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Rearing of High Yielding Turkey Poults: Problems and Future Prospects in Bangladesh: A Review

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Abstract

Turkey farming is a profitable business idea in the mid-level economic country like Bangladesh, Pakistan, India, Sri Lanka and Arabian Gulfs. It grows faster like broiler chickens and become suitable for slaughter purpose within a very short time. Turkey is also very popular for meat than egg production. Now, the area of turkey in Bangladesh is one of the important sub-sectors of agriculture, which meets important needs of human beings such as meat, and eggs. On the one hand, the protein, lipid carbohydrate and mineral content of turkey egg are 13.1%, 11.8%, 1.7% and 0.8%, respectively. The cholesterol content is 15.67-23.97 mg/g of yolk. Turkey meat also has high nutritional and sensorial properties which make it almost ideal raw material for rational and curative nutrition. People prefer turkey meat because of its leanest nature. The protein, fat, and energy contents of turkey meat are 24%, 6.6%, 162 Calories per 100 g of meat. Mineral like potassium, calcium, magnesium, iron, selenium, zinc and sodium are also present in turkey meat. It is also rich in essential amino acids and vitamins such as B3 (niacin), vitamin B6 and B12, unsaturated fatty acids and essential fatty acids, and low cholesterol contents. In the recent years, turkey chicken has become socially and economically acceptable because the need for animal protein, scientific improvements in the field of its breeding and feeding, the possibility of intensification, the requirement for relatively smaller areas when compared to other animal husbandry branches and the contribution to rural development. The significant improvements have been achieved in the poultry sector especially for the production of egg, and meat through the development of newest technologies as well as favorable environment. Finally, turkey sector will be able to keep quick contributions in increasing national incomes, creating job and employment opportunities, and foreign exchange earnings, which has become the new door for the sustainable development of the country.

Keywords: Turkey rearing; Health management; Nutrition facts; Fertility; hatchability; Production

Introduction

Poultry sector of Bangladesh has been expanding day by day and therefore, is providing a source of protein as well as employment in the country. Turkey production may not be very common in Bangladesh, but district livestock officer and the farmer who have found financial success in turkey production certified that it could be a good way for the Asian country to prosper [1]. However, the domestic turkey *Meleagris gallopavo*, a large poultry bird, is one of the two species in the genus *Meleagris* and the same as the wild turkey [2]. Commercial turkey farming is a profitable business idea in Bangladesh. Turkey grows faster like broiler chickens and become suitable for slaughter purpose within a very short time. Turkey farming for meat production is very popular than egg production in Bangladesh. Although some people keep one or several toms (a mature male turkey) as a pet. Turkey farming is similar to other poultry birds farming like chickens, ducks, quails etc [3]. It provides valuable amounts of protein, and therefore, turkey is often regarded as a high-protein food. Skinned turkey breast provides the most protein per serving, (34 g in 4 oz). Besides this the consumers get 31 g and 21 g of protein from 4 ounces of turkey leg and thigh respectively [4]. Turkey is an excellent source of vitamin B3 (niacin) and provides over 13 mg in 4 oz, or over 80% of the Dietary Reference Intake (DRI). It is also a very good source of vitamin B6, amounting 0.92 mg in 4 oz (54% DRI). By providing 22% DRI for choline in 4 oz, turkey also ranks as a good source of this B vitamin. In terms of minerals, turkey is the richest in containing selenium and provides over 60% of the DRI in a single 4-oz serving [4]. Therefore, zinc, copper, phosphorus, magnesium, potassium, and

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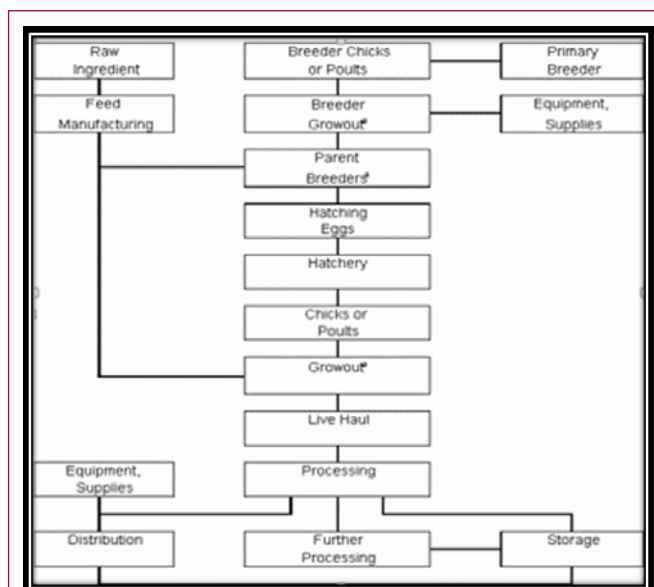
iron are also provided by this turkey meat with noteworthy amounts [4]. For these reasons, turkey is more resistant to disease compared to other poultry species like chicken, duck and quail. It has also been reported that mortality rate of turkey is very low compared to other poultry bird as it is resistant to Marek's and Infectious bronchitis, and commonly encountered with other diseases like mycoplasmosis, fowl cholera, erysipelas and hemorrhagic enteritis [5].

Turkey is a unique bird, which is suitable for rearing in hot humid climatic condition like Bangladesh. But due to unknown reasons, it has not been explored in Bangladesh and other developing countries. In fact, turkeys are adaptable to wide range of climatic conditions and can be raised successfully almost anywhere in the world if they are well fed and protected against diseases and predators. The meat of turkey is considered by many peoples as a luxury meat. Moreover, it has an aesthetic value due to their beauty [6]. Because of the above reasons, turkey is becoming popular gradually in developing countries like Bangladesh [7]. There is no doubt that exciting times lie ahead for the Bangladesh poultry industry. The combination of basic low input-low output, subsistence level growers, and all combinations up to end including large scale commercial production, presents a daunting and stimulating prospect to the government preoccupied with poverty and malnutrition. Nevertheless, the poultry industry represents one way of accomplishing several national goals under a single banner. Employment, poverty alleviation and improved nutrition, for example, are all potential benefits arise from continued support and encouragement of poultry development. The poultry sub-sector is crucially important in the context of agricultural growth and improvement of diets particularly important in that it is a significant source of protein and nutrition in the household's nutritional intake in Bangladesh. Turkey farming is undoubtedly an attractive economic activity, especially for the rural women and poor population in the country [8].

Turkey Breeding, Life-cycle and Nursing Protocols

Turkey farming is a new farming enterprise in Bangladesh. Comparatively young population get involved with this farming and the ownership of farming mostly belonged to male farmers. Turkeys are grown not only for food but also for pleasure and competition at shows and exhibitions by hobbyists and fanciers around the world [9]. Most of the farmers are dependent on other farmers than government livestock offices for having technical supports. The interviewed livestock officers informed that as turkey is a new species to them, they do not have adequate awareness, knowledge and skill on it. It was observed that none of the farmers received any kind of training on turkey rearing. However, the life cycle of turkey is simple that includes eggs, poults, feed, adults and produce (Figure 1).

Average flock size of turkey is small because of newness of the enterprise and most of the farmers are likely to rear both white and black turkeys. However, white turkey is the most favored globally



for meat [10]. The mating ratio was higher than the ratio of 1: 2.75 that reported for turkey raised by local farmers at Nassarawa state in Nigeria [11]. However, it was at the higher limit of the continuum (1.67-3.69), which was reported for native turkey breeders in the state of Me-hoecan, Mexico [12]. The body size, egg number, hatchability, heat tolerance, body conformation and disease resistance were the traits of utmost importance for selection purpose among rural turkey farmers in Nasarawa. However, there is absence of structured market for turkey in Bangladesh. Weight of available adult tom, hen and egg in Bangladesh were comparatively low than those of developed countries. This might be because of lighter varieties of turkey reared by the farmers of Bangladesh. The hatchability of eggs was low because of lower fertility including insufficient knowledge of farmers on turkey breeding and egg incubating procedure. Although commercial livestock species completely dependent upon artificial insemination (AI) for fertile egg production, none of them were the respondent farmers. The problem of unfertilized eggs has long been identified as one of the most critical factors limiting the success of breeding programs, which were ranged from 10.0 to 98.2% [13]. The higher numbers of male than female among turkey keepers were also reported in Nassarawa. Analysis of education data revealed that 100% farmer respondents received formal education that ranged from less than Secondary School Certificate (SSC) to Master's Degree. The results indicate that participation of women in turkey farming was lower and the farmers were educated and most of them had prior experiences. Therefore, there is higher possibility to flourish turkey farming by these farmers in near future [11]. From the above discussion it is revealed that turkey chicken all over the world is remaining in popular condition. Human consumption and good health requirement are responsible for that. Hence, attention needs to be given to keep the increasing rates of turkey production to fulfill the demands the for the next generation.

Turkey rearing is a new farming activity in Bangladesh, where 34.78, 19.57 and 45.65% of respondent farmers have been rearing turkey for ornamental, both egg and meat, and both meat and ornamental purposes, respectively [14]. Turkey farming can be opted as a viable farming, as a little investment is required for housing, equipment and management [15].

Rearing, Handling and Harvesting Techniques

Rearing systems

In one acre of fenced land under the free range system, we can rear around 200-250 adult turkeys. Shelter should be provided during night at the rate of 3-4 sq. per bird. They should be protected from predators during scavenging. Planting of trees is desirable for providing shade and cool environment (Figure 3). The range should be rotated which will help to reduce incidence of parasite infestation [16].

Turkeys of all age group can easily be driven from one place to another with the help of a stick. For catching turkeys, a darkened room is the best, from where they can be picked up with both legs without any injury. However, mature turkeys should not be kept hanging for more than 3-4 minutes [17]. The farmers get technical supports from different sources. The study showed that 10.88, 10.87, 28.26 and 50.00% farmers took technical supports from Department of Livestock Services (DLS), both internet and DLS, internet and other experienced farmers, and other farmers, respectively [14]. Adult turkey can easily be reared from hatching eggs through the raising of young poultries. They can be grown inside the domestic house without the use of expensive equipment, and also may be sold to live markets (auctions) or to the neighbors. Adult males have a naked, heavily carunculated (bumpy) head that normally is bright red but it turns to white and overlaid with bright blue when the birds are excited. Other distinguishing features of the common turkey are: a long red fleshy ornament (called a snood) that grows from the forehead over the bill; a fleshy wattle growing from the throat; a tuft of coarse, black, hairy feathers (known as a beard) projecting from the breast; and the more or less prominent leg spurs [18]. The male wild turkey (variously called a gobbler, tom, or jake immature male), may be 50 inches long and weigh up to 22 pounds, although the average weight is less. Female turkeys (hens) generally weigh only half as much and have less warty heads. Domesticated strains of the common turkey developed for their fine-tasting flesh may be much heavier. Turkey poults of different ages need separated places for grow out rearing (Table 1).

Artificial reproduction technique

As natural mating is not resulting fertile egg, there is an opportunity to promote AI (artificial insemination) technique in turkey for the production of commercial hatching eggs. It will decrease the costs for rearing more toms. It is reported that a well-developed pectoral muscle in turkeys has prevented the toms to mate naturally [19] and thus making AI a necessity. Fertility could be improved in turkeys by using AI. In addition, efficiency in use of semen could be increased because each tom can produce enough sperm to inseminate approximately 30 hens [20].

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Fertility and hatchability

Fertility and hatchability are the major determinant of profitability in the turkey breeding farming. These parameters appear to be very



Figure 3: Turkey Rearing System.

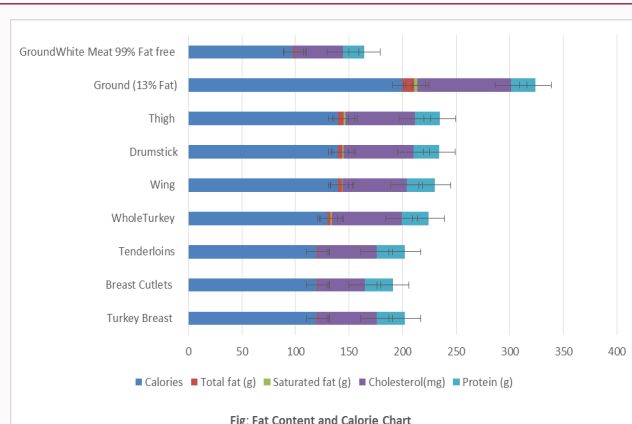


Figure 4: Fat Content and Calorie Chart: Per 3 oz skinless, cooked portion (www.ohiopoultry.org).

important as far as parent stocks are kept to produce final hybrids. Hatchability is a complex age dependent trait. It comprises of several sub-traits which are susceptible to genetic and environmental factors arising from various sources [21]. Turkey egg fertility and hatchability are usually lower in the summer months, when the temperature rises, compared to the other months. Researchers have proved that climate has the direct effects on the reproductive performance of the animals. Determination of the seasonal effect on hatchability should be given priority because of the adaptability, resistance to disease and successful rearing of turkey poults. Considering the above circumstances the study was undertaken with a view to determine the effects of month and season on the hatching performance of turkey and to identify suitable month and season of hatching their eggs [22]. Farmers experienced $32.00 \pm 1.00\%$ hatchability of eggs that indicated lower fertility and were not viable from business point of view. With this regard, 50.00, 21.74 and 28.26% farmers opined that the main reason of lower hatchability were due to low egg fertility, faulty incubation, and both low egg fertility and faulty incubation, respectively. Results on using hatching medium of turkey eggs

Table 1: Floor, feeder and watered space requirement for rearing of turkey poults in captive condition [16].

Age	Floor space (Sq.ft)	Feeder space (cm) (Linear feeder)	Waterer space (cm) (Linear waterer)
0-4 weeks	1.25	2.5	1.5
5-16 weeks	2.5	5	2.5
16-29 weeks	4	6.5	2.5
Turkey breeder	5	7.5	2.5

Table 2: Effects of season on hatching performance (mean $\pm$ SE) of turkey [23].

Seasons	Fertility (%)	Hatchability (%)		Embryonic Mortality (%)	
(2012-2016)		Total Hatchability	Fertile Hatchability	Dead Germ	Dead in Shells
Winter	75.37 $\pm$ 13.76 ^b	50.87 $\pm$ 9.29a	67.49 $\pm$ 12.32	15.15 $\pm$ 2.07	17.16 $\pm$ 2.40
(Jan-Feb)					
(n=7429)					
Summer	64.97 $\pm$ 1.33 ^d	40.91 $\pm$ 1.77 ^b	62.30 $\pm$ 2.02	18.47 $\pm$ 1.06	18.87 $\pm$ 0.72
(Mar-May)					
(n=10989)					
Southwest Monsoon	70.93 $\pm$ 1.78 ^c	42.88 $\pm$ 2.96 ^b	59.38 $\pm$ 3.40	20.37 $\pm$ 2.21	19.36 $\pm$ 1.18
(Jun-Sep)					
(n=2726)					
Northwest Monsoon	79.76 $\pm$ 1.49 ^a	53.36 $\pm$ 2.23 ^a	66.98 $\pm$ 2.42	16.97 $\pm$ 1.84	15.49 $\pm$ 1.16
(Oct-Dec)					
(n=4949)					
Overall mean	71.61 $\pm$ 0.88	46.09 $\pm$ 1.17	63.75 $\pm$ 1.26	18.25 $\pm$ 0.76	17.79 $\pm$ 0.51
(n=26093)					
F value	19.804	7.346	2.218	2.703	0.626
Significance	**	**	NS	NS	NS

Note: n: No. Eggs/Season; Mean bearing different superscripts within the same column differ significantly; *highly significant ($p \leq 0.01$); NS: Not Significant.

Table 3: Weekly nutritional requirement of turkey poultry in rearing system.

Items	Male	0-4 (weeks)	4-8 (weeks)	8-12 (weeks)	12-16 (weeks)	16-20 (weeks)	20-24 (weeks)	Adult/Breeder
	Female	0-4 (weeks)	4-8 (weeks)	8-11 (weeks)	11-14 (weeks)	14-17 (weeks)	17-20 (weeks)	
ME(k.call/kg) diet		2800	2900	3000	3100	3200	3300	2900
Protein (%)		28	26	22	19	16	14	14
Lysine (%)		1.6	1.5	1.3	1	0.8	0.65	0.6
Methionine (%)		0.5	0.45	0.38	0.33	0.28	0.23	0.2
Calcium (%)		1.2	1	0.85	0.75	0.65	0.5	2.25
Phosphorous (%)		0.7	0.6	0.5	0.5	0.4	0.4	0.6
Vitamin A (IU)		4000	4000	4000	4000	4000	4000	4000
Vitamin D3 (IU)		900	900	900	900	900	900	900
Choline (mg)		1900	1800	1300	1100	950	800	1800
Niacin (mg)		70	70	50	50	40	40	30

showed that 10.8, 18.9, 37.8 and 27.0% farmers hatched their eggs for production of turkey hen, chicken hen, both turkey and chicken hen, and incubator, respectively [14].

The effect of season on hatching performance of turkey is presented in Table 2. The mean percent of fertility and total hatchability were differed significantly ($P < 0.01$) between season and the values for winter, summer, southwest monsoon and northeast monsoon were 75.37 and 50.87, 64.97 and 40.91, 70.93 and 42.88, and 79.76 and 53.36, respectively. In our study, the rise in fertility and total hatchability were found during southwest monsoon and reached peak during northeast monsoon, then gradually reduced towards winter and lowest during summer season. Hatchability performance observed in our study concurs with the earlier findings [3]. The highest hatchability percentage was observed in winter followed (Table 2) by summer and monsoon/rainy season in this order [3].

Turkey Nutrition Facts

Feed

The energy, protein, vitamin and mineral requirements for

turkeys are high compared to other chickens. Since the energy and protein requirements for the both sexes vary, they must be reared separately for better results. The weekly nutritional requirement of male and female turkey is presented in Table 3. Feed should be given in feeders and not on the ground. Whenever change is made from one diet to another, it should be carried out gradually. Turkeys require a constant and clean water supply at all times and also at the times of need. More waters are required during the summer months. Feeding of turkey usually done during the cooler parts of the day in summer season. Pro Shell grit are supplemented at the rate of 30-40 g per day per bird to avoid the leg weakness. The farmers were not aware about feed efficiency. But the importance of feed efficiency is high due to the high cost of feed, which represents approximately 70% of the total cost of a turkey production system [24].

Green feeding

In intensive system, green feed can be upto 50% of the total diet on dry mash basis. Fresh Lucerne is the first class green feed for turkeys of all ages. Apart from this Desman thus and Stylo can be

Table 4: Weekly body weight and feed consumption of turkey poultry [16].

Age in weeks	Average Body Weight (kg)		Total feed consumption (kg)		Cumulative feed efficiency	
	Male	Female	Male	Female	Male	Female
Up to 4 th week	0.72	0.63	0.95	0.81	1.3	1.3
Up to 8 th week	2.36	1.9	3.99	3.49	1.8	1.7
Up to 12 th week	4.72	3.85	11.34	9.25	2.4	2.4
Up to 16 th week	7.26	5.53	19.86	15.69	2.8	2.7
Up to 20 th week	9.62	6.75	28.26	23.13	3.4	2.9

Note: FCR of 2.13 with feed consumption of 140g/day on feeding with 4,400k.cal/kg.

Table 5: Common diseases of turkey, and their causes, symptoms and preventions.

Common Diseases	Cause	Symptoms	Prevention
Arizonosis	<i>Salmonella arizona</i>	Poult unthrifty and may develop eye opacity and blindness. Susceptible age 3-4 weeks	Elimination of infected breeder flock and hatchery fumigation and sanitation
Blue comb disease	Corona virus	Depression, loss of weight, frothy or watery droppings, darkening of head and skin	Depopulation and decontamination of farm. Give rest period
Chronic respiratory disease	<i>Mycoplasma gallisepticum</i>	Coughing, gurgling, sneezing, nasal exudates	Secure and maintain Mycoplasma free stock
Erysipelas	<i>Erysipelothrix rhusiopathiae</i>	Sudden losses, swollen snood, discoloration of parts of face, dropy	Vaccination
Fowl cholera	<i>Pasteurella multocida</i>	Purplish head, greenish yellow droppings, sudden death	Sanitation and disposal of dead birds
Fowl pox	Pox virus	Small yellow blisters on comb and wattles and scab formation	Vaccination
Haemorrhagic enteritis	virus	One or more dead birds	Vaccination

chopped and fed turkeys to reduce the feed cost (Table 4).

Energy Requirements of Turkey

Protein and amino acids

A protein requirement of 28 percent for starting poult is supported by the previous works [25-27]. Reduced levels of protein can decrease early growth, but if the protein reduction is moderate, compensatory gain of large-type turkeys prior to marketing may overcome the deficit. The progressive reduction in the protein requirement as the turkey grows is well established. A level of 12 percent protein with 2,900 kcal ME/kg for holding turkeys prior to reproduction is consistent in terms of the protein: energy ratio with the 14 percent protein at 3,526 kcal. The protein need for egg production has been observed to vary from 10 to 18 percent of the diet, with the value of 14 percent chosen as being the most representative [28].

Minerals

The determination of calcium requirement with starting poult has been reported to be as high as 1.7% [29] and 1.5% [30], and as low as 1.0% [31] and 0.81% [32]. The requirement of 1.2 percent [33] dietary calcium was found to be appropriate when total phosphorus and vitamin D levels were 0.8% and 1,100 IU/kg of diet, respectively.

The nonphytate phosphorus requirement of 0.6 percent for starting poult agrees with the findings reported by Bailey et al. [34]. This value has been shown to decrease with age [35]. It has also been reported that nonphytate phosphorus requirements for breeder hens in egg production ranged from 0.30 to 0.55% [36,37]. The latter value was relatively high and probably occurred because of a low phosphorus availability in the feedstuffs employed; thus 0.35 percent nonphytate phosphorus was selected to represent the requirement.

The magnesium requirement of 500mg/kg of diet has been reduced from the 600mg listed in the previous edition to better reflect the value of 475mg/kg [38]. The manganese requirement may vary with the type of diet and supplement used. The recommended value of 60 mg/kg is the same as the requirement observed [39].

Vitamins

The previous requirement for vitamin A was listed as 4,000 IU/kg of diet. Vitamin A at 5,000 IU/kg of feed provides the maximum growth performance and liver storage [40] and has been chosen to represent the requirement, although 2,000 IU/kg will also support optimal performance [41]. Vitamin A at 5,000 IU/kg is also recommended for breeder hens, but lower levels (about 2,500 IU/kg) have been shown to maintain egg production, hatchability, and survival [42].

The value given as the vitamin E requirement of starting turkeys is the same as that reported by Scott [43], when the dietary selenium concentration was 0.1 mg/kg. The vitamin E requirement of breeder hens was observed to be twice of this level (24 IU/kg) [44]. Extensive increases in vitamin E were well above the requirements for optimal growth are necessary in order to provide the carcass meaningful protection against oxidative rancidity when carcasses are held in frozen storage [45]. All other vitamin requirements have been determined only for the first 4 or 8 weeks of age. In some instances, there is good agreements among the researchers on the required value but in other instances, considerable disparity exists. The committee has revised the requirement values given for several vitamins either to better represent old information or to reflect new reports. Vitamin K at 1 mg/kg of diet was increased to 1.75 mg/kg, which was the same as the value observed by Griminger [46] to optimize blood prothrombin time. The new value is considered as adequate under practical conditions because poult were reared in wire-floored pens and coprophagy, and therefore, the additional source of vitamin K, was prevented [46].

Health Management

The study showed that while 36.96% farmers had encountered with diseases like New Castle, Fowl cholera, Fowl pox, Mycoplasmosis etc., 63.04% had not experienced any disease. Similarly, while 19.57% farmers had used vaccine, 80.43% had not used any vaccine for preventing from diseases [14]. It was reported that 74 (77.9%)

Table 6: Vaccination schedule of turkey poults from 8 to 10 weeks [16].

Day old Vaccination Schedule	ND – B1 Strain
4 th and 5 th Weeks	Fowl pox
6 th Week	ND – (R2B)
8 – 10 Weeks	Cholera vaccine

out of the 95 interviewed turkey farmers had no record of disease attack in their flock in Nigeria [47]. During the in depth discussion on the issue, it was found that most of the farmers did not follow deworming schedule for turkey as like chicken. Some experienced with respiratory infection which might be due to Mycoplasma. Some farmers got weak poults with malformed legs which might be caused owing to improper temperature and humidity during incubation and poor nutrition of parents (Table 5).

Low disease prevalence

Turkey is more disease resistant to diseases than other poultries like chicken, duck and quail. Mortality rate of turkey is very low compared to other poultry birds. It has also been reported that turkeys are resistant to Marek's and infectious bronchitis and commonly encountered with other diseases like mycoplasmosis, fowl cholera, erysipelas and hemorrhagic enteritis. Farmers mostly do vaccination only for new castle disease, fowl pox and fowl cholera (Table 6). Similar findings were found in Nigeria and it has been reported that the farmers fed their breeder turkeys with different classes of commercial feed probably because of insufficient knowledge of the levels of nutrient requirements of breeder turkeys [48]. However, the results indicated that prevalence of turkey disease was comparatively low. Most of the farmers had not used vaccines as preventive measures.

Alternative Source of Protein and Income Generation

While broiler meat market is facing problems of higher diseases and lower taste, turkey meat could be an alternative for consumers. Therefore, it could be an effective alternative source of protein. Moreover, this bird is quite suitable for uplifting livelihoods of small and marginal farmers as it can easily be reared in free range and under both intensive and semi-intensive system with little investment for housing, equipment and management. It may create good opportunity for unemployed youths to start farming and earn income. Turkey bird has a promising potential to be an alternative to livestock in meat production [49]. In the context of competitive feeding and management cost, different countries searched such alternative source for protein (Figure 4).

The study reported that with the continued rise in the cost of production of cattle, sheep and goat, which are the primary sources of animal protein in Nigeria, it has become very necessary to explore efficient and less common but potential sources of animal protein for economic viability [50]. Male and female British United Turkey reached, at 16 weeks of age, 14.60 kg and 10.25 kg, respectively [51].

Potential of Integrated Fish Farming with Turkey Poults

Integrated fish farming is a system of producing fish in combination with other agricultural/livestock farming operations centered around the fish pond. The farming sub-systems e.g. fish, crop and livestock are linked to each other in such a way that the byproducts/wastes from one sub-system become the valuable inputs

to another sub-system and thus ensures total utilization of land and water resources of the farm resulting in maximum and diversified farm output with minimum financial and labor costs. These enterprises not only supplement the income of the farmers but also help in increasing the family labor employment throughout the year [52-54]

In a proper fish, crop and livestock integrated farming system, the possible inter sub-system interactions are - excreta and waste feed from livestock sub-system act as manure and feed for fish as well as can be used as manure for crop land. By-product/wastes of crop can be used as feed, manure for the fish pond and as feed for livestock. Nutrient rich bottom silt and water of pond can be a good source of fertilizers for the crop land [55]. It thus appears that the different sub-systems in an integrated system are beneficially inter-linked to each other in a limited area, minimizing the production costs but resulting in diversified outputs viz. fish, meat, eggs, vegetables, fruits, fuel wood and fodder which are the basic need of a farm family [56].

In Bangladesh around 60% of the farmers have less than 0.8ha farm size which also limits space for taking up additional and diversified farming activities. Integrated fish farming on the other hand offers opportunity for taking up diversified farming activities with optimum utilization of available land space for food production, thus increasing household income of small farmers. In Bangladesh, the possibilities exist for integrated fish culture with livestock production. In addition to about 80 million cattle, buffaloes, sheep, goats, there are more than 130 million ducks and chickens (including turkey poults) in the country. Most of the excreta of these animals is not properly utilized and become wastes which may cause environmental pollution to some extent. If these livestock wastes could be applied in fish ponds through integrated fish farming system, fish production could be increased substantially without using any other fertilizer or supplementary feed for fish. As integrated fish-crop-livestock farming is economically and environmentally sound as well as the popularity of turkey farming is increasing day by day, the implementation of integrated fish farming with turkey chickens, in the rearing systems, would appear to be the national policy of the diversification of production in Bangladesh.

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