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# Existing Scenario and Profitability in Duck Farming in Selected Haor and Coastal Areas of Bangladesh

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## ABSTRACT

Duck farming has recently emerged as a lucrative business in Bangladesh. The study aimed to assess the current state of native ducks in specific regions of the country. Data (180) were collected through a structured questionnaire from six upazilas of the Coastal and Haor areas. Data were analyzed using the Statistical Package for Social Sciences. The mean age of duck farmers was 40.41 and 41.11 years in the Haor and Coastal areas. About 68.89% of farmers raised Native ducks and 31.11% of Khaki Campbell in Coastal areas, whereas 37.78% of Native ducks, 41.11% of Khaki Campbell, and 12.22% of Jinding ducks were raised in Haor. The scavenging system was practiced by 41.11% and 81.11% of farmers of the Coastal and Haor areas. The highest mature body weight of males and females was 1.92±0.07 kg and 1.66±0.07 kg in Native ducks in Haor, 1.85±0.05 kg and 1.47±0.06 kg in Khaki Campbell ducks in Coastal areas. The average egg production was highest at 238.46±9.39 in Jinding in Haor and 205.71±6.47 in Khaki Campbell in Coastal areas. The maximum age of first laying was 170.36±1.98 days for Khaki Campbell in Haor and 161.70±2.43 days for Native ducks in Coastal areas. The Benefit-Cost Ratio was 2.24 in Haor and 1.33 in Coastal areas. It can be concluded that duck farming holds significant potential and promising opportunities in Bangladesh's Haor and Coastal regions.

## INTRODUCTION

Duck rearing is a crucial component of Bangladesh's poultry industry. Ducks are a vital part of the farming system and play a key role in 80% of rural communities in Bangladesh. Ducks generate cash income and create employment opportunities, especially for small-scale and landless farmers (Afrin *et al.*, 2016). The duck population in Bangladesh is about 682.61 lakh in Number (DLS, 2024). Bangladesh's climate and environment are well-suited for ducks, and the numerous water bodies provide ideal conditions for duck farming (Parvez *et al.*, 2020). Duck farming contributes significantly to rural livelihoods and food security, especially in the Haor and coastal regions where ducks are well-suited to the local environment. Food and Agricultural Organization states that Bangladesh ranks 11th in duck meat production and 4th in egg production among Asian countries (Pingle, 2011). As a riverine nation with 16,488 km² of haors, canals, ponds, and low-lying water reservoirs, it can be effectively used for duck farming. While most ducks in the country are Indigenous, other important breeds include Khaki Campbell, Indian Runner, Jinding, Pekin, and their crossbreeds (Parvez *et al.*, 2020). The most commonly raised duck breeds in backyard duck farming include Deshi black or white ducks, Indian Runner, and Khaki Campbell (Zahan *et al.*, 2016). Conventionally, farmers across the country would keep a small flock of ducks alongside their chickens (Sheheli *et al.*, 2023). Farmers prefer Indigenous ducks in traditional scavenging systems due to their excellent adaptation to local farming conditions, strong foraging skills, long productive lifespan, and resistance to diseases (Pervin *et al.*, 2013; Morduzzaman *et al.*, 2015). Ducks pose fewer risks than other birds, and their eggs are heavier and richer in nutrients. They have a longer productive egg-laying lifespan, are excellent foragers, and require less feed. Duck meat is delicious, and they don't need complex housing. Additionally, ducks naturally help control pests and snails (Bangladesh Bureau of Statistics, 2017). Duck farming provides employment opportunities for rural populations, especially for small-scale and landless farmers. Moreover, duck rearing is ideal for broad adoption because it is inexpensive, requires minimal skills, offers high productivity, and can be easily integrated into household activities (MKI, 2012). Therefore, a survey was carried out to know the existing scenario of duck farming, and to identify the major problems faced by duck farmers in Haor and Coastal areas along with their profitability in duck rearing.

## MATERIALS AND METHODS

### Study areas

A total of Six (06) districts namely Patuakhali, Pirojpur, Gopalgonj, Kishoregonj, Netrokona, and Sunamgonj were chosen from six divisions of Bangladesh for initial data collection. Six districts were chosen 3 from the Haor area and 3 from the Coastal areas, and data were gathered to cover at least one of the upazilas from each district.

### Methods

A baseline survey was carried out to understand the current state of duck farming and its management system in the selected regions of Bangladesh. To concentrate on the goals or aims of the study, a systematic questionnaire on the production and potentialities of local duck germplasm



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was formulated and pretesting was also carried out. Data were collected from available primary and secondary sources between June and August of 2024. A total of 30 duck-raising farmers were interviewed through the structured questionnaire and direct observation of the farmer's household. A total of 180 farmers' data were gathered from each selected district. Simple and easy questions were used to ensure easy understanding by the farmers and maximize the accuracy of the obtained data. Information on Key Informant Interviews (KIIs) was also gathered from the Upazila Livestock Office and relevant experts in the livestock sector in each location. KIIs accumulated information on issues and solutions involved in duck farming. The data-collecting process focused on the relevant quantitative and qualitative data. A variety of sources, including books, Google Scholar, journals, thesis papers, government documents, and Bangladesh's statistics yearbooks were also used to collect and compile secondary data. Data on duck farming, egg production, housing, hatching, brooding, and management practices were also included in the survey.

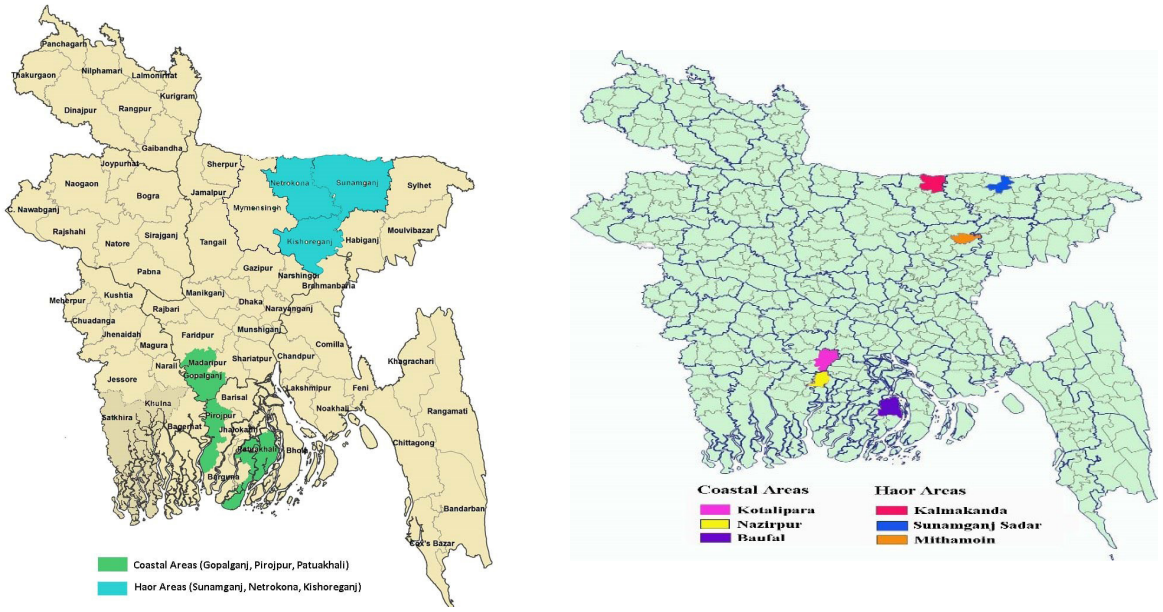


**Figure 1:** Study Locations (a. District-wise Map; b. Upazila-wise Map)

**Statistical analysis**

Microsoft Excel sheets were used to enter, sort, assemble, tabulate, and arrange the collected data and statistical analysis especially descriptive statistics including frequency distribution, percentage, mean value, and standard error using the Statistical Package for the Social Sciences (SPSS), Version -25.

For calculating net return, we used the following formula:

Net return= GR-GC (Where, GR=Gross return, GC=Gross cost)

GC=TFC+TVC (Where, TFC=Total fixed cost, TVC=Total variable cost)

To calculate the benefit-cost ratio, we used the following formula

Benefit-Cost ratio = (Gross return (GR))/(Gross cost (GC)) .....(1)

The gross return includes the average return from the main product and by-products of different Ducks. Gross cost includes the total cost of Duck rearing. The benefit-cost ratio was a relative measure that was used to compare benefit per cost. It helped to analyze the financial efficiency of the farms. The multiple regression model was used to determine the effects of key variables in overall duck farming. The relationship between Y and X was established through regression analysis, where the variation in Y due to changes in X was estimated using a Linear multiple Regression model, which is represented as follows:

$Y = a + b1X1 + b2X2 + b3X3 + b4X4 + b5X5 + b6X6 + ei$ .....(2)

Where, Y = Profit of Duck-rearing farmers (BDT/year)

a = Constant b = Regression coefficient

X1 = Duck/Duckling Cost (BDT/year)

X2= Doctor fees (BDT/year)

X3 = Feed cost (BDT/year)

X4= Medicine, Vaccine, and disinfectant cost (BDT/year)

X5= Family Labor cost (BDT/year)

X6= Hired labor cost (BDT/year)

X7= Housing Cost with 10% depreciation (BDT/year)

X8= Transportation Cost (BDT/year)

X9= Housing cost (BDT/year)

X10= Electricity Cost (BDT/year)

Hey = Disturbance factors

## RESULTS AND DISCUSSIONS

Socio-Economic Status of Farmer

Table 1 highlights the socio-economic condition and farming experience of the duck-rearing farmers in the Haor and Coastal regions, indicating variations in age, family size, earning members, and farming experience. The age range of duck farmers was divided into three

(03) categories, with a significant majority of farmers (70.00%) between 36-50 years of age and 24.44% of farmers 35 years or younger in Haor. Only 5.55% of farmers were over 50 years old. The mean age was approximately 40.41±0.84 years in Haor and 41.11±1.02 years in Coastal areas. On the contrary, 4.44% of farmers were within the 36-50 years of age category, with 30.33% in 35 or younger and 12.22% being older than 50 years in Coastal areas. Family size was predominantly moderate in Haor areas, where 42.22% of farmers had 5-6 members in their households followed by 34.44% of farmers who had 4 or fewer members and 23.33% of farmers' families contained more than 6 members. In Coastal areas, a slightly larger family size was observed with 47.77% of farmers having 5-6 members, 41.11% of farmers' families composed of 4 or fewer members and only 11.11% of farmers reported having more than 6 family members. The average family size was lower in Coastal areas (4.84±0.14) than in Haor (5.51±0.22) whereas the average earning member was also seen higher in Haor (1.41±0.08) than in Coastal areas (1.31±0.07). The mean duck farming experience was slightly higher (12.16±0.95 years) in Coastal areas than in the Haor (10.79±0.84 years) region. A significant portion of farmers (57.78%) in the Haor region had 1-10 years of duck farming experience, while 31.11% of farmers had 11-20 years and only 11.11% of farmers possessed 21-30 years of experience. Conversely, about 52.22% of farmers in the Coastal region had 1-10 years of duck raising experience, 31.11% of farmers were experienced within 11-20 years and only 16.67% possessed experience of 21-30 years (Table 1).

**Table 1:** Socioeconomic Status of Farmer

| **Parameter** | **Percent (n)** | | **(Mean±S.E)** | |
|---|---|---|---|---|
| **Age range** | **Haor** | **Coastal** | **Haor** | **Coastal** |
| ≤35years | 24.44(22) | 30.33(30) | 40.41±0.84 | 41.11±1.02 |
| 36-50years | 70.00(63) | 54.44(49) | | |
| >50 years | 5.55(5) | 12.22(11) | | |
| **Family Member Range** | | | | |
| ≤4 | 34.44(31) | 41.11(37) | 5.51±0.22 | 4.84±0.14 |
| 5-6 | 42.22(38) | 47.77(43) | | |
| >6 | 23.33(21) | 11.11(10) | | |
| Earning Member | | | 1.41±0.08 | 1.31±0.07 |
| **Experience of Farming** | | | | |
| 1-10 year | 57.78(52) | 52.22 (47) | 10.79±0.84 | 12.16±0.95 |
| 11-20 year | 31.11(28) | 31.11 (28) | | |
| 21-30 year | 11.11(10) | 16.67 (15) | | |

Figure 2, represents a comparative analysis of educational attainment among duck-rearing farmers from Haor and Coastal regions. In terms of education, 25.55% of farmers in the Haor region were illiterate and 21.11% could only sign their names. In contrast, the Coastal region had a significantly lower percentage of illiterate farmers (8.89%) and 28.89% who could only sign. Approximately, 30% of farmers completed primary education (grades 1-5) in the Haor region followed by 17.78% who attained Secondary Level (6-10), and only 1.11% of farmers were educated up to higher secondary education level (11-12). On the other hand, 46.66% of farmers completed primary education, while 10% attained secondary level education, and 4.44% had higher secondary level education in the coastal region. Graduation and post-graduation levels were 4.44% in Haor and 1.11% in Coastal areas.

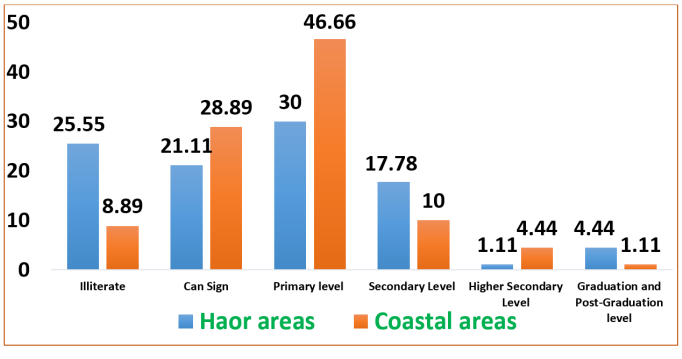


**Figure 2:** Educational level of duck rearing farmers in Haor and Coastal region

About 56.67% and 37.78% of farmers were engaged in agriculture in the Haor and Coastal regions. The Coastal region showed a notable presence of labor selling, accounting for 20%, while a minimal percentage (2.22%) was seen in the Haor region. Additionally, 12.22% of respondents in the Coastal area were employed in service roles. Business activities were relatively similar across both regions, with 21.11% in Haor and 17.78% in Coastal areas. Only 20% and 12.22% of farmers were involved in other occupations in the Haor and Coastal regions (Table 2).

**Table 2:** Farmers' occupation In a different location

| Farmer's Occupation | Haor | Coastal |
|---|---|---|
| Agriculture | 56.67 (51) | 37.78 (34) |
| Labor Selling | 2.22 (2) | 20.00 (18) |
| Service | - | 12.22(11) |
| Business | 21.11 (19) | 17.78(16) |
| Others | 20.00 (18) | 12.22 (11) |

**Duck Farm Size and Types of Duck Reared by Farmer**

Figure 3 provides an overview of training participation among duck-rearing farmers in the Haor and Coastal regions. A total of 88.89% and 82.22% of non-trained farmers were observed in the Haor and Coastal regions. Only 5.56% of farmers received training from DLS with 1.11% from NGOs and 4.44% facilitated training from other sources. In opposition, 17.78% of farmers got training only from DLS in the Coastal region and there were few or limited facilities for farmers to get training from other sources.

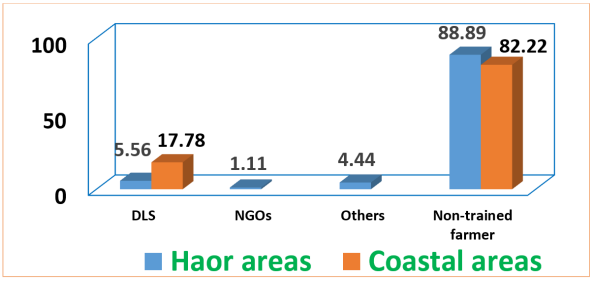


**Figure 3:** Training received by the farmers on duck Farming

**Table 3:** Size of farm and Duck types

| Duck Population and Types | Netrokona % (n) | Sunamgonj% (n) | Kishorgonj% (n) | Haor % (n) | Patuakhali % (n) | Pirojpur % (n) | Gopalgonj % (n) | Coastal % (n) |
|---|---|---|---|---|---|---|---|---|
| S 1-25 | 14.44 (13) | 20.00 (18) | 6.67 (6) | 41.11 (37) | 32.22 (29) | 32.22 (29) | 33.33 (30) | 97.78 (88) |
| M 26-100 | 3.33 (3) | 1.11 (1) | 3.33 (3) | 7.78 (7) | 1.11 (1) | 1.11 (1) | - | 2.22 (2) |
| L >100 | 15.56 (14) | 12.22 (11) | 23.33 (21) | 51.11 (46) | - | - | - | - |
| Khaki Campbell | 5.56 (5) | 2.22 (2) | 33.33 (30) | 41.11 (37) | 1.11 (1) | 4.44 (4) | 25.56 (23) | 31.11 (28) |
| Native Duck | 6.67 (6) | 31.11 (28) | - | 37.78 (34) | 32.22 (29) | 28.89 (26) | 7.78 (7) | 68.89 (62) |
| Jinding | 1.11 (1) | - | - | 1.11 (1) | - | - | - | - |
| Khaki Campbell+Native | 6.67 (6) | - | - | 6.67 (6) | - | - | - | - |
| Jinding+Khaki Campbell | 12.22 (11) | - | - | 12.22 (11) | - | - | - | - |
| All type | 1.11 (1) | - | - | 1.11(1) | - | - | - | - |

Table 3 provides a details overview of farm size and duck populations across various districts in the Haor and Coastal regions. The Coastal region showed an impressive 97.78% of small-sized (1-25) duck farms whereas 51.11% of large-sized (L>100) duck farms was higher in the Haor region. Within the Coastal region, Gopalganj (33.33%) represented a significant proportion of small-category farms, while Patuakhali (32.22%) and Pirojpur (32.22%) exhibited also the same percentage of small and medium-sized duck farms. Kishorgonj (23.33%) showed a higher proportion of large-sized farms among three selected districts from the Haor region. Only 3.33% of large farms (Above 1000 ducks) were observed in Sunamganj districts among the overall selected areas. In the Haor region, the Khaki Campbell breed comprised the higher at 41.11% of the duck population while Native Ducks represented 37.78%. A small number of farmers (1.11%) also had Jinding and all types of ducks followed

by 12.22% of Jinding+Khaki Campbell and 6.67% of Khaki Campbell+Native. Conversely, the Coastal region had a maximum presence of Native Ducks at 68.89% and Khaki Campbell ducks accounted for 31.11%.

**Productive Performance of Different Ducks at Haor and Coastal Areas**

Table 4 presents the average egg production and body weight gain of different ducks in the Haor and Coastal regions. The Khaki Campbell ducks showed the highest productivity in the Haor region, while 50.91% of farmers reported that they got more than 200 eggs per year with 32.73% mentioning the annual egg production of 151-200 and 16.36% responding to 150 or fewer eggs they got per year from Khaki Campbell duck. However, Native Ducks showed a different distribution where 60.98% of farmers reported egg production of 151-200 with 31.70% responding to exceeding 200 eggs and only 7.32% of farmers mentioned 150 or fewer eggs laid by Native Ducks per year. Jinding duck showed a smaller sample size in the study areas with 84.62% of farmers reporting an annual production of over 200 eggs. In the Haor region, the age at first laying was observed as 170.36 days for Khaki Campbell ducks followed by 175.77 days for Jinding ducks and 176.75 days for Native Ducks. In comparison to Haor, Khaki Campbell ducks had a slightly higher age at the first laying of 173.92 days but an earlier age of 161.70 days was found for Native Ducks in the Coastal region.

**Table 4:** Egg Production and Body Weight Gain of Different Duck

| **Parameters** | | **Haor** | | | **Coastal** | |
|---|---|---|---|---|---|---|
| | | Khaki Campbell (n=55) | Native Duck (41) | (n=13) | Khaki Campbell (n=28) | Native Duck (n=62) |
| Avg. Egg production Percent % (n) | | | | | | |
| ≤150 | | 16.36(9) | 7.32(3) | 7.69(1) | 3.57(1) | 29.03(18) |
| 151-200 | | 32.73(18) | 60.98(25) | 7.69(1) | 57.14(16) | 41.94(26) |
| >200 | | 50.91(28) | 31.70(13) | 84.62(11) | 39.29(11) | 29.03(18) |
| Age at 1st laying, Days (Mean±SE) | | 170.36±1.98 | 176.75±2.53 | 175.77±2.64 | 173.92±2.14 | 161.70±2.43 |
| Avg. Body weight (kg) | Male (Mean±SE) | 1.67±0.03 | 1.92±0.07 | 1.61±0.03 | 1.85±0.05 | 1.81±0.04 |
| | Female (Mean±SE) | 1.50±0.02 | 1.66±0.07 | 1.41±0.02 | 1.47±0.06 | 1.46±0.03 |

The highest average body weight was observed for Native male ducks (1.92±0.07kg) in the Haor region whereas the average 1.85±0.05kg of male body weight was higher for the Khaki Campbell breed in the Coastal region (Table 4). However, the average male and female body weight for Khaki Campbell ducks was 1.67±0.03kg and 1.50±0.02kg after 1.66±0.07kg for Native females with 1.61±0.03kg for Jinding males and 1.41±0.02kg for Jinding females in the Haor region. In the Coastal region, female Khaki Campbell ducks had an average weight of 1.47±0.06kg followed by 1.81±0.04kg for Native males and 1.46±0.03kg for Nactive female ducks.

**Duck Rearing and Feeding System**

Table 5 represents an insight into the various duck-rearing methods practiced in the Haor and Coastal regions. The Haor region showed a diverse approach to duck rearing, with the majority of farmers (41.11%) practicing a scavenging system, 38.89% following semi-intensive, 8.89% adopting Harding, and 11.11% of lending methods employed by duck-rearing farmers, respectively. Most of the Coastal farmers (81.11%) depended on scavenging systems for duck rearing, while 18.89% of farmers utilized semi-intensive systems.

**Table 5:** Duck Rearing System

| **Area** | **Semi-intensive % (n)** | **Scavenging % (n)** | **Harding % (n)** | **Lenting % (n)** |
|---|---|---|---|---|
| Netrokona | 17.78 (16) | 4.44 (4) | 8.89 (8) | 2.22 (2) |
| Sunamgonj | 17.78 (16) | 8.89 (8) | - | 6.67 (6) |
| Kishoregonj | 3.33 (3) | 27.78 (25) | - | 2.22 (2) |
| Haor | 38.89(35) | 41.11(37) | 8.89(8) | 11.11(10) |
| Patuakhali | - | 33.33 (30) | - | - |
| Pirojpur | 16.67 (15) | 16.67 (15) | - | - |
| Gopalgonj | 2.22 (2) | 31.11 (28) | - | - |
| Coastal | 18.89(17) | 81.11(73) | | |

Table 6 presents a comparison of the usage and supply of different feed ingredients in duck rearing in the Haor and Coastal regions. Both regions reported full dependency on rice (100%), with 97.78% of rice bran. However, the supply of boiled rice varied in the Coastal region, with a higher utilization rate of 86.67% compared to 71.11% in the Haor region. Rice husks were also significantly used with 93.33% in Haor and 80.00% in Coastal farms. A higher proportion of maize bran and wheat usage was observed in Haor than in the Coastal region. In Haor, around 55.56% of duck farmers incorporated soybean into duck feed while only 10.00% of Coastal farmers used it. Oyster shell usage was notably low across both regions, with 11.11% in Haor and just 1.11% in Coastal areas. The inclusion of vitamin-mineral premix was minimal, reported at 2.22% in Haor, with no usage recorded in the Coastal region. Additionally, the ready feed was more commonly used with 53.33% of farmers adopting it in the Coastal region compared to 40.00% in the Haor region.

**Table 6:** Supplementation of different feed ingredients

| Feed Ingredients | Haor% (n) | Coastal% (n) |
|---|---|---|
| Rice | 100 (90) | 100 (90) |
| Rice Bran | 97.78(88) | 97.78(88) |
| Boiled Rice | 71.11(64) | 86.67(78) |
| Maize bran | 23.33(21) | 15.56(14) |
| Wheat | 56.67(51) | 26.67(24) |
| Rice Husk | 93.33(84) | 80.00(72) |
| Soybean | 55.56(50) | 10.00(9) |
| Oyster Shell | 11.11(10) | 1.11(1) |
| Vit-min Premix | 2.22(2) | - |
| Ready Feed | 40.00(36) | 53.33(48) |

**Sources of Duck and Duckling**

The main source of duck/ duckling in coastal areas from the market sources was 61.11% followed by a few other sources mentioned in Table 7. On the contrary, Haor areas farmers take duck or ducklings from a variety of sources for rearing. Especially they take ducklings from Hatcheries for commercial farming. In coastal areas, a record of hatchery sources was not found as there were no commercial duck hatcheries in those areas.

**Table 7:** Sources of Duck and Duckling for rearing at farmer's level

| Sources | Haor % (n) | Coastal% (n) | Sources | Haor% (n) | Coastal % (n) |
|---|---|---|---|---|---|
| Market | 20.00 (18) | 61.11 (55) | Faria + Hatchery | 10.00 (9) | - |
| Other farmers | 21.11(19) | 25.56 (23) | Hatchery + farmer | 5.56 (5) | - |
| Faria | 2.22 (2) | 3.33 (3) | Market + Neighbor | 14.44 (13) | - |
| Neighbors | - | 2.22 (2) | Market + Farmer | 2.22 (2) | - |
| Hatchery | 11.11 (10) | - | Market + Faria | 7.78 (7) | 6.67 (6) |
| Neighbor + Hatchery | 4.44 (4) | - | Market + Hatchery + Neighbor | 1.11 (1) | 1.11(1) |

**Demand and Market Value of Duck and their Product**

Table 8 represents the value of duck, their demand, and the purpose of rearing. Khaki Campbell breed was the most popular duck in the Haor region, covering up the demand of 46.67% where 60% of the demand was covered by Native ducks in the Coastal areas. There was minimal interest in the rearing of the Jinding breed (1.11%). Additionally, the combination of demand for Native and Khaki breeds accounted for 14.44%, with 7.78% for Native and Jinding ducks. About 46.67% of the farmers preferred a duck weight of >2 kg in Haor, 68.89% of farmers preferred a 1 kg body weight in Coastal areas both for selling and purchasing, where the highest 71.11% of farmers demanded duck eggs in Haor, and 33.33% demanded Layer + Duck eggs in the Coastal areas. The majority proportion of the respondents (67.78% in Haor and 60.00% in the Coastal area) preferred duck and duck eggs mostly for consumption in various family events as well as the tastiness of the duck meat. A significant percentage of respondents (58.89% in Haor and 100% in the Coastal region) indicated that they raised ducks both for additional income and their own/ family consumption.

**Table 8:** Demand for Duck, egg, their values, and Purposes of Duck Rearing

| Demanded Duck | Haor% (n) | Coastal% (n) | Sources | Haor% (n) | Coastal % (n) |
|---|---|---|---|---|---|
| Native | 30.00 (27) | 60.00 (54) | Family event | 13.33 (12) | - |
| Khaki Campbell | 46.67 (42) | 21.11 (19) | More meat | - | - |
| Jinding | 1.11 (1) | - | Tasty | 18.89 (17) | 40.00 (36) |
| Native + Jinding | 7.78 (7) | - | Family event + Tasty | 67.78 (61) | 60.000 (54) |
| Native + Khaki Campbell | 14.44 (13) | 18.89 (17) | Demanded Duck Eggs | | |
| Demandable body weight of Duck | | | | | |
| 1 kg | 14.44 (13) | 68.89 (62) | Layer chicken eggs | 10.00 (9) | 3.33 (3) |

| | | | | | |
|---|---|---|---|---|---|
| 2 kg | 38.89 (35) | 25.56 (23) | Duck eggs | 71.11 (64) | 27.78 (25) |
| >2 kg | 46.67 (42) | 5.56 (5) | Native chicken eggs | 3.33 (3) | 3.33 (3) |
| Purpose of Duck rearing | | | Layer + Duck eggs | 15.56 (14) | 33.33 (30) |
| Extra income | 37.78 (34) | - | Duck + NC eggs | - | 13.33 (12) |
| Own | 3.33 (3) | - | Layer + NC eggs | - | 11.11(10) |
| Both | 58.89 (53) | 100.00 (90) | Layer + Duck eggs + NC eggs | - | 7.78 (7) |

Table 9 outlines the price of ducks in different stages along with their egg prices. The average price of four Duck eggs was BDT 66.67, whereas the average duck price at an early age (duckling) was 66.72 BDT, Grower 317.39 BDT, Adult female 500.28 BDT and Adult male 587.66 BDT.

**Table 9:** Market Price of Duck

| Market Price | Mean (BDT) | Minimum (BDT) | Maximum (BDT) |
|---|---|---|---|
| Duck egg/hali | 66.67 | - | - |
| Duckling | 66.72 | 30 | 100 |
| Grower | 317.39 | 200 | 500 |
| Adult Female | 500.28 | 400 | 700 |
| Adult Male | 587.66 | 400 | 800 |

**Benefit-Cost Ratio (BCR) in Duck Farming**

Table 10 provides costs and returns in duck farming in the Haor and Coastal areas and an overall combined view. Duck buying cost was significantly higher in Haor areas at 22,821.22 BDT/year compared to 1,370.33 BDT/year in Coastal areas, with an overall average of 12,095.78 BDT/year. Costs for veterinary services, doctor fees, feed costs, labor costs, housing costs, transportation costs, electricity costs, and miscellaneous costs were also higher in Haor areas rather than in Coastal regions (Table 10). This was due to the duck farm size in Haor areas being higher whereas, in the Coastal areas, most of the duck farms were smaller.

**Table 10:** Total costs and returns involved in duck farming

| Parameter | Haor (BDT/Year) | Minimum (BDT) | Maximum (BDT) |
|---|---|---|---|
| Duck buying cost | 22821.22 | 1370.33 | 12095.78 |
| Doctor fee | 552.22 | 68.89 | 310.56 |
| Veterinary cost | 8038.89 | 315.00 | 4176.94 |
| Supplemented feed cost | 208053.56 | 7087.50 | 107570.53 |
| Family labor cost | 83633.16 | 15968.75 | 49800.96 |
| Hired labor | 12133.33 | 61.11 | 6097.22 |
| Housing cost | 1316.89 | 385.56 | 851.22 |
| Transportation cost | 1344.44 | 61.67 | 703.06 |
| Electricity cost | 482.22 | 30.56 | 256.39 |
| Miscellaneous cost | 663.33 | 342.78 | 503.06 |
| Gross cost | 338928.16 | 25692.14 | 182310.15 |
| Duck selling | 138886.67 | 4208.33 | 71547.50 |
| Egg selling | 509087.23 | 22363.13 | 265725.18 |
| Chick selling | 0.00 | 373.33 | 186.67 |
| Family consumed duck | 4397.78 | 1750.00 | 3073.89 |
| Family consumed egg | 5039.11 | 2442.22 | 3740.67 |
| Gift to others | 213.33 | 348.89 | 281.11 |
| Closing stock | 101435.22 | 2625.00 | 52030.11 |
| Gross Return | 759059.34 | 34110.91 | 396585.12 |
| Net Return | 420131.18 | 8418.77 | 214274.97 |
| BCR | 2.24 | 1.33 | 2.18 |

The gross cost of duck farming elevated in Haor was 338,928.16 BDT/year compared to Coastal areas 25,692.14 BDT/year. The overall average gross cost was 182,310.15 BDT/year. The egg-selling return was a substantial contributor, highest in Haor (509,087.23 BDT/year) and significantly lower in Coastal areas (22,363.13 BDT/year). Gross return followed similar trends, with Haor 759,059.34 BDT/year and in the Coastal areas 34,110.91 BDT/year. Higher net returns were observed in the Haor region 420,131.18 BDT/year as opposed to the Coastal regions 8,418.77 BDT/year. The Benefit-Cost Ratio ((BCR) was highest in Haor regions at 2.24 showing a significant return relative to costs, in contrast with the Coastal region at 1.33. The overall BCR in duck farming was 2.18, which means duck farming was profitable.

**Production Function Analysis**

**Factors affecting the production function of duck farming:**

Table 11 represents the econometric regression results of the parameters of the factors affecting the production function of duck raisers.

**Table 11:** Production function Analysis through Multiple Regression

| **Multiple Regression and Coefficient Test** | | | |
|---|---|---|---|
| **Independent Variables** | **Coefficients** | **t-test** | **Probability** |
| (Constant) | -58649.401 | -2.813 | 0.005 |
| Duck/ Duckling Cost | -0.125 | -5.648 | 0.000 |
| Doctor fee | 0.077 | 3.815 | 0.000 |
| Medicine, Vaccine, and Disinfectant Cost | 0.157 | 6.135 | 0.000 |
| Feed Cost | 0.731 | 20.485 | 0.000 |
| Family Labor Cost | 0.137 | 2.999 | 0.003 |
| Hired Labor Cost | -0.081 | -4.038 | 0.000 |
| Housing Cost | 0.096 | 3.670 | 0.000 |
| Transport Cost | 0.004 | 0.188 | 0.851 |
| Electricity Cost | 0.080 | 4.275 | 0.000 |
| Others Cost | 0.024 | 0.979 | 0.329 |
| F Value | 358.194 | | 0.00 |
| R Square | 0.955 | | |
| Adjusted R Square | 0.952 | | |

**P<0.001 indicates the probability level at 1%, *P>0.05 indicates Non-significant value; Y=Total Income (Dependent Variable)*

The parameter estimates of duckling cost, Doctor Fees, Medicine, and health management (Vaccine, and Disinfectant) cost, feed cost, family labor engaged, hired labor cost, housing, and electricity cost were highly significant at a 1% probability level. Among the mentioned variables in the model, two variables showed a negative correlation coefficient value, while the transportation and other costs were not statistically significant. The present results indicated that those factors had a significant effect from zero and are therefore important to explain the production function of duck farming. The coefficients of the parameter estimate the representative percentage change in the cost of duck farming when the explanatory variables change by one percent. The diagnostic statistic results showed an F-value of 358.194, which expressed a statistically significant effect at a 1% probability level. The coefficient of determination ($R^2$) means that about 95.5% of the variability in per unit variable cost was accounted for by the explanatory variables in the model. Indeed, the explanatory factors in the cost function model explained the production function of duck raisers. Thus, the cost function regression model was adequate. According to Gujarati and Porter (2003) in determining model adequacy, broad features of results, such as the value of the coefficient of determination ($R^2$) and F-value should be looked at. Production function was generated when a firm used its resources and capabilities to achieve a lower cost structure. Based on this, factors that reduced per unit cost of production would promote production and profit from duck farming. Thus, a negative parameter estimate indicated that a reduction in the explanatory factor would result in a reduction in per unit cost; hence it promotes production and profit. Among all the parameter estimates, the maximum variable input costs (six) used in the model were positive and statistically significant at a 1% probability level, implying that the cost function monotonically increased in variable input prices. As the two variables showed a negative correlation coefficient value so, it is clear from Table 11 that duckling and hired labor costs had the highest effect on the overall cost, confirming their significant effect on duck production in the study areas. All other things being equal, if duck producers could have access to ducking at competitive prices and also adopt proper labor management practices, they would be able to reduce production costs significantly to gain the optimum production and maximize profit. Efforts should

be directed at reducing the cost of these two inputs to improve the production of the duck farming sector. The negative coefficient of the hired labor cost implied that duck raisers who engaged more hired labor obtained the minimum profit on production cost than those who didn't engage hired labor in their farming business. The variable of hired labor cost showed a significant effect at a 1% probability level, the negative coefficient indicated that the maximum working ability of the minimum labor force of hired labor would enhance the production and profit in duck farming. Moreover, utilization of increased production capacity of duck raising farmers would ensure that cost spread over larger output and reduction in per unit cost of production would promote the production function in duck farming.

**Discussion**

In the current study (table 1), a higher age of farmers was observed than Alam *et al.* (2012) who conducted a study with duck-rearing farmers in the Rajshahi region reporting a lower average age of 34.48 years. Jha *et al.* (2015) presented also lower results of 33.33 years of duck-rearing farmers. Rahman *et al.* (2009) carried out a study with duck farmers in Coastal districts (Noakhali and Ramgoti) where they also found a lower mean age of 33.33±8.44years. They also stated that most of the farmers (39%) were in middle age (36-50 years) similar to this study. According to Hoque *et al.* (2010), the similar mean age of duck-raising farmers compared to the present findings was 41.2 years in the Coastal region. Islam *et al.* (2016) described the duck farmers' ages ranged from 25 to 90 years with a mean age of 42.02 years in the Mymensingh district which was similar to the current findings. Zannat *et al.* (2018) classified the duck-rearing households in the Haor areas into three groups: small (0-5 members), medium (6-8 members), and large families consisting of more than 8 members where 32% of duck farmers household were in small, 48% families were medium and rest 20% families were in a large category. Though these categories were slightly different from the findings of Table 1, the results were closely related to current findings. Alam *et al.* (2012) also reported the highest percentage (57%) of small families (Up to 4) followed by 31% of medium (5-6) and 12% of large families (Above 6) in the Rajshahi region which was different from present findings due to different location and time of the study was also different. The average family size in the Haor region was closely similar to the (BBS, 2022) and slightly supported the family size of the Coastal region where notably mentioned that the average household size in the household income and expenditure survey was 4.26. A notable proportion of duck farmers in the southern Coastal districts (49.58%) belonged to a large family (more than 7 members), with 26.25% having medium (5-6) and 24.47% having small (up to 4) sized family (Rahman *et al.*, 2009). Hoque *et al.* (2010) also mentioned an average family size of 5.6 in the case of duck-raising farmers on the Coastal Island of Hatia. Approx. 42% of duck farmers had more than 6 members in their family (larger size) followed by 32% of medium (5-6) and 26% of the small sized family (up to 4) as stated by Jha *et al.* (2015). These results were almost similar to the current findings and a slight difference was observed due to the difference in sample size, location, research time, and selected livelihoods. Hoque *et al.* (2010) reported that duck farmers had 1 to 50 years of farming experience under traditional duck-raising practices. Based on the rearing experience, Islam *et al.* (2016) categorized duck farmers into 03 groups such as- shorter (20 years), moderate (10-20 years), and longer (>20 years), with an average age of 13.88 years with the experience ranged from 3 to 60 years they reported in their study similar with present findings. As duck rearing was a common livestock farming practice in Bangladesh, most of the farmers had a lot of experience in it which will vary from place to place with the age of the farmers.

Zannat *et al.* (2018) described a higher percentage (34%) of illiterate farmers in the Haor areas than in the present study findings (figure 2), where they reported about 42% completed primary education with 16% got a secondary level of education and only 8% had above secondary education which also varied with the current findings. According to Alam *et al.* (2012), about 69% of respondents belonged to the secondary level with 23% primary and 8% above secondary education. Rahman *et al.* (2009) reported about 30% of farmers in the southern Coastal region attended primary education, while only 9% received education up to a higher secondary level or above. Comparatively lower literacy rates (57%) seemed to be documented in their study than in the recent findings. Hoque *et al.* (2010) stated that the education status of duck farmers varied from 49% to primary level, 14% to secondary, and 2% to higher secondary with a few college graduates (1%) in the coastal Island of Hatia. Nearly similar results were observed in the study of Islam *et al.* (2016) where they stated about 32% of duck farmers in the Mymensingh district were illiterate and 36% received primary education with the rest of 32% leaving school after completing primary education. According to Jha *et al.* (2015), 28% of farmers got primary education whereas only 5% received education up to a higher secondary level or above with a literacy rate of 48% percent in the Haor areas. The difference in education level was due to farmers were not same as in the previous study along with different locations and sizes of farmers. Table 2 states that most of the farmers' main occupation was agriculture. Duck farming was the primary occupation of 40% of farmers and the rest 60% of duck farmers were engaged in agriculture, fishing, service, and other businesses as their primary occupation in the Haor areas reported by Zannat *et al.* (2018). Alam *et al.* (2012) reported that 50% of duck farmers received farming as their main occupation followed by 32% in agriculture, 13% in business, and 5% in service in the Rajshahi region. According to Rahman *et al.* (2009), agriculture was the main occupation of 61% of coastal farmers who are

generally involved in duck rearing followed by 17% of the business, 7% of service, and 15% of farmers depended on other work for generating income. Jha *et al.* (2015) reported that 50% of farmers depended on agriculture as their primary occupation 25% on Duck farming, 18% on business, and 7% on service. Duck farmers often engaged in some subsidiary occupations that provided them extra income. In both areas, most of the farmers were involved in agriculture (Crops, livestock, fisheries, and others) which was related to the mentioned research findings. Alam *et al.* (2012) reported that the maximum proportion (58%) of duck farmers didn't get any training which showed a lower proportion compared to the present study (Figure 3). A relatively lower percentage of the farmers (73%) didn't receive any training, whereas about 17% and 10% of farmers got moderate and short-term training, respectively, and no one had received long training in their studied area, as mentioned by Jha *et al.* (2015). In Figure 3 we found a lower portion of farmers got training which was related to the research of the mentioned authors but differed in percentages.

The flock size ranged from 5 to 45 on the coastal Island of Hatia reported by Hoque *et al.* (2010) related to the present findings. Islam *et al.* (2016) categorized the duck raising farmers into three groups' namely small producers (3-5), medium (6-12), and large producers (13-69) where the highest proportion (48%) of the farmers had medium-sized duck farms. SHAHABUDDIN *et al.* (2021) mentioned that about 50% of farmers reared more than 700 ducks at a large scale whereas the rest of the farmers reared fewer than 200 ducks population at a small scale in the Jaintapur, Sylhet. This data was related to findings of Table 3 in the Haor areas though the flock size was different. In the current findings, a higher percentage of small farm size was seen both in Haor and Coastal areas but a higher proportion of large-sized farms was also observed in the Haor region. Alam *et al.* (2012) mentioned the highest proportion (75%) of duck farmers in the Rajshahi region were marginal farmers followed by 15% of small farmers and 10% of medium farmers which was similar to current findings. The majority of duck farmers reared khaki Campbell ducks in Haor areas, whereas deshi ducks reared in coastal areas were more (Table 3). The study of Alam *et al.* (2012), reported that the majority of the respondents (65%) reared Deshi ducks, with 23% of Khaki Campbell and 12% of Jinding ducks in the Rajshahi region was similar to the findings of the coastal area but different from haor areas data. Islam *et al.* (2016) described the duck farmers in rural areas of Mymensingh district where 52% of farmers reared Deshi subsequently 18% reared Khaki Campbell, 10% Jinding duck's farmers, 20% reared Khaki Campbell with Jinding and 2% of farmers reared Deshi with Khaki Campbell and Deshi, Khaki Campbell with Jinding ducks. Different varieties of duck breeds were also reared in Haor areas but khaki Campbell was significantly reared in those areas. SHAHABUDDIN *et al.* (2021) reported that about 40% of respondents chose the khaki Campbell duck breed for rearing in the Jaintapur upazila, Sylhet relates to the current findings of Suamgonj and overall Haor areas. The majority of the duck farmers (65.50%) raised Deshi ducks followed by 21.50% of Khaki Campbell and 13% kept Zinding ducks in their farms presented by Jha *et al.* (2015) similar to current findings.

Comparatively lower egg production than the recent study findings (Table 4) stated by Rahman *et al.* (2009), they reported only 77.15 annual egg production of deshi duck in the Coastal region. The mean yearly egg production was 79 (22–200) per layer per household farm in the Coastal region reported by Hoque *et al.* (2010), which was also lower than the present findings. The present findings in Table 4 showed higher egg production than Islam *et al.* (2016) who found the egg production of ducks ranged from 80-200/duck/year with a mean annual production of 117.5 eggs. Among all the respondents, 48% reported an annual egg production of 80-100 eggs/duck, and 48% observed 101-150 eggs/duck. A higher egg production was found than that of Islam *et al.* (2003) and Sarker (2005). This variation was due to rearing improved ducks, supplying supplemented feed, changes in the production of ducks with the changes of the year, and also recent data from different locations. The maximum age at first laying was found in the findings of Rahman *et al.* (2009) where they reported that the age of sexual maturity of deshi duck was 26-27 weeks in the Coastal region nearly similar to current findings. The study results of Hoque *et al.* (2001) and Islam *et al.* (2003) were more or less similar to the present findings as they reported the age at sexual maturity of 23-25.5 weeks for Indigenous ducks. Nearly similar findings were observed in the study of Hoque *et al.* (2010) where they stated that around 74% of farmers reported the sexual maturity of the local Indigenous ducks was below 22 weeks and 26% mentioned the mature age of ≤22 weeks. According to the study by Islam *et al.* (2016), the age at sexual maturity of ducks varied from 180 to 210 days with a mean age of 183.6 days in the Mymensingh district was higher than current research findings. About 78% of farmers got their first egg from the duck at 180-189 days. This result was slightly different from the study of Islam *et al.* (2003) and Sarker (2005). They indicated that the Indigenous duck reached sexual maturity at 180 to 210 days of age. The body weight of Khaki Campbell ducks (1484.50g) at 150 days of age was slightly higher than that of Jinding (1435.80g) and significantly higher than that of Deshi (1140.62 g) genotypes in the Coastal region presented by Islam *et al.* (2012). Islam *et al.* (2016) mentioned the body weight of a duck ranged from 1.4 to 2.0 kg at the adult stage with a mean of 1.69 kg. Almost 54% of the respondents reported an adult body weight of 1.6 to 1.8kg. This result agreed with the findings of Islam *et al.* (2003) and Sarker (2005) who found 1.5 to 1.8kg of adult weight in Indigenous ducks. These data were similar to the current findings of Table 4 in some respects but varied due to differences in locations, respondents, and farm management.

Variation in the rearing system due to farm size and

availability of rearing areas (Table 5). In coastal areas canals, rivers, ponds, and beel areas are available for the scavenging of ducks. On the other hand, In Haor areas ducks were reared in a scavenging system during the dry season, but when the water level increased in Haor areas it was difficult to rear ducks in this method and farmer reared their duck in a semi-intensive system during rainy season till decreasing water level.

Alam *et al.* (2012) reported that 64% of farmers who covered the majority proportions of their study were provided mixed feed to their ducks, while 20% supplied paddy with wheat and 16% of farmers offered paddy only in the Rajshahi region. About 26% of the farmers depended on the scavenging system as ducks collected feeds from natural sources in their study areas. Islam *et al.* (2016) reported that almost all the farmers (100%) in the Mymensingh area raised ducks in a semi-scavenging system where 62% of farmers provided rice and rice polish, 20% of farmers supplied rice, rice polish, and commercial feeds, 6% farmers utilized rice, rice polish, and paddy, 6% of farmers supplied rice, rice polish and broken rice and rest of the farmers offered rice, rice polish, wheat bran, and snail as a feed ingredient to their ducks. Rahman *et al.* (2009) stated a greater percentage of farmers (67.50%) allowed their ducks to scavenge on the ponds surrounding their household in the Coastal region compared to the current study. They also mentioned that 38.50% of farmers did not provide additional feed ingredients to their ducks and ducks were mainly reared with natural feed resources under scavenging conditions during the rainy season. About 62% of farmers supplied supplemental feeds to maximize egg production. The supplemental feeds contained a single or a combination of components of rice polish, a mixture of rice polish with broken rice, and a mixture of rice polish with wheat bran. Hoque *et al.* (2010) reported that around 86% of the farmers offered feed supplements during the laying period enriched with a grain (rice and wheat), protein (snail and duckweed), and minerals (snail shells and calcium carbonate) in the Coastal region. Shahabuddin *et al.* (2021) stated that duck farmers supplied paddy and Rice polish or a mixture of paddy, and rice polish with water. They supplied mash feed at an earlier age, especially to ducklings and farmers allowed ducks to scavenge their feed from surrounding sources of water and wetlands. According to Jha *et al.* (2015), 46.50% of respondents did not provide additional feed, and Ducks were reared with natural feed resources only under scavenging conditions during the rainy season, whereas, 53.50% supplied supplemental feed ingredients to optimize the egg production in the Haor region, especially in Sylhet district. They mentioned that the major ingredients of supplemental feed were paddy, a combination of rice with broken rice and rice polish, wheat bran, and mixed feed materials. Nearly 38% of farmers offered supplement feeds to their ducks with mixed feed whereas 23.50%, 21.50%, and 17% of farmers provided supplement feeds with paddy, a combination of rice and broken rice/ a mixture of rice polish and wheat bran, respectively additionally explained by Jaha *et al.* (2015). In the current research areas, as farmers had few records on the amount of feed supplemented to their ducks in different rearing systems, they only mentioned which types of feed they provided to their ducks during rearing was noted in Table 6 which was similar to the research taken by mentioned authors.

The variation in demand for duck, their eggs, values, and purposes was different due to the variation in locations, farm size, availability, consumer attitude, and traditional facts (Table 8). The current finding in Table 9 showed the highest market price of different aged duck and their eggs. On the contrary, the cost of duckling varied from 20-25 BDT whereas adult ducks varied from 150-210 BDT reported by Islam *et al.* (2016). This variation was due to the market price increasing day by day. Consumers had also a high demand for duck meat and eggs eight years ago. Consumer attitude changed along with the value of all consumable products increased and also for inflation of money.

The cost -returned mentioned in Table 10 were closely similar to Afrin *et al.* (2016) mentioned the net returns were 77324.47 BDT and the benefit-cost ratio was 2.03 in the Kishoregonj, a Haor area. On the Contrary, Sheheli *et al.* (2023) reported a Net return of 48830.2 BDT and BCR 1.67 in Haor areas which was lower than the present study. This variation was due to different sample sizes, duck population sizes, study time, and locations of study. Zannat *et al.* (2018) also showed a lower BCR of 1.71 in comparison to this Study. Profitability in duck farming in coastal areas was lower than in Haor areas due to small farm size with poor backyard farming practices. The coefficient of determination (R2) means that about 95.5% of the variability in per unit variable cost was accounted for by the explanatory variables in the multiple regression function model (Table 11). Indeed, the explanatory factors in the cost function model explained the production function of duck raisers. Thus, the cost function regression model was adequate.

## CONCLUSION

Duck farming is a promising livestock farming business in Bangladesh, especially in the Haor and coastal areas, where water and natural feed sources are very available. Duck farming not only provides eggs and meat but also provides income generation opportunities for poor rural farmers. Ducks can sustain in adverse climatic conditions. As a farmer of the Haor and Coastal areas reared their duck in a backyard farming system, they obtained poor productivity from them. Farmers in this area had less knowledge and obtained little training, they faced various challenges even though the market demand for the duck was high. Proper remedies and measures need to be taken to overcome these gaps and improve the farming system to establish duck farming as a big business model for the economic improvement of Bangladesh.

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**Authors Contribution**

This work was carried out in collaboration among all authors. Author Syidul Islam conceptualized and designed the study, and wrote the protocol and manuscript. Authors Syidul Islam and Sharmin Sultana wrote the Methodology, completed the formal analysis, and wrote the manuscript. The author Md. Ashraful Islam and Sharmin Sultana helped with data collection. Md Sazedul Karim Sarker helped to write the original manuscript. Author Syidul Islam, Md Ashraful Islam, and Sharmin Sultana edited the manuscript for final submission. Author Razia Khatun provided guidelines for writing the manuscript and financial support for the manuscript. All Authors read and agreed to the published version of the manuscript.

**REFERENCES**

Afrin, H., Begum, R., Ahmed, M. J. U., Rahman, M. A., & Haque, S. (2016). Profitability analysis and gender division of labor in duck rearing: a case of Kishoreganj district in Bangladesh. *Progressive Agriculture, 27*(4), 482-489.

Alam, M. B., Uddin, A. B. M. S., Bablu, M. A. Z. H., Kamaly, M. H. K., Rahaman, M. M. (2012). Socio-economic profile of duck farmers and duck management practices in Rajshahi region. *Bangladesh Journal of Animal Science, 41*(2), 96-105.

Bangladesh Bureau of Statistics. (2017). *Statistical Year Book of Bangladesh*. Division of Planning, Ministry of Planning, Bangladesh Secretariat, Dhaka.

Bangladesh Bureau of Statistics. (2022). *Statistical Year Book of Bangladesh*. Division of Planning, Ministry of Planning, Bangladesh Secretariat, Dhaka.

DLS. (2024). *Livestock Economy at a Glance (2023-2024).* https://dls.portal.gov.bd/sites/default/files/files/dls.portal.gov.bd/page/ee5f4621_fa3a_40ac_8bd9_898fb8ee4700/2024-08-13-10-26-93cb11d540e3f853de9848587fa3c81e.pdf

Gujarati, D. N., & Porter, D. C. (2003). *Basic Econometrics, McGraw-Hill.* New York.

Hoque, K. S., Sarker, M. S. K., Huque, Q. M. E., & Islam, M. N. (2001). Duck production in the Sylhet basin of Bangladesh- Prospects and problems. International Poultry show. The World's Poultry Science Association, Bangladesh Branch at IDB Bhaban, February 16-17, pp. 40–51.

Hoque, M. A., L. F. Skerratt, M. A. Rahman, A. B. M. Rabiul, A. B., & Debnath, N. C. (2010). Factors limiting traditional household duck production in Bangladesh. *Tropical animal health and production, 42,* 1579-1587.

Islam, M. A., Howlider, M. A. R., Alam, M. A., Heyamet, M. A., & Debnath, M. (2016). Present status, problem, and the prospect of duck farming in rural areas of Mymensingh district, Bangladesh. *Asian J. Med. Biol. Res., 2*(2), 202-212.

Islam, M. A., Khan, M. J. Debi, M. R. and Rahman, M. M. (2012). Growth performance of three genotypes of ducks in the coastal region of Bangladesh. *Bangladesh Journal of Animal Science, 41*(1), 19-23.

Islam, M. N., Huque, Q. M. E., Uddin, M. S. and Sarker, M. S. K. (2003). Potentiality of native genotypes of Ducks. Proceedings of Third International Poultry Show and Seminar, World's Poultry Science Association, Bangladesh Branch, Dhaka. pp. 259–270.

Jha, B., Hossain, M. M., Baishnab, P. C., Mandal, P. K. and Islam, M. R. (2015). Socio-economic status of duck farmers and duck farming in haor areas of Sylhet district in Bangladesh. I*nternational Journal of Natural Sciences, 5*(2), 73-79.

MKI, K. (2012). Status of Household's Ducks and their Associated Factors under Scavenging System in a Southern Area of Bangladesh. *International Journal of Natural Sciences, 2*(4), 108-112.

Morduzzaman, M., Bhuiyan, A. K. F. H., Rana, M. M., Islam, M. R. & Bhuiyan, M. (2015). Phenotypic characterization and production potentials of Nageswari duck in Bangladesh. *Bangladesh Journal of Animal Science, 44*(2), 92–99. https://doi.org/10.3329/bjas.v44i2.26007

Parvez, S., Miah, M. Y., & Khan, M. H. (2020). Smallholder duck farming: a potential source of livelihood in hair women in Bangladesh. *Asian Journal of Medical and Biological Research, 6*(1), 73-80.

Pervin, W., Chowdhury,y S. D., Hasnath, M. R., Khan, M. J., Ali, M. A., & Raha, S. K. (2013). Duck Production Strategy and Profile of Duck Farmers in the Coastal Areas of Bangladesh. *Livestock Research for Rural Development, 25*, 129-140.

Pingle, H. (2011). Waterfowl Production for Food Security. *Lehman Information, 46,* 34- 37.

Rahman, M. M., Khan, M. J., Chowdhury, S. D., & Akbar, M. A. (2009). Duck Rearing System in Southern Coastal Districts of Bangladesh. *Bang. J. Anim. Sci., 38*(1&2), 132–141.

Shahabuddin Ahmed, M. D., Famous, M., Hossain, M. T., Zonayet, M. D., & Hossain, N. (2021). A report on problems and prospects of duck rearing system at Jaintiapur Upazila, Sylhet, Bangladesh. *Journal of Global Agriculture and Ecology, 11*(2), pp.25-35.

Sarkar, K. (2005). *Duck farming for resource-poor farmers in Bangladesh. In: Proceedings of the 4th International Poultry Show and Seminar*. Dhaka, Bangladesh. World's Poultry Science Association, Bangladesh Branch, 130-141pp.

Sheheli, S., Mithun, S., Alom, M. N., & Banik, S. (2023). Profitability and Problems of Farmers in Duck Farming: A Study on Haor Areas in Bangladesh. *International Journal of Agricultural Science, Research & Technology (IJASRT), 13*(3).

Zahan, M. N., Sufian, M. K. N. B., Rahman, M. K., & Parvej, M. S. (2016). Socioeconomic status of farmers and production performance of khaki campbell ducks reared under backyard farming in Bangladesh. *Wayamba Journal of Animal Science, 8,* 1307-1311.

Zannat, M., Sharmin, S., Tama, R. A. Z., & Akteruzzaman, M. (2018). An Economic Study on Production and Marketing of Ducks in Haor Areas of Netrokona District. *Research in Agriculture, Livestock, and Fisheries, 5*(1), 65-74.