A comprehensive survey on the present scenario and future production potentials of small-scale turkey farming in Bangladesh

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ABSTRACT

Turkey (*Meleagris gallopavo*) is one of the potential species of specialized fowls, quite popular in western countries, has recently been introduced in Bangladesh, and gained considerable attention from small-scale poultry farmers. The purpose of this study was to assess the current scenario, production systems and potentialities of turkey farming in Bangladesh. Data were collected using a pre-tested questionnaire from 100 turkey farmers residing in rural areas in different districts of Bangladesh. The problems and prospects of turkey rearing in the selected areas were quantified and assessed. No illiterate farmers were involved in turkey farming and 97% of the farmers have small household with 3.67 members per family. Most of the farmers (60%) were medium income size with income range BDT 250001 to 400000 year. Most of the farmers (57%) reared turkey for meat purpose whereas the average turkey population per household was 43.20 birds. About 24% of farmers reared turkey in confinement system, and 76% of farmers reared in semi-intensive management system and 68% of farmers had no related training on turkey farming. All farmers use ready broiler/layer feed due to the unavailability of turkey feed that was bought from local market. Grazing was practiced to supply vegetative plants as diet for turkeys. Most of the farmers (86%) vaccinate turkey regularly, and among them 96% complained about vaccine unavailability. Average mortality was recorded at around 6.2%. All the farmers follow a natural breeding system for reproduction. The farmers mentioned that turkey farming is decreasing day by day due to unskilled farmers, lack of turkey ready feed, unavailability of vaccines and lack of marketing facilities. Collectively, it can be inferred that the introduction of ready-made turkey feed, ensuring vaccination, providing financial and technical assistance and offering training to small-scale turkey farmers are the pivotal factors in boosting small-scale turkey farming in Bangladesh. This, in turn, may have the potential to increase household income and generate employment opportunities for youth, rural women, and small-scale marginal farmers.

Introduction

Poultry is the fastest growing livestock sub-sector that plays a significant role for the subsistence and sustainable economic development of the countries. Among different poultry species, production of turkey (*Meleagris gallopavo*), a large gallinaceous bird belonging to the family Meleagridae, is regarded as one of the most significant and remarkably profitable agricultural industries due to the raising demand for its

How to Cite

product on a worldwide scale (Yakubu *et al.,* 2013). Alongside chicken, the duck, guinea fowl, quail occupy a significant position that substantially improves the nutritional and economic conditions of diverse people in many countries (Hayet *et al*., 2021). The birds account for approximately 1.2% of the total poultry population worldwide (FAO, 2020) and are primarily raised for their premium and exquisite meat, making turkey meat the second largest contributor to global poultry meat production after chicken (Aslam *et al*., 2012). Turkey plays a significant role in supplying the animal protein of western countries, particularly in Europe and America (Ahmed *et al.,* 2009). These birds are reared especially for meat purpose, because turkey is considered one of the leanest meat producers among all the domestic poultry species (Oblakova *et al.,* 2015). Many consumers consider turkey meat, more precisely heritage turkey meat, as a luxury one and are willing to pay more due to its special taste, texture and quality (Mulhollem, 2018). Turkeys have unique and remarkable phenomena in adaptability to wide range of climatic conditions and can be raised successfully almost everywhere in the world if they are well fed and protected against diseases, predators and adverse weather conditions (Bhanja and Majumdar, 2001). Furthermore, the birds have a special attribute for scavenging, ability to consume huge green grasses, leaves and vegetables that eventually would reduce the overall production cost. Turkeys like to eat the growing tips of the grass and adult turkeys can consume as much as 50% of their intake from pasture or range grass. As turkey is an herbivorous bird, the feed is partially digested by acid hydrolysis early in the digestive tract, and the small particles of the fluid digesta obtained may undergo a limited fermentation in the caeca with the aid of symbiotic microflora (Durant *et al.,* 2004). Ogundipe and Dafwang (1980) mentioned that apart from the role of supplying animal protein, the birds also have an aesthetic value due to their beautiful appearances.

The introduction of turkey in Bangladesh is very recent; in fact, turkey is a newly introduced poultry species in Bangladesh. Unfortunately, there is no specific information on how, when and from where turkey production has been started in this country. The ease of raising turkeys in a free-range backyard system, where they can forage for grass and vegetables, has reduced dependence on commercial feed (Islam *et al*., 2023). The birds that presently available in Bangladesh, are mostly heritage types and they might enter in Bangladesh from neighbouring countries. Since the species is very new in Bangladesh, the farmers are not aware of various aspects of rearing such as feeding, housing, prevention and management of disease, standard growth pattern, feed efficiency, incubation of hatching egg etc. (Islam *et al*., 2023).

There is a great potential in improving the productivity of turkeys through better feeding and management. The problems and prospects of heritage turkey rearing has not been assessed and quantified. Very few research works have been done on the potentiality, productivity and profitability of heritage turkey. Taking the above facts and findings in mind, a comprehensive survey was conducted in various regions of Bangladesh to assess the sustainability of small-scale turkey farming. The survey aimed to understand the current situation, identify the challenges faced by the farmers, and project the production potentials of heritage turkeys in the country.

Materials and Methods

Study area and duration of the study
The current study was conducted purposively in a few selected villages under Jamalpur, Bogura, Sirajgong, Rajshahi, Natore, and Pabna districts of Bangladesh. These areas were considered representative in terms of availability of Turkey.

Selection of the turkey farmers
A total of 100 turkey farmers were selected randomly based on the data available in the study areas. The data were collected using different approaches like survey questionnaires (both open and closed), face to face interviews, observation and Focus Group Discussion (FGD), review of secondary data, etc. The questionnaire was pre-tested with 10 farmers to judge suitability to the turkey farmers before actual interviews. Keeping the objectives of the study in view, a list of 150 turkey farmers was prepared from all over Bangladesh through personal communication and different sources. A simple random sampling technique was used to select 100 turkey farmers. Thus, the primary data were collected from 100 respondent farmers selected from different districts of Bangladesh. The sources of secondary data were journals, official documents, libraries,

research institute notes and reports, internet etc. Participatory Rural Appraisal (PRA) tools like Focus Group Discussion (FGD), seasonality analysis of diseases and market etc. were also used in relevant cases to collect and verify the data.

Data computing, processing and analysis
Data collected from the field were entered into computers using MS Excel. The qualitative data were transformed into quantitative data by appropriate scoring technique. For analysing the data, a combination of descriptive statistics (sums, averages, percentages, etc.) and inferential techniques were used to obtain meaningful results.

Table 1. Family demography and socioeconomic characteristics of the turkey farmers in the survey areas (n = 100)

Characteristics	Category	Farmer %	Mean of the category for each parameter	SD
Age (year)	Young (< 36 years)	58	34.34	8.176
	Middle aged (36-50 years)	42		
	Old aged (above 50 years)	0		
Education (year of schooling)	Can sign only (score 1)	16	2.92	1.502
	Primary (score 2)	36		
	Secondary (score 3)	12		
	Higher Secondary (score 4)	20		
	Graduate (score 5)	8		
	Masters and Others (score 6)	8		
Household size	Small size (1-5)	97	3.67	0.911
	Medium size (6-10)	3		
Primary occupation	Student	16	2.68	1.014
	Agro-farming	24		
	Business	36		
	Housewife	24		
Secondary occupation	Student	2	2.21	0.456
	Agro-farming	75		
	Business	23		
Yearly income status	Low income (up to BDT 250000)	20	319.22	0.911
	Medium income (BDT 250000 - 400000)	60		
	High income (above BDT 400000)	20		

*SD= Standard Deviation

Results and Discussion

Family demography and socioeconomic characteristics of the turkey farmers
Investigation of socioeconomic characteristics of farmers is vital for understanding various aspects of turkey farming in Bangladesh. These socioeconomic aspects encompass age, educational level, household size, primary and secondary occupations, and yearly income status. The current survey data revealed that the majority of turkey farmers were young (58%), while the rest (42%) was fall into middle-aged category

(Table 1), which is supported by Asaduzzaman *et al.* (2017). The predominance of young farmers suggests a potential trend towards younger individuals engaging in the relatively new and emerging turkey farming sector in Bangladesh, possibly influenced by evolving economic opportunities and a growing interest in sustainable practices. This however signifying a demographic shift in the agricultural sector and showcasing the devotion of youngers for innovation and adaptation of modern agricultural practices compared to the older farmers. Ethelbert *et al.*

(2022) also emphasized that turkey production is dominated by young individuals due to their physical capabilities, potential for higher profits and protein intake, and greater propensity to adopt new innovations compared to older farmers. Furthermore, the majority (48%) of farmers have completed secondary education or higher, with 36% having completed primary education, while 16% have only acquired the ability to sign. The findings regarding education levels align with the previous reports of Rashid *et al*. (2020) and Asaduzzaman *et al*. (2017). The involvement of individuals with higher education levels, including graduates and those with master's degrees, diploma, and other degrees, suggests a potential for innovation and application of scientific knowledge in modern turkey farming practices. Ali *et al*. (2019) highlighted the score of success in turkey farming referring the education level of the farmers, with 80% having completed secondary or higher secondary education and 10% being graduates, indicating a promising future for turkey farming and a stable future economy for the country. The study revealed that 97% of the turkey farmers had a small household size (averaging 3.67 members per household), emphasizing the family centric nature of turkey farming involving the farmers and their immediate relatives in the farm operation and suggests that the limited labor force inherent to such household sizes may affect the scope and efficiency of turkey farming operations, mirroring a common pattern in agriculture where smaller households are often more efficient and adaptable. The primary occupation of turkey farmers, including students (16%), agro-farmers (24%), businessmen (36%), and housewives (24%), reflects a diverse distribution, while the secondary occupation, predominantly involving agro-farmers (75%), businessmen (23%), and a smaller percentage of students (2%), underscores the economic significance and flexibility of turkey farming as a supplementary income source, especially for those in agricultural and entrepreneurial sectors. Rashid *et al.* (2020) found that the majority of turkey farmers (56% main and 88.57% secondary occupation) are from the business group rather than traditional farm households, limiting available

farming space due to their primary business occupation. The survey revealed that most (60%) turkey farmers have a medium yearly family income (BDT 250000 - 400000), with some having high or low income, indicating that turkey farming is a profitable and viable enterprise, which can generate a decent and stable income for rural households.

The overall livestock-rearing scenario of the turkey farmers

The distribution of the farmers based on type of livestock rearing highlights a significant proportion (68%) engaging in a multifaceted approach by rearing both poultry and ruminant species (Table 2). In terms of livestock variety, the prevalence of indigenous livestock species (52%) underscores the importance of preserving local breeds, suggesting that many farmers value their unique attributes, such as adaptability to local environments and cultural significance. The involvement of both male and female households in livestock rearing, with 68% of cases featuring joint participation, emphasizes the collaborative nature of this agricultural activity (Table 2). The substantial engagement of female households (28%) in livestock rearing activities suggests a broader empowerment of women in farm practices, contributing to the economic resilience of households. The shared ownership model, where both male and female members collectively own livestock in 40% of households, reflects a cooperative and inclusive approach to asset ownership within the families. The overwhelmingly predominant practice of self-ownership (98%) in livestock rearing indicates a strong sense of personal investment and commitment among the farming community. In the present study, categorizing farmers based on the worth of their livestock provides significant insights into the socioeconomic perspective, with results showing that farmers having both low (40%) and high (40%) livestock worth primarily invest in turkey rearing for income generation, focusing the distinctive patterns in livestock-related economic strategies among different socioeconomic groups 2.

Table 2. The overall livestock rearing scenario of the turkey farmers (n = 100)

Characteristics	Category	Farmer %
Type of livestock rearing	Poultry	20
	Ruminant	12

	Both	68
Variety of livestock rearing	Indigenous	52
	Cross-bred	28
	Both	20
	Male	4
Livestock rearer	Female	28
	Both	68
	Male	36
Livestock ownership of the family	Female	24
	Both	40
Rearing ownership	Self-ownership	98
	Lease from other	2
	Low livestock worth (up to BDT 50000)	40
Livestock worth per household	Medium livestock worth (BDT 50001 - 100000)	20
	High livestock worth (Above BDT 100000)	40

*SD= Standard Deviation

Categorization and participation of small-scale turkey farmers in various farm operation practices

The results on categorization and engagement of turkey farmers in survey areas are presented in the Table 3. As turkey is newly introduced in Bangladesh, most farmers were inspired through neighbours (40%) and friends (28%), emphasizing the significance of community-based approaches in promoting sustainable practices, however the farmers inspired less when influenced by NGOs (20%) and online platforms (12%). The turkey farming community in Bangladesh exhibits a range of experience levels, with 40% new, 40% moderate (1-2 years), and 20% with long-term engagement, reflecting a dynamic learning environment and the prevalent challenges due to the majority (80%) having less than two years of experience. The training aspect gains prominence in light of the recent introduction of turkey farming in the country, where the majority of farmers (68%) reporting not receiving related training, highlighting potential gaps in knowledge dissemination channels. Asaduzzaman *et al.* (2017) found that 50% of the farmers relied on neighbor farmers for technical support, 28.26% on both internet and neighbor farmers, and only 10.88% on the Department of Livestock Services (DLS). In Bangladesh, farmers keep turkeys primarily for meat production (57%), with a significant number also focusing on dual-purpose (39%) and a minority on egg and poult production

(4%), highlighting its role in enhancing household nutrition and providing a source of income. A recently published report by Ethelbert *et al.* (2022) also suggests that women are highly involved in poultry production because they enjoy rearing domestic birds and spending quality time with their families, and they use the extra income to help their men with basic needs. Nielsen *et al.* (2003) also indicate that females participate more than males in rural poultry production. The majority of turkey farmers (76%) employ a semi-scavenging rearing system. Sultana *et al.* (2021) reported that turkey farmers in Bangladesh mostly used semi-scavenging system for their birds that had a traditional house with feeder and drinker and birds were allowed to scavenge during the day. However, semi-scavenging systems may also pose threats and challenges such as exposure to diseases, parasites, predators, and contaminants that could affect the health and productivity of turkeys. On contrary, Asaduzzaman *et al.* (2017) found that approximately 64.92% turkey farmers rear their turkey in intensive system. The classification of rearing practices into short-term (up to 3 months) (8%), medium-term (3.01-8 months) (28%), and long-term (above 8 months) (64%) reflects a commitment to sustained turkey farming, with the majority focusing on long-term rearing to maximize growth and weight for meat, despite the higher costs and risks associated with extended periods, such as feed expenses, disease prevention, and mortality losses.

Present scenario of small-scale turkey farming in Bangladesh

Table 3. Categorization and participation of the small-scale turkey farmers in various farm operation practices (n=100)

Characteristics	Category	Farmer %	Mean of the category for each parameter	SD
Turkey rearing inspiration	Online	12	-	-
	Friends	28		
	Neighbors	40		
	NGO	20		
Turkey rearing experience	Shorter (<1 year)	40	1.6	0.498
	Moderate (1-2 years)	40		
	Longer (>2 years)	20		
Related training information of the farmers	Not at all	57	-	-
	Upazila Livestock Office	3		
	NGO	20		
	Youth Development	3		
	Others	17		
Purpose of turkey keeping	Only meat purpose	57	-	-
	Meat and egg purpose	39		
	Egg and poultry (income)	4		
Flock size of turkey	Small size farm (up to 20)	28	43.20	33.536
	Medium size farm (21-50)	40		
	Large size farm (above 50)	32		
Involvement of the family members	Wife	78	-	-
	Husband and Wife	11		
	Wife and Daughter	8		
	Wife and Son	2		
	Employed labor	1		
Turkey rearing system	Semi-scavenging	76	-	-
	Intensive	24		
Turkey rearing duration	Short term (up to 3 months)	8	12.40	7.083
	Medium term (3.01-8 months)	28		
	Long term (above 8 months)	64		

*SD= Standard Deviation

Table 4. Biosecurity practices, sanitizations, house management and litter materials used in small-scale turkey farming within the survey areas (n=100)

Characteristics	Category	Farmer %
Provision of buffer area	Absence of buffer areas	92
	Presence of buffer areas	8
Use of disinfectant	Use of disinfectant	32
	No use at all	68
Housing of turkeys	New shed	87
	Old shed	13
House construction cost	Low (< BDT 50)	21
	Medium (BDT 50-100)	66
	High (> BDT 100)	13
Use of bedding materials	Saw dust	25
	Rice husk	43
	Sand	18
	Slate	14
Cleaning of turkey house	Regular cleaning	96
	Irregular cleaning	4

*SD= Standard Deviation

Feeding management practices in small-scale turkey production

Table 05 represents the feeding management of turkeys under small-scale farming. Since heritage turkeys are newly introduced in Bangladesh, commercial feeds are not available in the local market (Sultana *et al.*, 2021). Farmers are compelled to depend on commercial broiler feed (for meat production) and layer feed (for egg production) because of the high protein requirement (CP=28%; Sultana *et al.*, 2021; Rashid *et al*., 2020) and the unavailability of specific commercial feed for turkey. Thus, the predominant use of commercial layer feed (44%) and commercial broiler feed (26%) observed in current study indicates a reliance on formulated diets designed for specific poultry purposes. Turkey farmers use of a variety of supplementary feeds, including 19% rice polish and paddy and 11% a mix of rice polish, maize, and wheat bran, showcases a flexible and diverse approach to nutrition that blends commercial and local feed options. Sultana *et al.* (2021) reported that farmers fed commercial broiler feed during early stage, but during the growing stage some farmers still continue with broiler starter or grower feed along with different locally available grains with vegetable and kitchen wastes such as rice, wheat, boiled vegetables, kitchen waste, water hyacinth, etc. Several published reports suggested that turkeys are good foragers and consume good amounts of tender green grasses, vegetables, kitchen waste, water hyacinth, etc. and transform it into valuable products such as turkey meat and eggs (Asaduzzaman *et al.*, 2017; Famous *et al.*, 2019; Sultana *et al.*, 2021). Feed cost represents 60% of total cost in poultry production (Sultana *et al.*, 2021). The study reveals that the daily cost of a turkey's diet is quite economical, averaging Tk. 2.7, with most farmers (66%) spending between Tk. 1.5 to Tk. 2.5. This cost-effectiveness is vital for the economic viability of turkey farming and ensures that more farmers can provide proper nutrition to their flocks. Rashid *et al.* (2020) reported that turkeys, being good foragers, can lower their feeding expenses by getting extra nutrients from forage, as they have more microbes in their guts that help them break down fiber. The average daily feed supplied to turkey's ranges

from 80g/day to 200g/day, with an average of 125.27g/day. Notably, some farmers fed once (17%) or three times a day (15%), showing the flexibility and adaptability of feeding routines based on individual preferences and management strategies.

Table 5. Feeding pattern, types of feed supplied, and proportion of supplementary feeds utilized in turkey production (n = 100)

Characteristics	Category	Farmers %	Mean of the category for each parameter	SD
Types of feed supply	Commercial layer feed	44	-	-
	Commercial broiler feed	26		
	Rice polish and Paddy	19		
	Maize, Rice polish and Wheat bran	11		
Supplemented feed cost (turkey/day)	Low (< 1.5 Tk.)	21	2.7	0.583
	Medium (1.5 – 2.5 Tk.)	66		
	High (> 2.5 Tk.)	13		
Amount of feed supplied to turkey/day	Low (< 120 g.)	39	125.27	8.2933
	Medium (120 – 150 g.)	47		
	High (> 150 g.)	14		
Feeding pattern	One time/day	17	-	-
	Two times/day	68		
	Three times/day	15		

*SD= Standard Deviation

Vaccines, vaccination and disease control management

Vaccination practices are one of the health management tools that helps keep turkey flocks healthy. The results of the current study revealed that most of the farmers (86%) vaccinate their birds sincerely (Figure 1, a). They commonly used vaccines of BCRDV, RDV, and Fowl Pox to prevent the relevant disease. Turkey has higher genetic resistance to diseases like Marek's and infectious bronchitis than other poultry, so farmers usually vaccinate only for New Castle disease, fowl pox, and fowl cholera (Rashid *et al.*, 2020). Famous *et al.* (2019) also reported that most of the turkey farmers vaccinate their birds regularly. However, during the study period, 96% of farmers claimed unavailability of vaccines (Figure 1, b), leading to vaccination challenges and subsequent disease outbreaks in their localities. Contrarily, Asaduzzaman *et al.* (2017) reported that turkey farmers in Bangladesh rarely vaccinate their turkeys due to low disease incidence. Similarly, Sultana *et al.* (2021) stated that disease outbreaks often devastate the flock because most farmers are unaware of vaccination.

The data on the disease management of small-scale turkey farmers are presented in Figure 1, c and Table 6. All farmers in the study area reported that turkeys had less infestation of disease than other poultry species and had an average mortality of 6.2, indicating their resistance to diseases. Similarly, Sultana *et al.* (2021) stated that turkey had more genetic resistance to disease (like Marek's and Infectious bronchitis) than other poultry species. Very few farmers identified diseases like Fowl cholera, Newcastle disease, Fowl pox, Mycoplasmosis, lameness, etc, yet the majority had not encountered any diseases in turkeys, indicating a very low disease infestation, which was a positive indicator for turkey rearing. The common

diseases of turkeys observed in survey areas are reported as Newcastle disease, Fowl cholera, Fowl pox, Mycoplasmosis, etc., although the outbreaks of Coccidiosis, Salmonella, Avian-influenza, and Colibacillosis were also noticed (Asaduzzaman *et al.*, 2017; Ali *et al.*, 2019; Rashid *et al.*, 2020). When a disease outbreak occurred, most of the farmers (50%) contacted local trained personnel and consulted with poultry experts, Upazila livestock officers, company livestock professionals, etc. A few of them did self-treatment. Previous report suggests that the turkey farmers sought advice from different sources, mainly Upazila Livestock Hospital (69.47%), and also private clinic (4.21%), veterinary surgeon (2.11%) and others (Rashid *et al.,* 2020). All farmers in the study area reported not using medicine regularly, suggesting a lack of awareness about disease prevention and control measures among turkey farmers.

Table 6. Disease control, treatment procedure and mortality of turkeys (n = 100)

| Characteristics	Category	Farmers %	Mean of the category for each parameter	SD
Controlling procedure of diseases	Vaccination only	22	-	-
	Vaccination and Medication	64		
	Medication	11		
	Nothing	03		
Treatment procedure	Communicate with Consultant	24	-	-
	Communicate with ULO	04		
	Communicate with local trained personnel	50		
	Self-treatment	22		
Mortality of turkey	Low (<5%)	28	6.2	2.481
	Medium (5-10%)	59		
	High (>10%)	13		

*SD= Standard Deviation
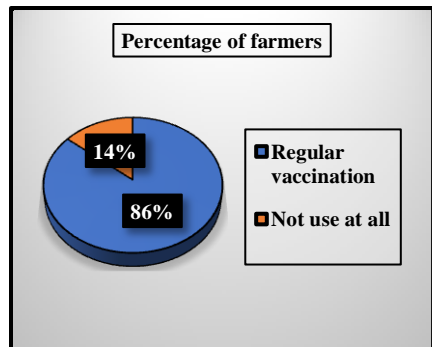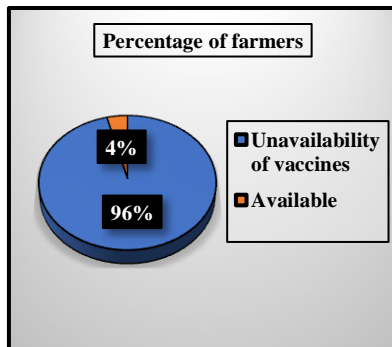

Figure 1 (a): Vaccine administration status

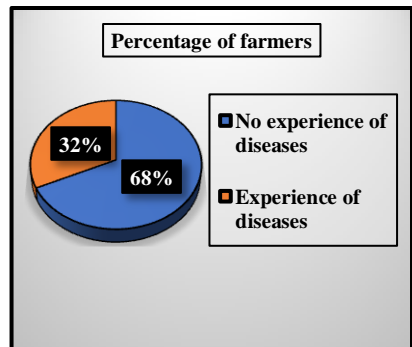Figure 1 (b): Status of vaccine availability

Figure 1 (c): Status of disease experienced by turkey farmers

Overall productive performances of the heritage turkeys within the survey areas

Productive performance of the turkey is shown in the Table 7. As turkey is a new introduction in our country, it is highly necessary to assess its actual productive and reproductive performances for effective farm management and farm sustainability. The age at sexual maturity is a key factor for reproductive performances and economic efficiency of turkey production. The observed variation in the age at sexual maturity, ranging from 180 to 210 days with a mean of 192.03 days, is within the typical range for the heritage varieties. This result was consistent with

Asaduzzaman *et al.* (2017), who found the both tom and hen reached puberty at the same age of 216±1.8 days. Most farmers (81%) said egg laying started at 190-200 days, which aligns with the expected timeframe for sexual maturity in turkeys. Other studies also reported almost similar ages for the first egg lay, such as Ali *et al.* (2019) at 26 weeks, Rashid *et al.* (2020) at 28.32 weeks, and Sultana *et al.* (2021) at 30 weeks of age. The small variation in sexual maturity may be influenced by genetic, nutritional, and environmental factors, and standardizing and optimizing all these attributers could lead to better consistent productive and reproductive performances of the birds. The weight of adult tom is an important indicator of overall growth and meat production potential. The mean tom weight was 6.12 kg/bird, within the desirable range for marketable toms, but with a range from 5.5 to 6.7 kg. Asaduzzaman *et al.* (2017) reported a similar average tom weight of 6.58±0.15 kg. In the present study, average hen weight was 3.04 kg/hen, with a variation from 3.0 to 3.5 kg, which is found a relatively lower than the observation of Asaduzzaman *et al.* (2017). Egg production is a crucial metric for assessing the reproductive efficiency of turkey flocks. Famous *et al.* (2019) reported that the average egg production of turkey is 90 eggs per year, within a range of 80-100 eggs. Most farmers (49%) in survey areas reported that the annual egg production was 81-90 eggs per bird, indicating a moderate to high level of reproductive performance. However, our study found lower egg production of turkey than the previous reports of Rashid *et al.* (2020) and Ali *et al.* (2019), who found an average of 139 and 120 eggs/bird/year. Contrarily, Sultana *et al.* (2021) and Famous *et al.* (2019) found lower egg production in turkeys might be because of improper nutrition, poor management, lack of

scientific knowledge, improper lighting, overcrowding, improper male-female ratio, ignorance of vaccination, diseases, improper treatment, biosecurity management, and other causes. Turkey eggs, ranging from 60 to 70g with a mean of 65.21 g, align with typical weights for heritage turkey eggs, with the majority of farmers (62%) reporting weights in the 63-65 g range, highlighting the significance of maintaining consistent egg weights for market standards and overall egg quality. Similarly, Asaduzzaman *et al.* (2017) found that the average weight of turkey egg was 66.13±0.63g/egg. On the contrary, Ali *et al.* (2019) found that the average weight of turkey egg was 82.04g. The egg hatchability ranging from 50-70% with a mean of 62.13%, indicates the reproductive success of the turkey flocks, with most farmers (55%) reporting hatchability between 60-65%. Rashid *et al.* (2020) found that the average hatchability rate was 73.95%, which is slightly higher than the present findings (62.13%). The absence of artificial insemination (AI) techniques indicates a reliance on natural mating behaviors. Sultana *et al.* (2021) and Rashid *et al.* (2020) reported that all the farmers used natural mating, as they were unaware of and did not practice AI. The study revealed that 94% of turkey farmers maintain a practical 1:5 male-to-female ratio, crucial for effective natural breeding and reproductive success for such types of heavy birds. Rashid *et al.* (2020) revealed that the most used of male-female ratio in Bangladesh was found 1:3, which is standard/recommended for heritage turkeys to obtain expected facility and hatchability. Similarly, Asaduzzaman *et al.* (2017) found that the farmers kept a male-female ratio of 1:4.60±0.17. Despite having a good male-female ratio, sometimes reproductive performance may be low due to infrequent mating, male heaviness, and mating disruption (Yassin *et al.*, 2013).

Table 7. Overall productive performances of the heritage turkeys within the survey areas (n = 100)

Characteristics	Category	Farmer %	Mean of the category for each parameter	SD
Sexual maturity	Early (<190 days)	17	194.03	7.062
	Moderate (190-200 days)	81		
	Late (>200 days)	02		
Weight of adult Tom (kg)	Low (< 6 kg)	38	6.12	0.301
	Medium (6-6.5 kg)	57		

	Category	Farmer %	Mean	SD
	High (> 6.5 kg)	05		
Weight of adult Hen (kg)	Low (< 3 kg)	44	3.04	0.281
	Medium (3-3.5 kg)	52		
	High (> 3.5 kg)	04		
Egg production (per turkey/year)	Low (70-80)	46	83.5	4.201
	Medium (81-90)	49		
	High (91-100)	05		
Egg weight (g/egg)	Low (< 63 gm.)	22	65.21	1.301
	Medium (63-65 gm.)	62		
	High (> 65 gm.)	16		
Hatchability %	Low (< 60%)	33	62.13	1.861
	Medium (60-65%)	55		
	High (> 65%)	12		

*SD= Standard Deviation

Marketing of the eggs, poults, and adult of the turkeys, and benefit-cost scenario

Data on the marketing system of turkey in Bangladesh is presented in the **Table 08.** Poults are considered as one of the key inputs of turkey farming, as the overall poults quality greatly impacts on the profitability. The average marketing age of turkey was found 6.8 months, and the average body weight was 6.12 kg/bird for male and 3.04 kg/bird for female, with an average market price of taka approximately 320.00 /kg live bird. According to Famous *et al.* (2019), the optimal body weight for marketing turkeys is 7.26 kg for tom and 5.53 kg for hen at the 16th week of age. In survey area, the average net profit per male turkey was taka approximately 370.00 and per female turkey was taka 265.00, showing that it is a profitable household income generating small-scale turkey farming approach.

Consumption pattern and consumers' attitude towards turkey meat and eggs

The consumption pattern of turkey meat and egg is presented in the Figure 2. Many people did not like turkey meat and egg because of consumer's habit, lack of awareness about nutritional value of turkey meat and religious issue. These factors indeed hinder the growth and expansion of turkey farming in the country. Our survey results indicate that about 26.2% of the consumers did not eat turkey meat and 11.3% did not eat turkey egg. More campaigns describing the quality and benefits of turkey meat and eggs in public media are recommended to change the consumer's notion.

Table 8. Market price, age, and weight of the bird and net profit in turkey rearing (n = 100)

Characteristics	Category	Farmer %	Mean of the category for each parameter	SD
Source of poults	Market/dealer	87		
	Neighbor	09	-	-
	Own	04		
Market price of poults	Low (< 100 Tk.)	11	116.03	7.081
	Medium (100-120Tk.)	56		
	High (> 120 Tk.)	33		
Market price per kg of	Low (< 300 tk.)	28	320.5	8.071

|				
live turkey	Medium (300-350 tk.)	53		
	High (> 350 tk.)	19		
Marketing age	Early (< 6 month)	13	6.8	0.042
	Moderate (6-7 months)	66		
	Late (>7 month)	21		
Male weight at marketing (kg)	Low (< 6 kg)	38	6.12	0.301
	Medium (6-6.5 kg)	57		
	High (> 6.5 kg)	05		
Female weight at marketing (kg)	Low (< 3 kg)	44	3.04	0.281
	Medium (3-3.5 kg)	52		
	High (> 3.5 kg)	04		
Net profit per male	Low (< 350 tk.)	23	370.25	9.071
	Medium (350-400 tk.)	64		
	High (> 400 tk.)	13		
Net profit per female	Low (< 250 tk.)	21	265.5	7.031
	Medium (250-300 tk.)	71		
	High (> 300 tk.)	08		

*SD= Standard Deviation
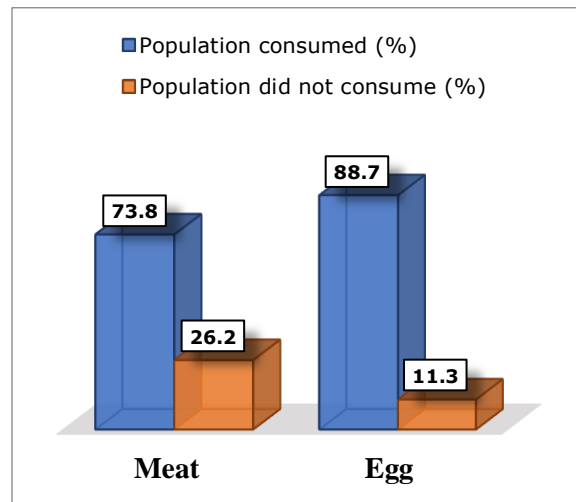
Figure 2. Meat and egg consumption pattern

Major constraints of turkey farming in the study areas

Turkey farming in Bangladesh faces significant challenges including the lack of turkey feeds in the market and proper nutrient specifications, leading to suboptimal growth of birds. Farmers often rely on homemade feeds and/or a combination of homemade and broiler/layer feed without understanding the specific nutrient requirements of turkeys, resulting in poor growth and reproductive performances. Furthermore, some farmers were unaware about the foraging ability of turkeys, which, when practiced properly, might reduce the overall feed cost. Additionally, noise complaints from neighbors, negative perceptions about turkey meat, interior outlook of

the birds and the absence of a structured market further hinder the growth and expansion of turkey faming. Since turkeys are relatively new species of poultry in Bangladesh, the farmers are not quite concerned with the general management and rearing techniques, therefore they continue to practice the traditional methods of rearing, as they practiced for broilers and layers. This is made worse by a lack of technical support and training from both government and non-government organizations. The heavy weight of turkeys and the significant size difference between males and females necessitate AI for successful breeding, yet many farmers are quite unaware of this technique. Finally, the lack of training and knowledge exchange opportunities leaves farmers reliant on traditional methods, which may result in lower egg quality and survival rates compared to modern rearing techniques. These gaps underscore the need for improved knowledge exchange and adoption of modern farming techniques to enhance productivity and sustainability in turkey farming.

Production potentials and future prospects of Turkey farming in Bangladesh

In Bangladesh, where about 31% of the population lives below the poverty line and faces nutritional insecurity, turkey farming holds promise in contributing to Sustainable Development Goals (SDGs) by addressing poverty and improving nutritional security. Heritage turkey's adaptability to local environments, their resistance to common poultry diseases when properly vaccinated, and their foraging abilities make them a cost-effective protein source. Turkey meat's taste preference, safety, and health benefits offer an alternative to broiler or red meat, while turkey farming provides accessible livelihood options for small-scale farmers and unemployed youths. Published reports suggest the challenges of natural mating in turkeys because of the well-developed pectoral muscle and wide variation in body weight between male: female, which prevents the toms for natural mating, and highlighting the necessity of AI technique. Moreover, AI allows for efficient semen utilization, with each tom capable of inseminating about 30 hens from the semen collected in single ejaculation. Thus, the promotion of AI techniques in turkey breeding can enhance hatching egg production, addressing infertility issues and reducing rearing costs. Utilizing semi-scavenging natural feed resources

not only contributes to eco-friendly meat production but also presents opportunities for developing turkey entrepreneurs within designated cluster areas, leveraging the comparatively educated and entrepreneurial initiatives of surveyed farmers.

The farmers who have lost everything by investing their last resource in commercial broiler and layer farming, for example, can maintain and successfully run their business because turkey farming is so far profitable because of least cost as well as ensuring quick return of the investment. Furthermore, the farmers have a lot of experiences, a pre-existing setup (such as poultry shed) and all other necessary equipment and accessories, all of which they can utilize in turkey farming. While considering the profitability of turkeys, emphasis has given on proper care and feeding of poults, with nearly 50% of their diet comprising cost effective green vegetables and field grasses as supplements to commercial feed. Furthermore, turkey farming offers an accessible livelihood option for small and marginal farmers, requiring minimal investment and adaptable to free-range, intensive, or semi-intensive systems, potentially providing employment opportunities for unemployed youths. With the majority of surveyed turkey farmers displaying comparatively educated and entrepreneurial in initiative, there is significant potential to develop turkey entrepreneurs within designated turkey cluster areas in Bangladesh, providing them with readily accessible technical expertise in turkey rearing.

Conclusion

It might be very relevant to train farmers in turkey management and feeding practices to boost the production of turkey meat and eggs in Bangladesh, particularly with the emphasis on the availability of specific ready-made commercial turkey feeds in the poultry market. There should be market availability for all essential medications and additives, as well as specific vaccines for common turkey diseases, and immunization of birds against the diseases must be ensured. Since turkey farming would be a good source of income generation, family nutrition and create employment opportunity for the unemployed young, rural women, and small-marginal farmers, the government should provide financial and technical supports to farmers and establish a robust market chain that will facilitate easy

access to the local, national and international markets for turkey eggs and meat.

Authors contribution

MA Hossain, M Akter and J Ferdous carried out the study. T Ahmed and A Lahiry wrote the draft text. B Dey critically review the manuscript and SC Das oversaw the whole research project, organized the study, and provided a critical evaluation of the manuscript.

Data availability

With the authors' permission, all relevant data used in this study will be made public.

Conflict of interest

The authors declare that there is no conflict of interest regarding publication of this paper.

Consent to participate

The authors provide full consent to participate.

Consent for publication

All authors are fully agreed to publish this article in the Bangladesh Journal of Animal Science.

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