difference was not statistically significant *(P*>.05). In terms of experience, 53.3% had 7-15 years of farming experience. This study found that poultry farming served as the primary occupation for 60% of respondents, with the remaining 40% considering it a secondary source of income. Previous research by Alam et al [4] reported that 55% of poultry farmers relied on farming as their primary source of income which is directly relevant to the present study. A highly significant difference *(P*=.03*, P*=.02) was observed between farmers regarding investment and government subsidies. Only 13.3% relied on government subsidies in case of losses, while 80% primarily financed their farms through self-investment. This suggests a potential association between wealth and farm involvement, with wealthier individuals possibly having greater resources for self-investment. These findings support the study conducted by Alam et al. [4] in Gazipur district, which suggests that wealthier farmers are more likely to be engaged in poultry farming compared to those who are economically disadvantaged.

3.2 Management Condition of Farm

An overview of farm management practices, categorized by specific variables, is provided in Table 2. This study investigated various management practices employed by poultry farmers and their association with disease control. A significant difference was observed in rearing systems, feed types, and vaccination status across the surveyed farms. The study included broiler, layer, and sonali chicken farms. Free-range farming was not practiced by any farms, and floor rearing was the dominant system (66.7%), primarily used for broiler and sonali chicken production. Layer chicken farms

predominantly employed cage systems (33.3%). Recognizing the potential for nutritional imbalances and nutritional disease outbreaks with own-formulated feed, farmers overwhelmingly preferred pre-formulated feed (83.3%). Vaccination was implemented in 86.7% of the farms. While no statistically significant difference was found in disease occurrence after vaccination, mortality after brooding, or frequency of veterinary consultations, a clear association emerged between biosecurity practices and disease control. Farms with good biosecurity practices (60%) reported lower disease occurrence after vaccination (33.3%) compared to farms with fair biosecurity (30%). Melkamu et al [10] described biosecurity practices among poultry farmers, reporting that 77.6% had footpaths, 63.3% wore protective clothing, and only 8.2% used hand gloves. These practices were associated with a disease occurrence rate of 38.8%. Interestingly, these findings exhibit close similarities to the present study. Additionally, farms with more frequent veterinary consultations (monthly consultations in 50% of farms) exhibited lower post- Brooding mortality on farms is at a rate of 43.3%. Melkamu et al. [10] a strong association between farm consultation with veterinarians and chick mortality rates. Farms with regular veterinary consultation (approximately 79.6%) exhibited lower mortality rates: 4% for chicks (up to eight weeks old), 15% for growers (8-20 weeks old), and 12% for layers (20-72 weeks old). These findings suggest that there may be a link between robust biosecurity measures and improved disease control in poultry farms.

3.3 Economic Analysis

In our study, we found that the annual average total variable cost of rearing per layer bird was 1276.32 BDT (Bangladeshi taka). For the six broilers reared in six batches in a year, the cost was 1374 BDT. Additionally, for the five sonali bird reared in five batches in a year, the cost was 1017 BDT (Tables 3, 4). A study on the economic analysis of poultry farming focusing on broiler and layer farming in specific areas of Gazipur district by Alam et al [4] revealed that the yearly total costs for rearing a broiler and a layer bird were recorded at BDT 925.5 and BDT 1332.5, respectively. Additionally, Saiful et al. [11] found that the total costs of raising each broiler in one batch amounted to BDT 107.78, BDT 107.07 and BDT 101 .62 for small, medium, and large-sized broiler farms, respectively. In our study, it was found that among the three types of poultry farming, layer farming has emerged as the most profitable option in our study (details in Table 4).

Table 1. Socio-economic status of the farmers

Variables	Categories	No. of farm	Percentage (%)	x^2-Value	*P*-value
Age	< 30	0	0	0.483	1.00
	30-40 years	8	26.7		
	> 40	22	73.3		
Education	Primary	7	23.3	2.014	.82
	Secondary	19	63.3		
	Above Secondary	4	13.3		
Investment	Self	24	80	7.407	**.03**
	Loan	6	20		
Get subsidy from govt.	Yes	4	13.3	6.876	**.02**
	No	26	86.7		
Sex	Male	27	90	4.676	.09
	Female	3	10		
Farming experience	< 7 years	10	33.3	6.397	.14
	7-15 years	16	53.3		
	> 15 years	4	13.3		
Size of the farm (no. of bird)	< 2000	16	53.3	23.92	**.00**
	2000-4000	9	30		
	> 4000	5	16.7		
Farming as a main occupation	Yes	18	60	7.349	**.03**
	No	12	40		
Training	Yes	9	30	1.009	.88
	No	21	70		

Table 2. Overall farm management condition

Variables	Categories	No. of farm	Percentage (%)	x^2-Value	*P*-value
Rearing system	Floor (saw dust)	20	66.7	30.262	**.00**
	Cage	10	33.3		
	Free ranging	0	0		
Feed type	Pre-formulate	25	83.3	9.441	**.005**
	Own-formulated	5	16.7		
Vaccination	Yes	26	86.7	6.876	**.02**
	No	4	13.3		
Disease occurrence after vaccination	Yes	10	33.3	0.418	1.00
	No	20	66.7		
Mortality after brooding period	Yes	13	43.3	3.462	.27
	No	17	56.7		
Frequency of vet consultations	Monthly	15	50	3.101	.26
	Occasionally If disease occurs	15	50		
	Never	0	0		
Biosecurity status	Good	18	60	2.303	.85
	Fair	9	30		
	Poor	3	10		

Table 3. Variable costs of poultry farming by bird type

Number of poultry farm	Day old chick (BDT)	Feed (BDT)	Vaccine (BDT)	Transport (BDT)	Labor and electricity (BDT)
Broiler (n=10)	57.60^{b}±3.50	153.80^{a}±4.32	13.00^{a}±1.58	2.20^{a}±0.84	2.40^{a}±0.55
Layer (n=10)	55.40^{b}±1.67	1170.00^{b}±23.71	33.00^{c}±2.25	8.40^{b}±1.14	10.00^{b}±1.58
Sonali (n= 10)	26.80^{a}±3.96	154.00^{a}±5.70	16.80^{b}±1.304	3.00^{a}±0.70	2.80^{a}±0.84

Results are presented in mean ± SD; means of the same letters across a column indicate no significant difference at p< 0.05. The expenses of broiler, layer and sonali chickens were calculated per batches. Broilers: 6 batches/year, Layer: 1 batch/year, sonali: 5 batches/year.

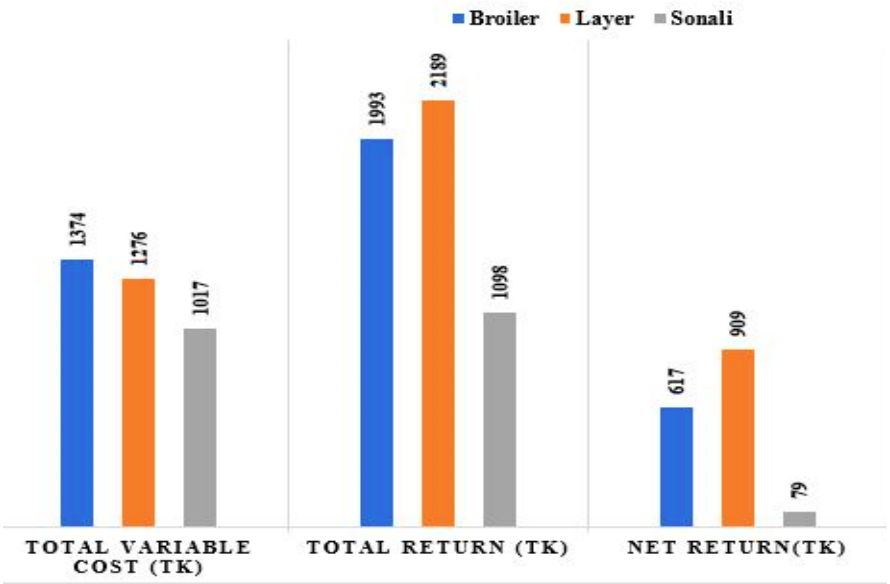

Fig. 2. Profitability assessment of three poultry farming practices

Table 4. Comparative economic performance in three poultry farming practices

Number of poultry farm	Total variable cost (BDT)	Total depreciation cost (BDT)	Total cost (BDT)	Total return (BDT)	Net return (BDT)	Cost income ratio
Broiler (n=10)	1374.00^{c}±64.54	1.96^{b}±0.71	1376.00^{c}±97.18	1993.20^{b}±6.94	617.2^{b}±43.43	1:1.44
Layer (n=10)	1276.32^{b}±51.66	3.20^{c}±1.31	1280.00^{b}±90.23	2189.00^{c}±88.75	909.00^{c}±64.76	1:1.71
Sonali (n= 10)	1017.00^{a}±64.14	1.60^{a}±0.55	1019.00^{a}±71.99	1098.00^{a}±7.96	79.00^{a}±55.87	1:1.07

Results are presented in mean ± SD; means of the same letters across a column indicate no significant difference at p<0.05. In case of broiler and sonali chicken total return comes from only selling of live bird. But in Layer total return comes form by selling of spent hen and Eggs. Cost income ratio (Total income per year/Total cost per year)

Despite having the second highest total cost, the net return is the highest in layer farming compared to broiler and sonali chicken due to factors such as egg production over a longer period (12 months), high price of spent hen and lower feed costs. The protein content in layer feed remains low at around 16%, resulting in lower feed costs compared to broiler and sonali feeds which have higher protein content at around 22% [12,13]**.** Proteins are primarily sourced from soybean meal, fish meal, and protein concentrate. However, in recent years, there has been a significant increase in their prices. Layer feed contains lower protein content compared to broiler feed, resulting in lower costs for layer feed. The cost of feed constitutes the majority of total variable costs. Consequently, layer farming yields the highest net return. In sonali chicken farming, the total cost is almost the same as the cost for layer and broiler chicken details in Table 4. Sonali chickens, which are a crossbreed of Rhode Island Red (RIR) and fayoumi, have a similar appearance and taste to that of local non-descript chickens. This allows farmers to sell sonali at a higher price than broilers. However, sonali chickens have a slower growth rate compared to broilers. While broilers can gain 1.5 kg of weight in 1 month, sonali chickens only gain 500 grams [14]**.** Additionally, the feed cost for sonali chickens is almost the same as broilers because sonali chickens are fed with broiler feed in intensive farming**.** Annual broiler production in Bangladesh allows for 6 batches, whereas sonali is limited to 5. Consequently, sonali experiences a decrease in total farming revenue**.** The current study shows a higher value for total cost and net return compared to the previous study. This is primarily due to the recent increase in the prices of DOC (day old chick), feed, chicken meat, and eggs.

3.4 Profitability Assessment of three Poultry Farming Practices

The Fig. 2 shows that the layer farming's total variable cost ranks as the second lowest among the three options but exhibits the highest net return, signifying greater profitability after accounting for all variable costs. Although sonali farming has the lowest total variable cost, its net return is the weakest. Layer farming achieved a cost-benefit ratio of 1:1.71, indicating that for every unit of currency invested, a return of 1.71 units is generated (Table 4). This value aligns closely with Alam et al., [4] findings of a 1:1.66 ratio for layer farming. Broiler farming, on the other hand, exhibited a ratio of 1:1.44, deviating from Alam et al., [4] reported ratio of 1:17.

4. CONCLUSION

Poultry rearing is a promising source of income for rural residents and young individuals. Variations were observed in farm management practices and socioeconomic status among farmers in Hathazari upazila, including differences in farm size, investment sources, occupation reliance on farming, government subsidies received, rearing techniques, feed preferences, and vaccination status. However, other variables related to socioeconomic status and farm management remained consistent across the surveyed farmers. In economic analysis Layer farming appears to be the most profitable option among broiler, layer, and sonali chicken farming. However, broiler farming can also be profitable, and the decision between the two may depend on factors such as access to markets for eggs or meat and personal preferences for broiler or layer chicken

production. Sonali chicken farming, based on this data, appears to be the least profitable option.

5. RECOMMENDATIONS

This study promotes layer farming, particularly for farmers who have access to reliable markets for eggs and encourages farmers who have little money or who want to make rapid profits to raise broilers, especially if they have easy access to meat markets. Unless niche markets or premium pricing techniques can be found, it discourages large-scale investments in sonali chicken production. To increase profitability, it is needed to teach farmers sophisticated rearing techniques, efficient feed management, and immunization procedures.

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DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist in this manuscript.

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