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Competitive Research Grant

Sub-Project Completion Report

on

Small-scale farming of guinea fowls and turkeys in Bangladesh-a tool for poverty reduction

Project duration

July 2017 to September 2018

Department of Poultry Science, Bangladesh Agricultural University, Mymensingh

Submitted

Project Implementation Unit-BARC, NATP 2
Bangladesh Agricultural Research Council
Farmgate, Dhaka-1215

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Project Implementation Unit
National Agricultural Technology Program-Phase II Project (NATP-2)
Bangladesh Agricultural Research Council (BARC)
New Airport Road, Farmgate, Dhaka – 1215
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Acronyms

NATP	:	National Agriculture Technology Project
BARC	:	Bangladesh Agricultural Research Council
CRG	:	Competitive Research Grant
PIU	:	Project Implementation Unit
USAID	:	United States Agency for International Development
DLS	:	Department of Livestock Services
GDP	:	Gross Domestic Product
FAO	:	Food and Agriculture Organization
et al.	:	Associates
cm	:	Centimeter
Kg	:	Kilogram
BAU	:	Bangladesh Agricultural University
^{0}C	:	Degree Celsius
PG	:	Pituitary gland
g	:	Gram
MS	:	Microsoft
µm	:	Micrometer
SPSS	:	Statistical Package for Social Science
GSI	:	Gonado-somatic Index
SGR	:	Specific Growth rate
BLRI	:	Bangladesh Livestock Research Institute
BAURES	:	Bangladesh Agricultural University Research System
FCR	:	Feed Conversion Ratio

Table of Contents

List of Tables

List of Figures

Executive Summary

Guinea fowls and turkeys are the specialized species of poultry. Among the two species, guinea fowls are being reared in Bangladesh since the British colonization in Indo-Pak sub-continent however turkey has been introduced recently. Unfortunately, there is no specific guideline for the farmers on rearing the birds and consequently, the farmers are facing problems in relation to housing, feeding, light management, artificial insemination technique, fertility and hatchability of eggs, vaccination and medication, etc. for raising guinea fowl and turkey. The project was therefore undertaken to study the growth and egg production performances of turkeys and guinea fowls under intensive and semi-intensive rearing system. The study on growth performances of the turkeys were conducted with a total of 320-day old unsexed poults of four plumage color types (Black, White, Bronze and Royal Palm). Out of the 320 poults, 160 were kept at BAU Poultry Farm for the purpose of intensive rearing and remaining 160 poults were distributed among 16 farmers for semi-intesive rearing for a period from 5 to 20 week of age. For guinea fowls, a total of 120 day old keets, 40 from each variety (Pearl, White and Lavender), were taken for the intensive system study at BAU. For the semi-intensive system of study a total of 400 keets were distributed to 20 selected farmers. Among the four-color types of male heritage turkeys under intensive system the Bronze color type male turkey attained highest body weight of 4206.55 g/bird followed by Black (3954.80 g/bird), Royal Palm (3931.39 g/bird) and White (3848.82 g/bird) at the age of 20 week. The feed conversion ratio (FCR) was better in Bronze (3.19), indicating that the birds in this particular group utilized feed more efficiently as compared to Black (3.40), Royal Palm (3.41) and White male (3.48) turkey. In case of semi-intensive system, Bronze male attained the highest live weight of 4433 g/bird at the end of the experiment followed by Royal Palm (4248 g/bird) Black (4171 g/bird) and White (3994 g/bird). Bronze type male turkey gained better FCR (3.01) followed by Royal Palm (3.13), Black (3.20) and White male (3.34). In the case of female turkeys, the Bronze female attained the highest body weight of 2626.49 g/bird, under intensive system and 2699.82 g/bird under semi-intensive system of rearing. The survivability in semi-intensive system was found to be better (97.55%) compared to the intensive system (95.97%). The results of the present study revealed that the semi-intensive system of rearing of turkey is significantly ($p<.05$) better than intensive system due to outdoor access of pasturing, low stocking density and better management practices. The hen-day egg production was ranged between 25-50%. The initial average egg weight, at 28 weeks of age, was 51.50 g/egg and at 59 weeks of age it reached to 73.48 g/egg. The average egg weight was 64.01 g/egg. From the above findings it could be concluded that the farmers may be advised to raise bronze color variety of turkey for more profit. Further research is needed on the formulation of turkey feed both for semi-intensive and intensive system of rearing. The experiment on guinea fowl could not be continued as the farmers became reluctant to raise guinea fowls to avoid social conflicts arouse from the noise pollution by the birds.

CRG Sub-Project Completion Report (PCR)

A. Sub-project Description

1. **Title of the CRG sub-project:**
   Small-scale farming of guinea fowls and turkeys in Bangladesh- a tool for poverty reduction

2. **Implementing organization:**
   Department of Poultry Science, Bangladesh Agricultural University, Mymensingh

3. **Name and full address with phone, cell and E-mail of PI/Co-PI (s):**

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4. **Sub-project budget (Tk):**
   4.1 Total: Tk. 20,00,000/-
   4.2 Revised (if any): Not Applicable

5. **Duration of the sub-project:**
   5.1 Start date (based on LoA signed): 11 July, 2017
   5.2 End date : 30 September 2018

6. **Justification of undertaking the sub-project:**

The small scale broiler and layers farmers in Bangladesh are under the threat of closing their business and facing extinction because of unhealthy competition with giant poultry farms, fluctuating market price of DOC, gradual increase of feed cost along with high market price of feed additives, vaccination and medication items. Meanwhile, good number farms have been closed and shut down their operations. These farmers are looking for alternative and restart their business using existing set-up like poultry shed, equipment and other accessories. Thus, the rearing of small scale guinea fowl and turkey has open new avenues for them. Again, poverty reduction and nutritional security are the key consideration of Government of Bangladesh to achieve Sustainable Development Goal (SDG) of the country. Production of small scale guinea fowl and turkey can also attributes, at least in a part, to achieve SDG by poverty reduction and nutritional security. Among the two species, guinea fowls are being reared since the British colonization in Indo-Pak sub-continent however turkey has been introduced recently. Unfortunately, there is no specific guideline to our farmers for rearing the birds. Therefore, farmers are facing problems in relation to housing, feeding, light management, artificial insemination technique, fertility and hatchability of eggs, vaccination and medication, etc for raising guinea fowl and turkey. Thus the project was undertaken to develop a useful comprehensive performance and management guideline for the small and medium scale guinea fowl and turkey farmers.

7. **Sub-project goal:**
The ultimate goal of the research is poverty reduction through small scale rearing of guinea fowls and turkeys.

8. **Sub-project objective (s):**

a) To observe the growth and egg production performances of turkeys under intensive and semi-intensive rearing system.
b) To observe the growth and egg production performances of guinea fowls under intensive and semi-intensive rearing system.
c) To analyze the economic feasibility of small scale turkey and guinea fowl rearing for poverty reduction.

9. **Implementing location (s):**

The present study was conducted at the farmers' level in Jamalpur and Rajshahi District & at on station in the Poultry Farm and Poultry Science Laboratory at the Department of Poultry Science, BAU, Mymensingh

10. **Methodology in brief:**

10.1. Growth and egg production performances of turkeys both at intensive and semi-intensive system of rearing

Growth performance of turkeys
This part of research was designed to investigate the comparative growth performance of four plumage color types i.e. Black, White, Bronze and Royal Palm heritage turkeys available in Bangladesh. A total of 355 day old poults were considered for the study. At first, all the day old poults were brooded and reared up to 5thweek of age under complete confinement at Bangladesh Agricultural University Poultry Farm. After completion of brooding 320 poults were selected for the experiment. Out of the 320 poults 160 were distributed among 16 farmers of *Masimpur* village under the Jamalpur district. The rest of the poults (160) were reared at BAU Poultry Farm to investigate growth performance under intensive rearing system with complete confinement. At BAU Poultry Farm, the male and female turkeys were reared separately. On the other hand, there was no separation of male and female birds at outreach station (*Masimpur,* Jamalpur). The plan of distribution of poults was as follows:

Plumage color	No. of birds (Intensive system)	No. of birds (Semi-intensive system)
Black	34	38
White	42	33
Bronze	46	47
Royal palm	38	42
Total	160	160

Selection of farmers
In order to fulfill the objectives of this study, farmers were selected based on the following criteria:

a. Farmers need to be enthusiastic to rear turkey.
b. The farmer must have homestead for scavenging turkey.
c. The minimum level of education so that they can keep record properly, serious to duties and responsibilities is given to them.
d. Special attention was given to involve rural women in taking care and management of birds as they are usually more devoted to performing these activities compared to man.
e. Obey the rules, suggestions and recommendations prescribed by the researcher.

Methods of fertile egg collection and hatching

Only good quality hatching eggs of turkey were collected from BAU poultry farm and also from Valuka, Dhanikhola and Trishal turkey farms, Mymensingh in order to conduct the research work. Although parent breeder turkeys are being kept at BAU Poultry Farm, the number of eggs collected was not sufficient to have good number of parents required for the experiment. Thus, some hatching eggs were collected from known farms to obtain sufficient number of poults from a single hatch. Mainly disease free, an optimum male-female ratio maintained flock and also neat and clean, properly collected eggs were selected in the collection of hatching egg. The eggs thereafter were properly cleaned and set at the incubator of BAU poultry farm for a period of 28 days.

Preparation of experimental house

A gable type, open-sided shed type house was considered for brooding and rearing of experimental turkey poults at BAU poultry farm. The poultry house cleaned and disinfected and allowed to rest for at least 7 days prior to poult placement. Some necessary equipment such as feeders, drinkers, brooders, etc. were also cleaned and disinfected accordingly. The whole room area was sanitized with Vircon maintaining a ratio of 1:100 (1%), a common but a widely used effective disinfectant purchased from Mymensingh. Before arrival of the poults, rice husk was provided as bedding materials. Afterwards, jute sack was placed over bedding material to avoid spraddle legs tendency, a common phenomenon usually found in poults soon after hatching. Smooth flooring condition such using newspaper on the floor usually aggravates the problems of legs spraddling, which consequently leads to leg paralysis of poults endeing with mortality. Thus, using any sorts of unsmooth materials on the floor for couple of days at early period of brooding, jute sack for example, certainly reduces the possibility of leg paralysis. Brooder and brooder guard were properly placed and checked. Drinkers and feeders were also provided prior to arrival of the poults.

Brooding and rearing

Brooding was performed in traditional system by using 100 and 200 watts electric bulbs under the hover, and then heat was decreased gradually by lifting up the bulbs and hover as per requirement of temperature. For optimization of the brooding temperature, even in some cases, the no. of bulbs or types of bulbs i.e. 100 watts or 200 watts were also adjusted. Thermo-hygrometer was hanged at the bird's level in the brooder to record temperature and relative humidity. A total of 355 day old poults were brooded and reared up to 5 weeks of age in the brooding house. During the brooding period a total of 35 poults died due to disease and spradell leg problems. Male and female turkeys were reared in separate shed at BAU poultry farm, however, in the farmer's house both male and female was reared together. Most of the farmer's turkey sheds were newly constructed using tin shed roof with semi-concrete floor and also soiled floor along with wire-netting sidewall. Adequate feeder and drinker were placed according to the requirements of the birds. In both experimental sites rice husk was used as bedding materials.

Floor space

In cases of intensive rearing system male turkey birds was provided at least 3.5 sq. ft. and for female 3 sq. ft. for each bird. The floor space was varied in case of farmers depending on the size of the shed, on an average 3.5 sq. ft. /bird was provided.

Feeder and drinker

Feeding in a traditional round feeder is problem. Thus, special feeding system was adapted. In order to conduct the research work, four specially made cemented feeders and three round drinkers were used in each shed at BAU poultry farm for feeding and drinking purpose. In case of rearing turkeys at farmer's house two round feeders and one drinker was used for each of 10 birds. The feeder and drinkers were placed in such way that the birds were able to eat and drink easily.

Feeding and drinking

During the entire experimental period fresh, clean and potable drinking water was supplied to the experimental birds. Usually the water was provided twice a day i.e. early in the morning and afternoon prior to providing feed. For feeding purpose commercial feed was considered, and the feed was provided twice a day at early in the morning and afternoon. For the first 5 weeks, broiler starter (Table 1) was provided followed by broiler grower diet for male (Table 2) and layer grower diet (Table 3) to the female birds up to 20th weeks; without any supplementation in case of intensive rearing at BAU Poultry Farm. And the same feeding regime was followed at farmer's house along with supplementation of green grass, kolmishak *(Ipomoea aquatica),* helencha *(Enhydra fluctuens),* banana leaf *(Musa acuminata),* water hyacinth *(Eichhornia crassipes),* neem leaf *(Azadirachta indica),* etc. Separate feeding schedule were maintained for both male (Table 2) and female (Table 3) turkeys at BAU Poultry Farm and the farmers house in case of commercial feed. Compositions of commercial feed are given in Table 1.

Table 1: Chemical composition of starter diet for poults

Chemical composition of the diet	Amount
ME (Kcal/kg)	3000
CP (%)	23
Fiber (%)	5
Calcium (%)	0.95
Av. Phosphorous (%)	0.45
Methionine (%)	0.45
Lysine (%)	1.05
Moisture (%)	12

Table 2: Chemical composition of Grower diet for male

Chemical composition of the diet	Amount
ME (Kcal/kg)	3050
CP (%)	20
Fiber (%)	5
Calcium (%)	0.95
Av. Phosphorous (%)	0.45
Methionine (%)	0.45
Lysine (%)	1.05
Moisture (%)	12

Table 3: Chemical composition of Grower diet for female

Chemical composition of the diet	Amount
ME (Kcal/kg)	2950
CP (%)	20.8
Fiber (%)	4.5
Calcium (%)	1.1
Av. Phosphorous (%)	0.5
Methionine (%)	0.45
Lysine (%)	1.0
Moisture (%)	10

Lighting

Lighting is very important in case of poults for first few weeks, as the birds are very nervous and when they get frightened usually die by pilling and also not eating due to confusion. For that purpose, 100 watts bulb along with natural lighting at day time was provided to the experimental poults for the first 5 weeks of age. Afterwards, natural lighting was applied throughout the entire experimental period only for day time.

Vaccination /immunization

For protecting the birds from common diseases the vaccination schedule followed is given in Table 4.

Table 4: Vaccination schedule

Age (days)	Name of the vaccine	Route of application	Dose/bird
1	CEVAC® BIL (IB+ND)	Eye drop	1 drop
18	CEVAC® BIL (IB+ND)	Eye drop	1 drop
35	Fowl Pox	Wing web	Full dose
50	PoulShot® LaSota (RDV)	Drinking water	Full dose

IB, Infectious bronchitis; ND, Newcastle disease; RDV, Ranikhet disease virus

After hatching of poults, at first, Infectious bronchitis and Newcastle disease vaccine (CEVAC® BIL) was administrated. One ampoule of vaccine was diluted with 100 ml of distilled water then using a dropper one drop of diluted vaccine was applied in intra-ocular route (one drop vaccine in one eye/bird). The booster dose was applied with the same product at 18 days. Then at the age of 35 days, Fowl Pox Vaccine was administered by the wing-web method and at 50 days of age for immunizing against Newcastle disease PoulShot® LaSota (RDV) vaccine was administered through drinking water according to the instruction of manufacturer.

Litter management

Fresh and dry rice husk was used as litter materials with the thickness of 2 inches for comfort of the birds. The voluminous droppings of turkey made the litter damp quickly when it compared with chicken; as a result extra attention was paid in the management of litter used. Since the turkeys are heavy birds, and more aggressive than any other species of poultry, drop down water and wet litter around the drinker are very common. Therefore, damp and wet litter was changed partially or fully once in 14 days to maintain good litter condition in and thus, to provide optimum comfort to the birds.

Biosecurity measures

A strict but possible biosecurity measures were maintained particularly in and around the experimental unit at BAU Poultry farm. Entrance of the personnel was completely prohibited to the research unit areas excepting the researcher. Research supervisor paid regular visit to the flock but necessary measures were also taken to avoid any disease contamination. Potassium permanganate solution was used as disinfectant in the footbath. Footbath water was regularly cleaned replaced with fresh disinfectant solution. Further, TH_4 solution was sprayed over the floor areas, litter, equipment and machineries, walls, doorsteps and around the house once before arrival of the poults and then on regular basis. Before entering into the shed, hands and foots were sprayed every time. Separate plastic sandals, apron and gumboot were used during routine care of the birds. But sanitary condition was not so good under village condition because birds were reared completely under semi-scavenging condition which frequently interrupted bio-security. During the entire experimental period there was no use of disinfectant solution and also other biosecurity measures like use of separate sandals, clothing, etc. were not observed. In fact at the farmer's level, the turkeys were reared with other domestic birds like chicken and duck.

Data collection and record keeping

For the successful and fruitful outcome of the experiment following records were kept during the trial period:

- Weekly average body weight
- Weekly average body weight gain
- Weekly average feed consumption
- Vaccination and medication
- Mortality

Parameters considered

I. Average live weight (g/bird) at different ages of poults

Average live weight was measured at the end of each week

II. Average live weight gain (g/bird)

The average live weight gain was calculated using the following formula:

Live weight gain = Final weight – Initial weight

III. Feed conversion ratio (FCR)

Feed conversion ratio was calculated by dividing the total feed consumption by average body weight gain.

$$\textbf{FCR}=\frac{\text{Amount of feed consumption (gm)}}{\text{Body weight gain (gm)}}$$

IV. Survivability

Survivability per cent of the birds were calculated at the end of experiment, dividing the number of birds alive by the total number of birds and multiplying by 100.

$$\textbf{Survivability \%} = \frac{\text{No. of initial live birds-No. of dead birds during the experiment}}{\text{No. of initial live birds}} \times 100$$

Statistical analysis

The recorded data were analyzed using One-way ANOVA (color types) and Independent t-test (system of rearing) procedure using SPSS computer software 22.00 (SPSS Inc. Chicago, USA 2013). Significance among color means were compared by using Duncan's multiple range test.

Egg production performance of heritage turkeys (under semi-intensive system)

Statement of the experiment

The experiment was conducted at Bangladesh Agricultural University (BAU) poultry farm, Mymensingh to investigate the egg production performance. A total of 36 heritage type turkey hens of the age of 28 weeks were used for this study. The birds were originally reared in BAU Poultry Farm, Mymensingh. The data were collected from the date of onset of egg production at 28 weeks to 59 weeks of age of the birds.

Preparation of the experimental house

In order to conduct the experiment, a gable type open-sided shed type house was used. The house, ceiling, sidewall was cleaned and washed followed by disinfection using vircon solution. The house was then left for 5 days for drying. Dry rice husk of 10 cm depth was used on the floor as a litter material. After that, new feeders, drinkers and other necessary equipment was placed accordingly.

Experimental diet
Commercial layer diet manufactured by Aman Feed Ltd. was used for the experiment. The chemical composition of the diet is given below in Table 5.

Table 5: Chemical composition of layer diet

Chemical composition of the diet	Amount
ME (Kcal/kg)	2800
CP (%)	18
CF (%)	3-5
Calcium (%)	3.80
Av. Phosphorous (%)	0.42
Methionine (%)	0.46
Lysine (%)	0.90
Moisture (%)	12

Management practices
The experimental turkey hens were provided similar care and management throughout the experimental period so far as floor space, feeding, drinking, lighting, etc. are concerned.

Floor space
As the turkeys are larger than other poultry species except ostrich, it requires relatively large floor space. The floor space provided for each bird was 3.5 sq.ft./bird.

Feeder and drinker
In order to conduct the experiment one large trough feeder and two specially made cemented feeders were used. For the drinking purpose three round drinkers were used. The feeder and drinkers were placed in such a way that the birds could eat and drink easily.

Feeding and watering
During the experimental period feed was supplied according to the requirement of birds. Mash feed was supplied. Feed was supplied twice daily, once morning and another at afternoon. Fresh and clean dirking water was supplied before feed supply and was made available at all times during the entire experimental period. The birds were also allowed to scavenge for sometime in the particular farm premises.

Ventilation system
Natural ventilation was provided to the birds during experimental period. Actually, the experiment was started in the winter period and continued throughout the summer period. When the temperature increased a stand fan was used to eliminate the heat stress.

Lighting management
In the experimental period 16 hours continuous lighting period (natural light +artificial light) and 8 hours dark period was allowed for the open sided house.

Litter management
Litter was stirred at the end of each week to break its compactness and preventing cake formation. In case of the litters becoming too wet it was changed on regular basis.

Sanitation and biosecurity
Potassium permanganate solution was used as disinfectant in the footbath. Footbath water was removed and cleaned daily followed by refilling with fresh disinfectant solution. Furthermore, TH_4

solution was sprayed over the floor areas, side wall, litter, equipment, doorsteps and around the house. Separate plastic sandals, apron and gumboot were used during daily care and management practices.

Vaccination

To protect the birds from the most common diseases of poultry the birds were vaccinated regularly following the vaccination schedule given in Table 4 under the growth performance study of turkeys.

Data collection and record keeping

Data on the following parameters were collected thought the experimental period to evaluate the egg production performance of birds.

I. Egg production

Egg production was recorded twice daily i.e. early in the morning and afternoon throughout the experimental period.

II. Feed consumption

Feed consumption **(g/bird/day)** was recorded on daily basis.

III. Egg production per cent

The egg production per cent was determined in the form of Hen-day- egg production using the following formula:

$$\text{Hen Day Egg Production (\%)} = \frac{\text{No. of eggs laid}}{\text{Total No. of hen days}} \times 100$$

IV. Egg weight

Eggs were weighed weekly by using digital weighing balance.

V. Egg mass determination

Egg mass was also determined by the following formula**:**

Average egg mass per hen per day in gram

$$= \frac{\text{Percentage hen-day egg production x Average individual egg weight in grams}}{100}$$

VI. Feed conversion ratio (FCR)

The FCR was calculated as the total feed consumption divided by egg mass, as an indicator of feed conversion using the following formula:

$$\text{FCR} = \frac{\text{Feed intake of the hen}}{\text{Total egg weight}}$$

The recorded data were analyzed by One-way ANOVA procedure using SPSS computer software 22.00 (SPSS Inc. Chicago, USA 2013). Significance among different species means were compared by using Duncan's multiple range test.

10.2. Growth performance of guinea fowl both at intensive and semi-intensive system

Statement of the experiment

The current research was designed to investigate the comparative growth performance of three varieties of guinea fowl i.e. Pearl, White and Lavender. The experiment was conducted from 13 October 2016 to 16 March 2017 under intensive system at BAU Poultry Farm, Mymensingh and under semi-intensive system at farmer's field at *Mehenchandi*, Rajshahi. The keets were brooded under complete intensive environment at BAU Poultry Farm. During this period brooding temperature and humidity, feed intake, feed conversion ratio (FCR), growth rate, mortality rate were investigated.

Experimental birds

A total of 120 day old keets, 40 from each variety (Pearl, White and Lavender), were taken for the intensive system study. For the semi-intensive system of study a total of 400 keets were distributed to 20 selected farmers. The keets were collected from the parent stock of BAU Poultry Farm.

Management procedure

Preparation of experimental house

A shed type, open-sided house was considered for brooding and rearing of experimental guinea fowl keets at BAU Poultry Farm. The poultry house was cleaned, washed and disinfected properly and allowed to rest for at least 7 days prior to placement of the keets. Before arrival of the keets, rice husk was provided as bedding materials.

Afterwards, jute sack was placed over the bedding material to avoid spraddle legs tendency. Brooder and brooder guard were properly placed and checked. Drinkers and feeders were also provided prior to the arrival of keets.

Brooding of the guinea fowls

Just after hatching, keets were supplied with a dextrose monohydrate solution containing glucose, galactose and electrolytes. Temperature was maintained at 33°C as brooding temperature which was decreased gradually in subsequent weeks @ 2.5°C/week until 4 weeks of age. When required the keets were given additional heat with electric bulb for first 4 weeks of age. The brooding of keets was performed at semi-monitored house, at BAU Poultry Farm.

Floor space

Floor space was maintained at the rate of 20 keets/m^2 during brooding period. After brooding was over floor space was increased as per requirements.

Source of feed

There is no specific feeding standard formulated for farmed guinea fowl. For this reason, in the present study, guinea fowls were fed with commercial broiler diets. The feed was procured from Nourish Poultry and Hatchery Ltd., Valuka, Mymensingh. Chemical composition of feed supplied to the keets is shown in Table 6 and that for the grower is presented in Table 7.

Table 6: Nutrient composition of broiler starter

Name of Nutrients	Amount
ME Kcal/kg	2900
CP (%)	22.3
D. Met+D. Cystine (%)	0.9
D. Lysine (%)	1.24
D. Threonine (%)	0.78
Calcium (%)	0.97
Av. Phosphorus (%)	0.5

Table 7: Nutrient composition of broiler grower

Name of nutrients	Amount
ME Kcal/kg	3050
CP (%)	21
D. Met +D. Cystine (%)	0.78
D. Lysine (%)	1.05
D. Threonine (%)	0.68
Calcium (%)	0.97
Av. Phosphorus (%)	0.43
Na (%)	0.17

Feeder and drinker

Tray feeder (22cm×20cm) was used during brooding for different variety of guinea fowl. Addition of round feeder was taken with the gradual incensement of age. Round drinker were provided according to the age of keets. Feeders were cleaned every week and drinkers were cleaned every morning.

Feeding and watering of birds

Broiler starter was fed up to 14 days of age as a mash form. Then broiler starter ration was fed directly up to the last day of experimental period. Feed and water were supplied as *adlibitum* to the keets throughout the experimental period. Both of ready feed supply and scavenging feeding practices were performed.

Ventilation system

Natural ventilation was provided to the turkey birds during experimental period. Actually, the experiment was started in the winter period and continued throughout the summer period. When the temperature increased a stand fan was used to eliminate the hot air from the house.

Light management

In the experimental period 16 hours continuous lighting period (natural light +artificial light) with a light intensity 20-50 lux and 8 hours dark period was given in the open sided house.

Litter management

Fresh and dry rice husk was used as litter materials with the thickness of 2" for comfort of the bird. Damp and wet litter was changed partially or fully once in 14 days.

Recording temperature (^{0}C) and humidity (%)

Temperature was recorded using a thermometer 3 times a day and humidity data recorded during the experimental period ranged between 57 to 97%.

Vaccination

To protect the birds from common diseases the same vaccination schedule was followed as given in Table 4 under the growth performance study of turkeys.

Sanitization and bio-security

A strict but possible biosecurity measures were taken particularly in and around the experimental unit at BAU Poultry farm. Entrance of the personnel for example was completely prohibited to the research unit areas except the researcher. Research supervisor paid regular visit to the flock but necessary measures were also taken to avoid any disease contamination. Potassium permanganate solution was used as disinfectant in the footbath. Footbath water was removed and cleaned daily followed by refilling with fresh disinfectant solution. Furthermore, TH_4 solution was sprayed over the floor areas, side wall, litter, equipment, doorsteps and around the house. Separate plastic sandals, apron and gumboot were used during daily care and management practices. But sanitary condition was not so good under village

condition because birds were reared completely under semi-scavenging condition which frequently interrupted bio-security. During the entire experimental period there was no use of disinfectant solution and also other biosecurity measures like separate sandals, clothing were not used. In fact the turkeys were reared with other domestic birds like chicken and duck.

Data collection and record keeping

For the successful and fruitful outcome of the experiment following data were recorded during the trial period:

- Weekly average body weight
- Weekly average body weight gain
- Weekly average feed consumption
- Feed conversion ratio (FCR)
- Vaccination and medication
- Temperature (^{0}C) and humidity (%)
- Survivability

Live weight

First of all initial weight of the keets were taken. Then the keets were weighed weekly (upto 20 weeks) early in the morning before feeding using an electronic weighing scale. A plastic bucket was kept on the weighing scale and adjusted to zero before keets were kept into the bucket and the weight recorded. The weekly weight gain was then calculated from the weekly weights recorded**.**

Feed intake

Feed intake was recorded weekly until the end of the experiment i.e. 20 weeks of age.

Feed conversion ratio (FCR)

The feed conversion ratio was calculated by dividing the total feed consumption by average body weight gain.

$$\text{FCR} = \frac{\text{Feed intake of the hen}}{\text{Total live weight}}$$

Survivability

The survivability percent of the birds were calculated at the end of the experiment, dividing the number of birds alive by the total number of the keets hatched and multiplying by 100.

$$\text{Survivability \%} = \frac{\text{No. of initial live birds-No. of dead birds during the experiment}}{\text{No. of initial live birds}} \times 100$$

Statistical analysis

The recorded data were analyzed using One-way ANOVA and Independent t-test (system of rearing) procedure using 2013 software.

10.3. Analysis of economic feasibility of small scale turkey and guinea fowl rearing for poverty reduction

Analysis of economic feasibility of small scale turkey and guinea fowl rearing could not be attempted due time constraints.

11. Results and discussion

11.1. Growth performance of Black, White, Bronze and Royal Palm heritage turkeys both under intensive and semi-intensive rearing system

Table 8 and 9 shows the feed intake by turkeys (male and female birds) during the experimental period of 6-20 weeks, both under intensive and semi-intensive system of rearing.

Table 8: Feed intake by male turkeys for intensive and semi-intensive system of raring

Age (weeks)	Daily feed intake (g/bird/day)	Weekly feed intake (g/bird/week)
6	60	420
7	65	455
8	70	490
9	85	595
10	95	665
11	100	700
12	110	770
13	120	840
14	130	910
15	135	945
16	140	980
17	145	1015
18	150	1050
19	155	1085
20	160	1120
Total amount of feed (g/bird)		**12040**

Table 9: Feed intake by female turkeys for intensive and semi-intensive system of rearing

Age (weeks)	Daily feed intake (g/bird/day)	Weekly feed intake (g/bird/week)
6	55	385
7	60	420
8	65	455
9	70	490
10	75	525
11	80	560
12	85	595
13	90	630
14	95	665
15	100	700
16	105	735
17	110	770
18	115	805
19	120	840
20	125	875

A. Growth performance of male heritage turkeys

a) Under intensive system

The growth performance including weekly body weight, body weight gain and feed conversion ratio (FCR) of Black, White, Bronze and Royal Palm plumage color male heritage turkeys under intensive system fed with same diet and identical management is shown in Table 10. Significant differences ($p<.05$) in live weight among the four plumage color of heritage turkeys were observed. Results of weekly body weight showed that the Bronze color type heritage male turkey attained significantly higher body weight (4206 g/bird) followed by Black (3954 g/bird) and Royal Palm (3931 g/bird) male. The lowest live body weight however was found in White color type male (3848 g/bird) which was significantly lower than any other color types of heritage turkey. There was trend of increasing body weight in Bronze color type male during the whole experimental period.

Table 10 indicates that the live weight of Bronze male even found significantly higher in each week of rearing compared to other color types of male turkey under intensive management system at BAU Poultry Farm. The result obtained in the present study revealed that there are significant differences in live weight of different plumage color type heritage male turkeys reared in intensive system birds fed with commercial diet.

But the result disagreed with the findings of Yahya (2016), who reported that there was no significant difference among the three color types of heritage turkey namely Black, White and Bronze. However, in that particular study both male and female turkeys were reared together without considering sex difference. The final body weight of male at 20^{th} week of age was similar to the study of Ramkrishna *et al.* (2012) but lower than the reports of Karki *et al.* (2005) and Hassan *et al.* (2014). Hybrid Converter poults exhibit fast-growing traits, for example, showed as much as body weights of approximately 9644 gm at 15 weeks of age (Yilmaz *et al.,*2011), which is much higher than the body weight found in the present study. A large variety turkey such as Broad Breasted Bronze even could achieve a body weight of 10900g at 24 weeks of age (Austic and Neshein, 1990). Almost similar results were postulated by Sampath *et al.* (2012).

Table 10: Growth performance of Black, White, Bronze and Royal Palm male heritage turkeys under intensive system

Age (week)	Body weight (g/bird)					Body weight gain (g/bird)					FCR				
	Black	White	Bronze	Royal Palm	P-value	Black	White	Bronze	Royal Palm	P-value	Black	White	Bronze	Royal Palm	P-value
5	410^{b}±4.7	391^{c}±5.6	434^{a}±3.9	409^{b}±3.6	<0.001 **	-	-	-	-	-	-	-	-	-	-
6	612^{b}±6.6	595^{c}±7.2	640^{a}±5.8	631^{a}±4.4	<0.001 **	202^{b}±2.2	203^{b}±4.1	206^{b}±2.0	222^{a}±3.5	<0.001 **	2.07^{b}±0.02	2.06^{b}±0.04	2.03^{b}±0.02	1.89^{a}±0.03	<0.001 **
7	812^{b}±3.8	785^{c}±9.5	841^{a}±5.4	820^{b}±2.0	<0.001 **	199±10.0	190±3.2	200±9.0	189±6.4	.252 NS	2.29±0.13	2.39±0.04	2.27±0.10	2.40±0.08	.250 NS
8	1057^{b}±4.0	980^{d}±8.4	1094^{a}±3.6	1005^{c}±6.7	<0.001 **	245^{a}±1.3	194^{b}±2.8	253^{a}±7.5	184^{c}±5.0	<0.001 **	1.99±0.01	2.51±0.03	1.94±0.06	2.65±0.07	<0.001 **
9	1546^{b}±3.6	1472^{d}±7.6	1616^{a}±7.3	1513^{c}±16.1	<0.001 **	280^{a}±2.3	221^{c}±1.27	292^{a}±3.27	251^{b}±16.3	<0.001 **	2.11^{a}±0.02	2.69^{c}±0.02	2.03^{a}±.02	2.37^{b}±0.16	<0.001 **
10	1546^{b}±3.63	1472^{d}±7.6	1616^{a}±7.3	1513^{c}±16.1	<0.001 **	207^{d}±1.9	271^{a}±1.3	229^{c}±3.7	255^{b}±7.6	<0.001 **	3.20^{d}±0.03	2.45^{a}±0.01	2.90^{c}±0.05	2.60^{b}±0.08	<0.001 **
11	1829^{b}±5.5	1745^{d}±5.7	1905^{a}±6.6	1802^{c}±17.1	<0.001 **	282^{b}±4.6	273^{c}±2.4	288^{a}±1.0	289^{a}±1.2	<0.001 **	2.47^{b}±0.04	2.56^{c}±0.02	2.42^{a}±0.01	2.42^{a}±0.01	<0.001 **
12	2117^{b}±6.4	2014^{d}±6.5	2232^{a}±3.0	2087^{c}±10.9	<0.001 **	288^{b}±1.7	268^{c}±2.4	327^{a}±3.6	284^{b}±9.0	<0.001 **	2.67^{b}±0.02	2.86^{c}±0.03	2.35^{a}±0.03	2.70^{b}±0.08	<0.001 **
13	2381^{b}±13.8	2283^{d}±5.5	2504^{a}±6.2	2323^{c}±12.8	<0.001 **	263^{a} ±7.4	268^{a}±0.9	271^{a}±3.2	236^{b}±7.7	<0.001 **	3.19^{a}±0.09	3.12^{a}±0.01	3.10^{a}±0.03	3.55^{b}±0.11	<0.001 **
14	2627^{b}±7.6	2557^{d}±8.6	2796^{a}±3.2	2606^{c}±7.9	<0.001 **	245^{c}±6.2	273^{b}±3.6	292^{a}±4.5	284^{a}±5.1	<0.001 **	3.70^{c}±0.09	3.32^{b}±0.04	3.11^{a}±0.48	3.20^{a}±0.06	<0.001 **
15	2887^{b}±9.8	2802^{d}±7.6	3067^{a}±11.3	2865^{c}±10.6	<0.001 **	260^{b}±4.5	245^{c}±1.1	270^{a}±8.1	257^{b}±2.6	0.002 **	3.63^{b}±0.06	3.85^{c}±0.02	3.50^{a}±0.10	3.67^{b}±0.04	0.001 **
16	3102^{b}±7.4	3013^{d}±5.8	3293^{a}±6.2	3076^{c}±6.8	<0.001 **	214^{b}±2.8	211^{b}±3.4	226^{a}±5.3	211^{b}±3.7	0.004 **	4.57^{b}±0.06	4.65^{b}±0.08	4.32^{a}±0.10	4.64^{b}±0.08	0.004 **
17	3312^{b}±5.8	3243^{c}±12.3	3526^{a}±6.3	3302^{b}±12.1	<0.001 **	209^{b}±2.3	229^{a}±7.5	232^{a}±4.0	225^{a}±5.7	0.003 **	4.83^{b}±0.06	4.43^{a}±0.15	4.36^{a}±0.08	4.49^{a}±0.11	0.002 **
18	3528^{b}±7.4	3455^{c}±10.9	3764^{a}±9.3	3516^{b}±12.2	<0.001 **	216^{b}±1.9	211^{b}±1.5	237^{a}±3.0	214^{b}±6.2	<0.001 **	4.85^{b}±0.04	4.95^{b}±0.04	4.41^{a}±0.06	4.90^{b}±0.14	<0.001 **
19	3741^{b}±9.7	3645^{d}±5.9	3981^{a}±6.0	3723^{c}±11.1	<0.001 **	212^{ab}±3.2	190^{c}±5.0	216^{a}±3.3	207^{b}±1.8	<0.001 **	5.10^{ab}±0.08	5.70^{c}±0.15	5.00^{a}±0.08	5.24^{b}±0.03	<0.001 **
20	3954^{b}±11.5	3848^{c}±16.0	4206^{a}±8.1	3931^{b}±14.6	<0.001 **	213^{b}±1.8	203^{b}±10.4	225^{a}±2.1	207^{b}±3.9	0.008 **	5.24^{ab}±0.05	5.51^{b}±0.28	4.97^{a}±0.05	5.39^{b}±0.10	0.012 *

*^{a,b,c,d}Means bearing uncommon superscripts in a row differ significantly. **, P<0.01; *, P<0.05; NS (Non-significant), P>0.05; BW= Body weight, BWG= Body weight gain, FCR= Feed conversion ratio and value indicate- Mean± Standard Deviation (SD)*

Table 10 also shows that the weekly body weight gain was higher during 8-15 weeks of age and the value of FCR in first couple of week was better than the remaining period. These results also resembled with the published reports of Isguzar (2003) and Hassan *et al.* (2014).

The Figure 1 shows the final body weight gain of four color type male heritage turkey under intensive management system. Among the four color types of Bronze male attained the highest (3772 g) body weight gain followed Black (3544 g) and Royal Palm (3522 g).

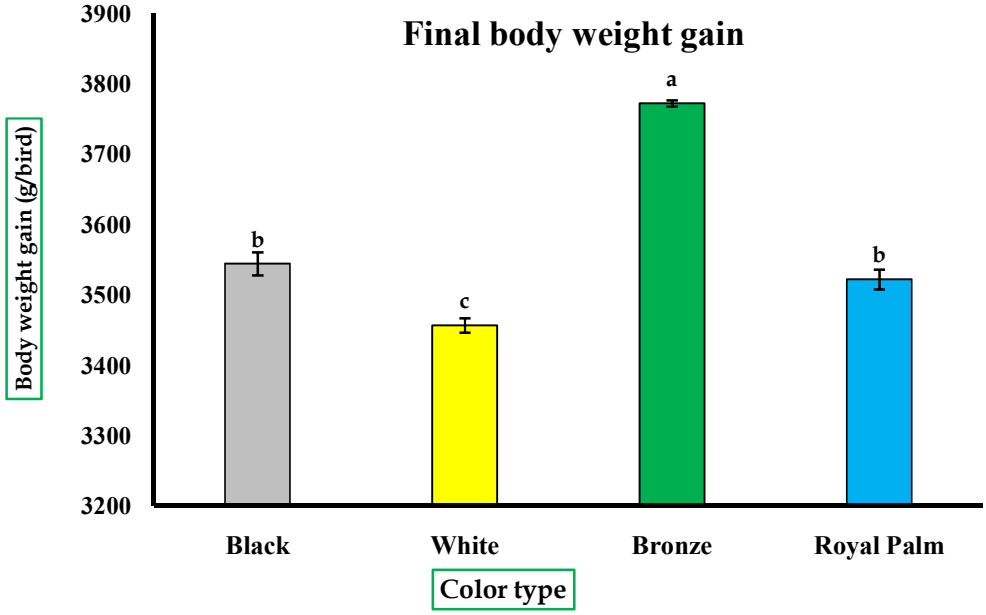

Figure 1: Final body weight gain of four heritage male turkeys under intensive system

The lowest body weight gain was observed in White color male turkey under intensive system. Results, which were found from the current study indicated that the body weight gain was similar with the report of Karki *et al.* (2005) but lower than the results of Yilmaz *et al.* (2011) and Hassan *et al.* (2014).

Figure 2 represents the FCR of four color types of male heritage turkeys reared under intensive system at BAU Poultry Farm. Results obtained from the experiment showed that the lowest value of FCR was found in Bronze (3.19) suggesting that the Bronze color type male birds utilize feed efficiently as compared to any other types of turkey. The FCR of the Black, Royal Palm and White turkeys were 3.40, 3.41 and 3.48 respectively. The similar result also founded by Yahya (2016), who mentioned the better FCR in Bronze followed by Black and White. Ahmed *et al.* (2009) also observed that the cumulative FCR value of tom was 3.4 at 20th week of age. The feed conversion ratio of turkey was very high and tends to increase from 1.3 to 3.4 as it grows (Sampath *et al.,* 2012).

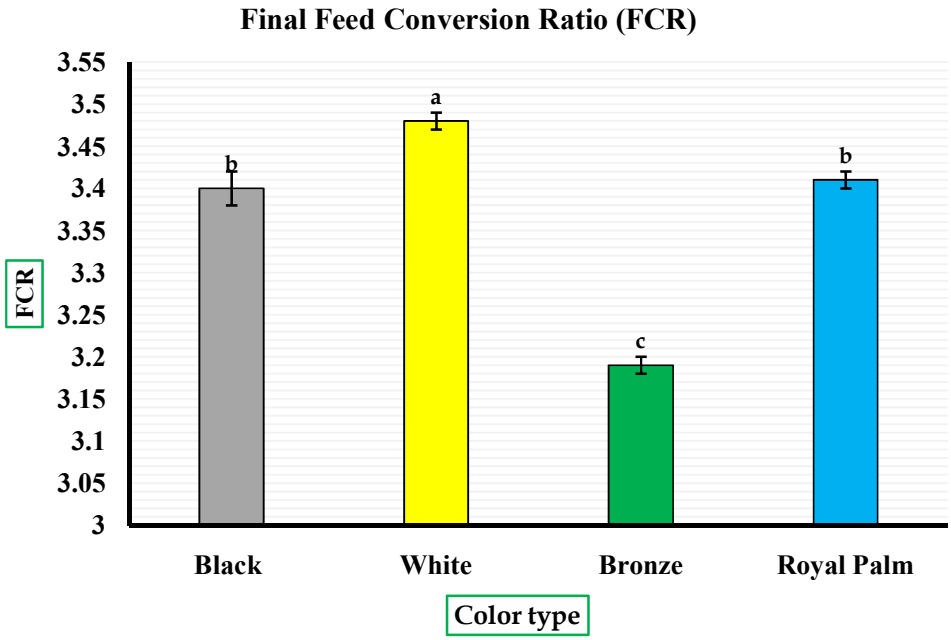

Figure 2: Final FCR of four heritage male turkeys under intensive system

However, Waibel *et al.* (2000) carried out an experiment at University of Minnesota on large white male turkey up to 20 weeks of age and observed feed to gain ratio of 2.729. Elibol *et al.* (2007) found a higher value of FCR for American Bronze turkeys (3.24) than that for the other two genetic groups, Large White (2.63) and their F1 generation (3.11) for a period of 3–8 weeks period.

b) Under semi-intensive system

The growth performance such as weekly body weight, body weight gain and FCR of Black, White, Bronze and Royal Palm plumage color male heritage turkeys under semi-intensive system fed the same commercial diet in addition to outdoor access of pasturing is shown in Table 11. Significant differences ($p<.05$) were found in live body weight among the four types of heritage turkeys studied. The weekly body weight of Bronze color type heritage male turkey was significantly higher (4433g/bird) followed by Royal Palm (4248g/bird) and Black (4171g/bird) male.

Table 11: Growth performance of Black, White, Bronze and Royal Palm male heritage turkeys under semi-intensive system

Age (week)	Body weight (g/bird)					Body weight gain (g/bird)					FCR				
	Black	White	Bronze	Royal Palm	P-value	Black	White	Bronze	Royal Palm	P-value	Black	White	Bronze	Royal Palm	P-value
5	412^{b}±7.9	392^{c}±2.9	436^{a}±4.1	411^{b}±5.3	<0.001 **	-	-	-	-	-	-	-	-	-	-
6	623^{b}±8.0	599^{c}±2.5	652^{a}±7.8	631^{b}±7.0	<0.001 **	211^{b}±0.6	207^{b}±1.3	216^{a}±3.9	219^{a}±1.9	0.001 **	1.99^{b}±0.01	2.03^{b}±0.01	1.93^{a}±0.04	1.91^{a}±0.02	0.001 **
7	832^{b}±7.7	801^{c}±3.3	865^{a}±6.5	839^{b}±8.1	<0.001 **	208^{b}±1.1	202^{c}±1.6	212^{a}±1.3	207^{b}±1.1	<0.001 **	2.18^{b}±0.01	2.25^{c}±0.02	2.14^{a}±0.01	2.19^{b}±0.01	<0.001 **
8	1081^{b}±8.7	998^{c}±6.4	1126^{a}±6.4	$1086.^{b}$±6.8	<0.001 **	248^{b}±1.4	196^{c}±3.4	260^{a}±0.7	247^{b}±1.7	<0.001 **	1.97^{b}±0.01	2.50^{c}±0.04	1.88^{a}±0.01	1.98^{b}±0.01	<0.001 **
9	1366^{b}±6.77	1224^{c}±10.9	1425^{a}±6.7	1362^{b}±6.2	<0.001 **	285^{b}±2.4	226^{d}±6.3	299^{a}±0.6	276^{c}±1.2	<0.001 **	2.09^{b}±0.02	2.62^{c}±0.07	1.99^{a}±.00	2.15^{b}±0.01	<0.001 **
10	1587^{b}±9.33	1492^{c}±13.5	1657^{a}±9.6	1586^{b}±13.3	<0.001 **	221^{c}±2.8	267^{a}±3.0	$232.^{b}$±3.0	223^{bc}±7.6	<0.001 **	3.00^{c}±0.04	2.49^{a}±0.03	2.86^{b} ±0.04	2.97^{bc}±0.10	<0.001 **
11	1876^{b}±8.1	1770^{c}±15.0	1955^{a}±13.6	1880^{b}±12.9	<0.001 **	288^{b}±2.3	278^{c}±2.3	297^{a}±4.1	294^{a}±0.5	<0.001 **	2.42^{b}±0.02	2.51^{c}±0.02	2.36^{a}±0.03	2.38^{a}±0.01	<0.001 **
12	2168^{b}±9.71	2046^{c}±12.3	2290^{a}±13.1	2177^{b}±12.7	<0.001 **	292^{c}±1.5	275^{d}±2.9	335^{a}±0.8	296^{b}±0.7	<0.001 **	2.63^{b}±0.01	2.79^{c}±0.03	2.29^{a}±0.01	2.60^{b}±0.01	<0.001 **
13	2446^{b}±10.1	2321^{c}±11.0	2570^{a}±10.9	2443^{b}±12.2	<0.001 **	277^{ab}±1.4	275^{b}±1.4	279^{a}±2.5	266^{c}±1.7	<0.001 **	3.02^{ab}±0.02	3.04^{b}±0.01	3.00^{a}±0.03	3.15^{c}±0.02	<0.001 **
14	2703^{c}±11.3	2607^{d}±10.9	2866^{a}±8.3	2739^{b}±13.5	<0.001 **	257^{c}±2.4	285^{b}±1.9	296^{a}±2.8	295^{a}±1.6	<0.001 **	3.54^{c}±0.03	3.19^{b}±0.02	3.07^{a}±0.03	3.08^{a}±0.02	<0.001 **
15	2970^{c}±9.7	2863^{d}±13.4	3154^{a}±5.0	3018^{b}±11.2	<0.001 **	267^{c}±2.2	256^{d}±2.4	288^{a}±4.5	278^{b}±2.8	<0.001 **	3.54^{c}±0.03	3.69^{d}±0.04	3.28^{a}±0.05	3.39^{b}±0.03	<0.001 **
16	3217^{c}±14.7	3090^{d}±16.6	3418^{a}±10.4	3269^{b}±12.6	<0.001 **	246^{b}±5.1	227^{c}±5.1	263^{a}±5.9	251^{b}±3.3	<0.001 **	3.98^{b}±0.08	4.32^{c}±0.10	3.72^{a}±0.08	3.90^{b}±0.05	<0.001 **
17	3470^{c}±13.5	3344^{d}±19.2	3686^{a}±8.4	3525^{b}±16.6	<0.001 **	253^{b}±1.6	254^{b}±7.6	267^{a}±2.0	255^{b}±4.2	0.014 *	4.01^{b}±0.03	3.99^{b}±0.12	3.79^{a}±0.03	3.97^{b}±0.07	0.017 *
18	3712^{c}±14.7	3578^{d}±21.1	3945^{a}±13.2	3774^{b}±17.3	<0.001 **	242^{c}±1.5	234^{d}±1.9	259^{a}±4.8	249^{b}±2.9	<0.001 **	4.33^{c}±0.03	4.48^{d}±0.04	4.05^{a}±0.08	4.20^{b}±0.05	<0.001 **
19	3951^{c}±16.1	3790^{d}±23.8	4203^{a}±15.3	4023^{b}±16.6	<0.001 **	238^{c}±1.6	211^{d}±2.7	257^{a}±3.5	248^{b}±2.4	<0.001 **	4.54^{c}±0.03	5.12^{d}±0.07	4.21^{a}±0.06	4.37^{b}±0.04	<0.001 **
20	4171^{c}±11.6	3994^{d}±24.6	4433^{a}±10.6	4248^{b}±17.7	<0.001 **	219^{b}±4.9	204^{c}±2.9	230^{a}±4.7	225^{ab}±2.2	<0.001 **	5.10^{b}±0.11	5.49^{c}±0.08	4.87^{a}±0.10	4.96^{ab}±0.05	<0.001 **

The lowest live body weight however was found in White color type male (3994 g/bird) which was significantly lower than any other plumage color type male birds. Through the entire experimental period, there was a trend of increasing body weight in Bronze color type male heritage turkey. Table 11 indicates that the Bronze male gained significantly higher live body weight even in each week of rearing compared to other color types of male birds under semi-intensive management system. The result obtained in the present study indicates that there were significant differences in live body weight of different plumage color type heritage male turkeys reared in semi-intensive system supplementation with commercial diet and outdoor access for green grass, water hyacinth, kolmishak, helencha etc. Similar findings were also reported by Hassan *et al.* (2014), who demonstrated that the semi-intensive system showed better result in terms of body weight and profitability. The body weight of male at 20th week of age obtained from the present study was similar to the published research report of Ramkrishna *et al.* (2012). The result of final body weight of the current study was lower than the report of Isguzar (2002), who found the mean body weight of White turkeys to be 18600 g at the end of 18 weeks due to longer fattening period. Elibol *et al.* (2007) conducted an experiment and showed that the Large White, Bronze and their F1 generation attained a body weight of 16062 g, 6920 g and 9737 g respectively for male. According to Ajala *et al.* (2007), male turkeys typically weigh from 11900 g to 14700 g between 17 and 20 weeks of age.

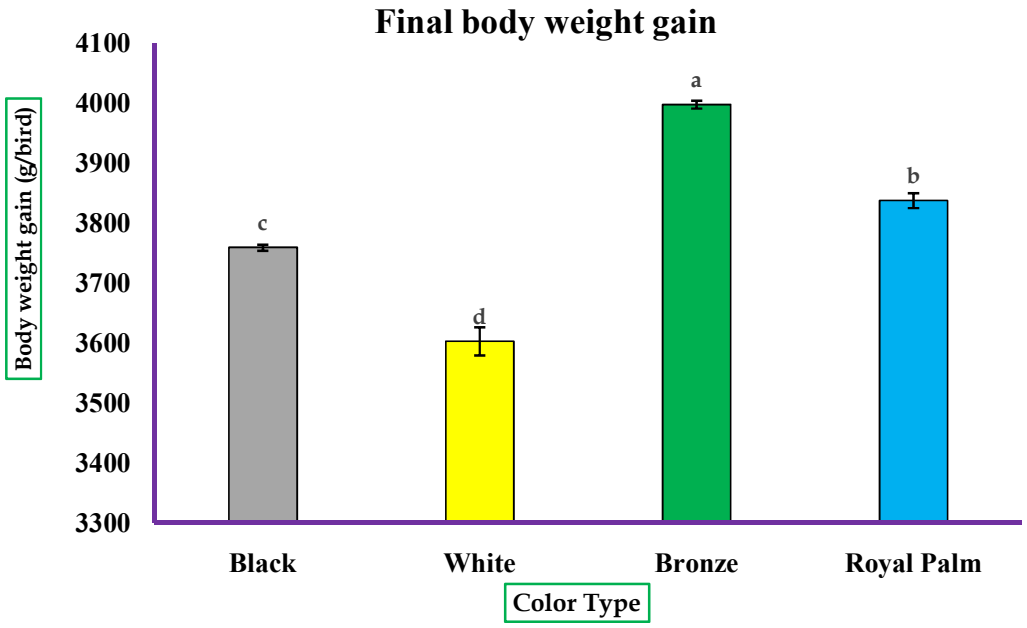

Figure 3: Final body weight gain of four heritage male turkeys under semi-intensive system

Figure 3 indicates the final body weight gain of four color type male heritage turkeys under semi-intensive management system. Among the four color types of male turkey, Bronze attained the highest body weight gain (3997g/bird) followed Royal Palm (3837g/bird) and Black (3758g/bird) in 5-20 weeks of rearing period. However, the lowest body weight gain was observed in White male (3602 g/bird). Yilmaz *et al.* (2011) conducted an experiment on Hybrid Converter poults and observed that the average body weight gain from 7-105 days to be 96.89 g.

Figure 4 shows the FCR of four color types of male heritage turkey reared under semi-intensive system. The results obtained from the experiment showed that the lower value of FCR was found in Bronze (3.01) followed by Royal Palm (3.13) and Black (3.20).

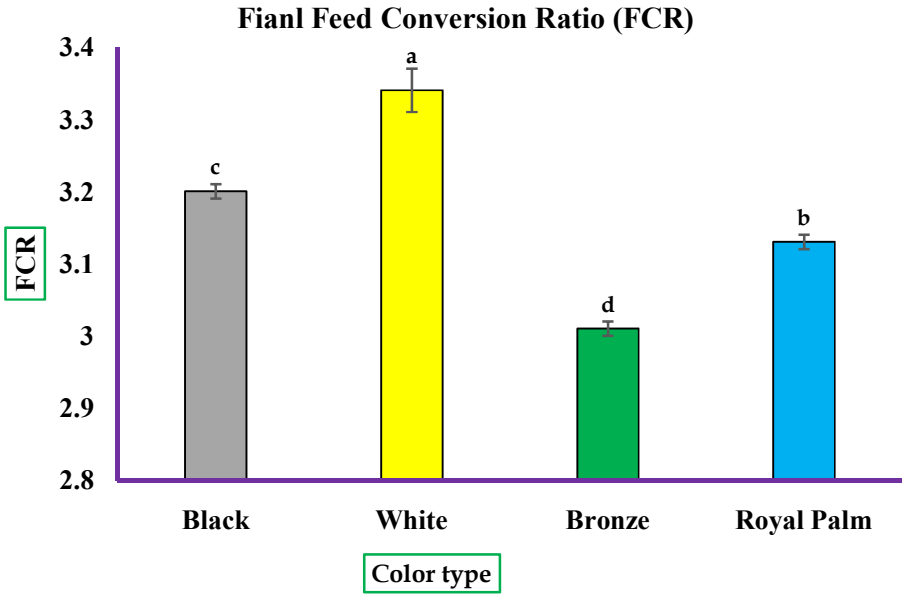

Figure 4: Final FCR of four heritage male turkeys under semi-intensive system

The highest FCR value was however observed in White male (3.34). The result obtained from the study was similar to research report of Yahya (2016), who found that the lower FCR value in Bronze followed by Black and white color types of heritage turkey. According to Sampath *et al.* (2012), the feed conversion ratio of turkey was very high and tends to increase from 1.3 to 3.4 as it grows due to higher feed consumption and slower growth rate.

B. Growth performance of female heritage turkeys

a) Under intensive system

The growth performance and FCR of Black, White, Bronze and Royal Palm plumage color female heritage turkeys under intensive system fed the same diet and identical management are shown in Table 12. The live body weights differed significantly ($p<.05$) among the four plumage color of heritage turkeys. Results of weekly body weight at 20^{th} week of age showed that the Bronze color type heritage female turkey gained significantly higher body weight (2626g/bird) followed by Black (2556 g/bird) and Royal Palm (2538g/bird) female. The lowest live body weight however was found in White color type female (2461g/bird) which was significantly lower than any other color types. The Bronze color type female heritage turkey showed a trend of increasing body weight during the whole experimental period. The weekly body weight shown in the Table 12 also indicates that the weekly live body weight gain also differed ($p<.05$) in the entire experimental period. Not only body weight but also weekly weight gain was better and also feed conversion ratio value was lower in Bronze female turkey under intensive system in all weeks except 6^{th}, 9^{th} and 15^{th} week of age where no significant difference was observed in terms of body weight gain and FCR values. The results obtained from the current study was not similar to the research report of Ajala *et al.* (2007), who found that the turkey hen attained a body weight of 6700 g to 7900 g between 14 and 16 weeks of age respectively. Whereas, Amirkhanov *et al.* (2017), observed that the live weight of hens up to 4 months of age, typically to exceed 6000 g.

Figure 5 shows the body weight gain of four color type female heritage turkey under intensive management system. Among the four-color types of female turkey, Bronze gained the highest body weight gain (2320g/bird) followed Black (2258g/bird) and Royal Palm (2255g/bird).

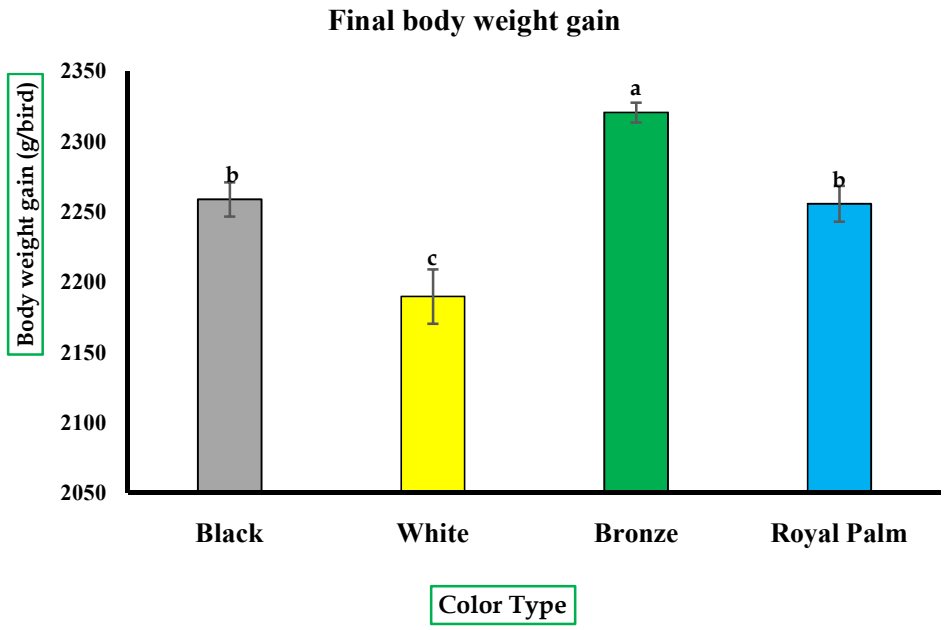

Figure 5: Final body weight gain of four heritage female turkeys under intensive system

The lowest body weight gain however, was observed in White (2189 g/bird). The result of body weight gain obtained from the present study was lower than the published research work of Karki (2005), who, postulated that the female turkey weigh 3245 g/bird at 0-20 weeks of age. Furthermore, Elizabeth *et al.* (2013) found that female turkey gains a body weight of 3852 g when fed *ad-libitum* basis.

Table 12: Growth performance of Black, White, Bronze and Royal Palm female heritage turkeys under intensive system

Age (week)	Body weight (g/bird)					Body weight gain (g/bird)					FCR				
	Black	White	Bronze	Royal Palm	P-value	Black	White	Bronze	Royal Palm	P-value	Black	White	Bronze	Royal Palm	P-value
5	297^{a}±5.7	271^{c}±6.5	306^{a}±6.8	282^{b}±3.3	<0.001 **	-	-	-	-	-	-	-	-	-	-
6	401^{a}±4.1	374^{c}±3.7	409^{a}±8.0	388^{b}±6.8	<0.001 **	104±4.8	103±3.1	103±1.9	105±4.8	0.839 NS	3.70± 0.17	3.73±0.12	3.71±0.07	3.64±0.16	0.848 NS
7	573^{b}±5.2	552^{c}±3.5	585^{a}±5.1	578^{ab}±4.6	<0.001 **	171^{b}±7.8	177^{b}±3.6	175^{b}±2.8	189^{a}±5.0	0.016 *	2.45^{b}±0.11	2.36^{b}±0.05	2.39^{b}±0.04	2.22^{a}±0.06	0.021 *
8	719^{b}±4.7	694^{c}±7.4	737^{a}±7.3	721^{b}±3.3	<0.001 **	145^{ab}±5.5	142^{c}±4.5	152^{a}±2.2	143^{ab}±1.1	0.114 NS	3.13±0.16	3.19±0.10	2.99±0.05	3.17±0.02	0.120 NS
9	829^{b}±4.5	803^{c}±7.4	848^{a}±5.2	826^{b}±9.8	<0.001 **	110±1.6	108±2.5	110±2.1	104±7.6	0.316 NS	4.42±0.07	4.53±0.11	4.42±0.09	4.69±0.35	0.328 NS
10	937^{ab}±4.1	911^{c}±10.7	950^{a}±4.8	934^{b}±7.7	0.001 **	107^{a}±2.3	108^{a}±3.4	102^{b}±0.6	107^{a}±2.2	0.037 *	4.90^{a}±0.11	4.83^{a}±0.15	5.14^{b}±0.03	4.87^{a}±0.10	0.027 *
11	1051^{b}±8.3	1019^{c}±12.5	1074^{a}±7.1	1051^{b}±10.8	0.001 **	114^{b}±4.2	107^{c}±2.2	123^{a}±2.2	117^{b}±3.2	0.001 **	4.89^{b}±0.18	5.22^{c}±0.11	4.54^{a}±0.08	4.77^{ab}±0.13	0.001 **
12	1226^{b}±10.3	1181^{c}±14.3	1263^{a}±7.0	1225^{b}±13.3	<0.001 **	174^{b}±2.0	162^{c}±2.3	189^{a}±0.8	173^{b}±2.5	<0.001 **	3.41^{b}±0.04	3.66^{c}±0.05	3.14^{a}±0.01	3.42^{b}±0.05	<0.001 **
13	1404^{b}±3.6	1348^{c}±14.0	1444^{a}±11.5	1398^{b}±12.4	<0.001 **	178^{ab}±3.9	167^{c}±1.9	180^{a}±4.5	173^{b}±1.0	<0.001 **	3.61^{b}±0.04	3.88^{c}±0.05	3.32^{a}±0.01	3.62^{b}±0.05	<0.001 **
14	1566^{b}±5.5	1503^{c}±12.3	1617^{a}±10.5	1557^{b}±10.2	<0.001 **	162^{b}±1.2	155^{d}±1.8	173^{a}±1.0	158^{c}±2.1	<0.001 **	4.10^{b}±0.03	4.29^{d}±0.05	3.84^{a}±0.02	4.20^{c}±0.06	<0.001 **
15	1734^{b}±5.2	1666^{c}±9.9	1785^{a}±10.9	1723^{b}±10.3	<0.001 **	167±3.4	162±2.6	167±2.2	165±1.3	0.151 NS	4.17±0.09	4.29±0.07	4.18±0.06	4.22±0.03	0.148 NS
16	1889^{b}±5.8	1825^{c}±11.1	1950^{a}±10.6	1885^{b}±11.7	<0.001 **	163^{a}±1.2	158^{b}±1.2	165^{a}±1.0	162^{a}±1.9	0.003 **	4.50^{a}±0.03	4.63^{b}±0.03	4.45^{a}±0.03	4.51^{a}±0.05	0.003 **
17	2060^{b}±6.5	1982^{c}±12.1	2118^{a}±10.8	2050^{b}±12.6	<0.001 **	162^{b}±1.5	156^{c}±1.3	168^{a}±0.3	164^{b}±1.0	<0.001 **	4.73^{b}±0.05	4.91^{c}±0.04	4.58^{a}±0.00	4.68^{b}±0.03	<0.001 **
18	2227^{b}±5.2	2144^{c}±13.5	2290^{a}±10.9	2212^{b}±13.3	<0.001 **	166^{b}±1.4	162^{c}±1.5	172^{a}±1.0	162^{c}±0.6	<0.001 **	4.83^{b}±0.04	4.97^{c}±0.05	4.67^{a}±0.03	4.95^{c}±0.02	<0.001 **
19	2397^{b}±5.9	2306^{c}±12.6	2463^{a}±12.5	2376^{b}±14.8	<0.001 **	170^{a}±0.2	162^{b}±1.5	172^{a}±1.9	163^{b}±1.5	<0.001 **	4.94^{a}±0.03	5.17^{b}±0.05	4.86^{a}±0.05	5.13^{b}±0.05	<0.001 **
20	2556^{b}±6.9	2461^{c}±15.1	2626^{a}±13.6	2538^{b}±14.8	<0.001 **	158^{b}±1.3	154^{c}±2.5	162^{a}±1.3	161^{ab}±0.0	<0.001 **	5.52^{b}±0.05	5.68^{c}±0.09	5.37^{a}±0.04	5.42^{ab}±0.00	0.001 **

*^{a,b,c,d}Means bearing uncommon superscripts in a row differ significantly. **, P<0.01; *, P<0.05; NS (Non-significant), P>0.05; BW= Body weight, BWG= Body weight gain, FCR= Feed conversion ratio and value indicate- Mean± Standard Deviation (SD)*

The FCR of four color types of female heritage turkey reared under intensive system at BAU Poultry Farm is shown in the figure 6. The results obtained from the present experiment revealed that the lower FCR value was in Bronze (4.07) followed by Black (4.18) and Royal Palm (4.19). The higher value of FCR however, observed in White plumage color turkey (4.32).

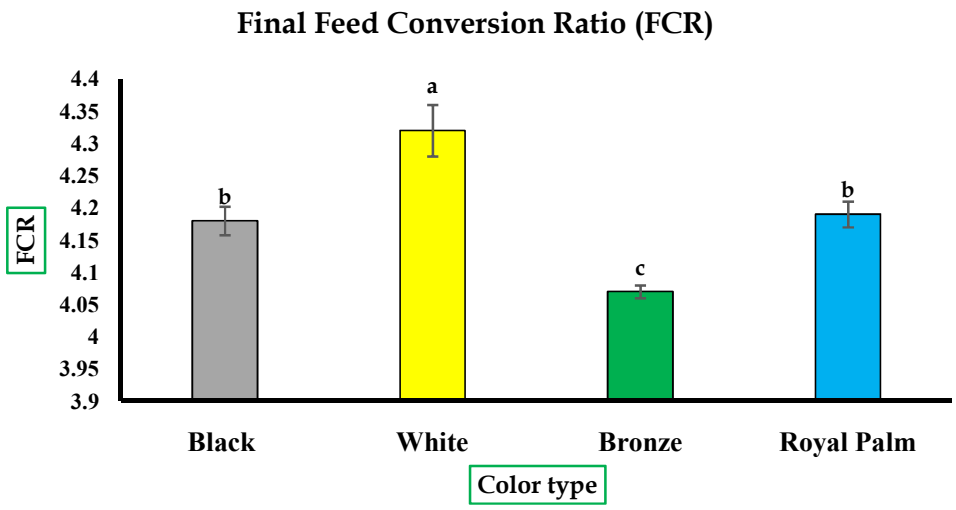

Figure 6: Final FCR of four heritage female turkeys under intensive system

The result obtained from the study is better than the report of Karki (2005), who found the FCR value of female turkey to be 5.337 at 20 week of age but higher than the published research work of Laudadio *et al.* (2009), the FCR value of Nicholas Large White females was 2.98 for the period between 31 and 114 days of age.

b) Under semi-intensive system

The growth performance and FCR of female heritage turkeys under semi-intensive system supplemented with same commercial diet, and outdoor access for pasturing shown in Table 13. The analysis of live body weights revealed a statistically significant difference ($p<.05$) among the four plumage color types of heritage turkeys. The results obtained from the present study showed that the Bronze color type heritage female turkey gained significantly higher body weight (2699g/bird) followed by Black (2601 g/bird) and Royal Palm (2594g/bird) female at 20th weeks of age. However, the lowest live body weight was found in White color type female (2534 g/bird) which was significantly lower than any other color types in the present study. Among the four plumage color types, the Bronze color type female heritage turkey showed a trend of increasing body weight during the whole experimental period. The Bronze color type of female turkey not only showed better body weight but also the weekly body weight gain, feed conversion ratio was better in Bronze female turkey under intensive system in all weeks except 6th and 8th week of age, when no significant difference was observed in terms of body weight gain and FCR. The weekly average body weight gain of Black, White, Bronze and Royal palm turkey under semi-intensive system were 153.5 g/bird, 150.1 g/bird, 159.4 g/bird and 154.17 g/bird respectively. However, Karki (2005) observed that average weekly body weight gain of female turkey to be 166.67 g/bird. Adikari *et al.* (2016) furthermore, found the weekly average body weight gain to be 343 g/bird in Bronze female turkey.

Figure 7 represents the body weight gain of four color type female heritage turkey under semi-intensive management system. The result achieved from the present study, showed that the Bronze color type female turkey attained higher body weight 2391 g/bird followed by Royal Palm (2312 g/bird) and Black (2303 g/bird) female turkey. However, the White plumage color of heritage female turkey attained

lowest body weight gain 2250 g/bird. Adikari *et al.* (2016) found the White Holland female bird to attain 5355 g/bird. Additionally, Singh and Moore (1972) observed a slow growth and poor feed efficiency for small variety turkey.

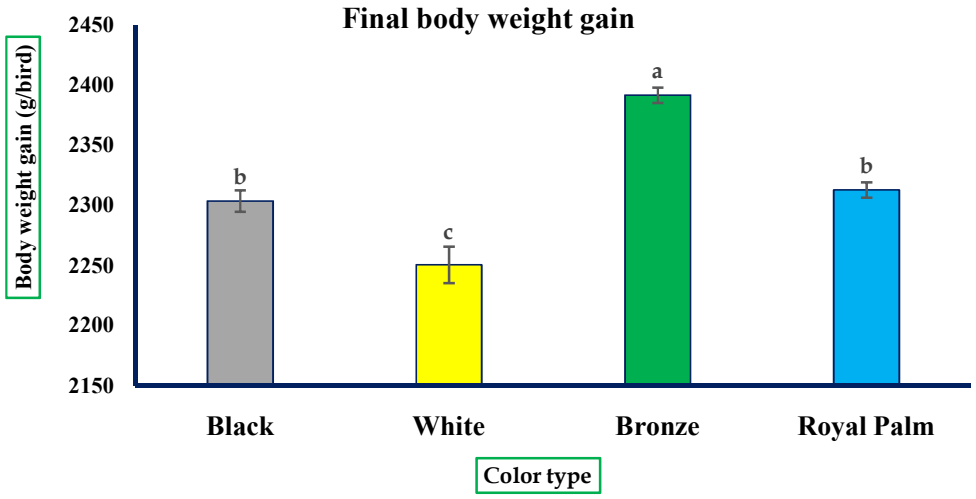

Figure 7: Final body weight gain of four heritage female turkeys under semi-intensive raring system

Table 13: Growth performance of Black, White, Bronze and Royal Palm female heritage turkeys under semi-intensive system

Age (week)	Body weight (g/bird)					Body weight gain (g/bird)					FCR				
	Black	White	Bronze	Royal Palm	P-value	Black	White	Bronze	Royal Palm	P-value	Black	White	Bronze	Royal Palm	P-value
5	298^{ab}±5.0	284^{b}±15.6	308^{a}±5.9	281^{b}±5.9	0.025 *	-	-	-	-	-	-	-	-	-	-
6	401^{ab}±6.5	387^{b}±14.7	415^{a}±6.2	385^{b}±5.7	0.014 *	103.±4.3	103±0.9	106±3.6	103±1.40	0.456 NS	3.73±0.16	3.71±0.03	3.60±0.12	3.71±0.05	0.472 NS
7	578^{a}±1.6	556^{b}±13.9	594^{a}±4.8	582^{a}±5.9	0.003 **	177^{b}±6.3	168^{c}±4.5	178^{b}±1.5	196^{a}±0.3	<0.001 **	2.37^{b}±0.08	2.49^{c}±0.07	2.35^{b}±0.02	2.14^{a}±0.00	<0.001 **
8	730^{b}±4.5	712^{c}±4.1	750^{a}±8.1	728^{b}±6.7	<0.001 **	151±2.9	155±12.1	156±3.2	145±1.0	0.247 NS	3.00±0.06	2.94±0.22	2.91±0.06	3.12±0.02	0.206 NS
9	839^{b}±4.0	812^{d}±2.7	862^{a}±2.3	832^{c}±3.7	<0.001 **	109^{a}±1.2	100^{b}±2.1	111^{a}±5.7	104^{ab}±3.3	0.019 *	4.47^{a}±0.05	4.88^{b}±0.11	4.39^{a}±0.23	4.68^{ab}±0.15	0.014 *
10	944^{b}±4.9	929^{c}±3.1	972^{a}±3.3	939^{bc}±8.3	<0.001 **	104^{b}±0.9	116^{a}±0.5	109^{b}±2.6	106^{b}±4.5	0.003 **	5.00^{b}±0.04	4.50^{a}±0.02	4.78^{b}±0.12	4.94^{b}±0.21	0.004 **
11	1062^{b}±9.4	1041^{c}±4.6	1102^{a}±4.4	1064^{b}±10.8	<0.001 **	117^{b}±4.5	111^{b}±1.5	130^{a}±2.3	125^{a}±5.3	0.001 **	4.78^{b}±0.19	5.02^{b}±0.07	4.31^{a}±0.08	4.48^{a}±0.19	0.001 **
12	1243^{b}±10.3	1214^{c}±6.2	1296^{a}±2.9	1243^{b}±8.8	<0.001 **	180^{b}±1.3	173^{c}±1.6	193^{a}±2.4	179^{b}±1.9	<0.001 **	3.29^{b}±0.02	3.43^{c}±0.03	3.07^{a}±0.04	3.32^{b}±0.04	<0.001 **
13	1424^{b}±11.9	1384^{c}±5.7	1483^{a}±3.8	1420^{b}±10.0	<0.001 **	181^{b}±1.6	170^{d}±1.3	187^{a}±1.0	176^{c}±1.2	<0.001 **	3.48^{b}±0.03	3.63^{c}±0.03	3.25^{a}±0.04	3.52^{b}±0.04	<0.001 **
14	1592^{b}±12.3	1551^{c}±9.3	1660^{a}±3.9	1585^{b}±13.6	<0.001 **	168^{b}±1.1	166^{b}±3.9	176^{a}±1.2	165^{b}±3.5	0.004 **	3.94^{b}±0.03	3.99^{b}±0.10	3.76^{a}±0.03	4.03^{b}±0.09	0.006 **
15	1765^{b}±13.4	1718^{c}±8.4	1834^{a}±4.2	1756^{b}±12.6	<0.001 **	172^{b}±1.2	166^{c}±1.1	173^{a}±0.7	170^{a}±0.9	<0.001 **	4.06^{a}±0.03	4.20^{c}±0.03	4.03^{a}±0.02	4.11^{b}±0.02	<0.001 **
16	1931^{b}±14.3	1881^{c}±7.8	2003^{a}±4.7	1922^{b}±13.2	<0.001 **	166^{b}±1.2	163^{c}±0.7	169^{a}±0.6	166^{b}±1.3	0.001 **	4.41^{b}±0.03	4.50^{c}±0.02	4.34^{a}±0.02	4.42^{b}±0.04	0.001 **
17	2098^{b}±14.3	2042^{c}±8.3	2177^{a}±6.4	2091^{b}±13.0	<0.001 **	167^{b}±0.0	160^{c}±0.4	173^{a}±2.0	168^{b}±0.5	<0.001 **	4.60^{b}±0.00	4.79^{c}±0.01	4.43^{a}±0.05	4.56^{b}±0.01	<0.001 **
18	2267^{b}±13.3	2207^{c}±9.8	2354^{a}±6.2	2259^{b}±13.6	<0.001 **	169^{b}±1.0	165^{c}±1.5	176^{a}±1.0	168^{b}±0.9	<0.001 **	4.76^{b}±0.03	4.86^{c}±0.04	4.57^{a}±0.03	4.78^{b}±0.03	<0.001 **
19	2439^{b}±11.6	2375^{c}±10.0	2530^{a}±5.9	2426^{b}±12.9	<0.001 **	171^{a}±1.7	167^{b}±0.6	176^{a}±0.8	167^{b}±0.6	<0.001 **	4.89^{b}±0.05	5.02^{c}±0.02	4.77^{a}±0.02	5.02^{c}±0.02	<0.001 **
20	2601^{b}±10.6	2534^{c}±11.1	2699^{a}±7.1	2594^{b}±12.3	<0.001 **	161^{b}±1.2	159^{b}±2.0	169^{a}±1.4	167^{a}±0.9	<0.001 **	5.41^{b}±0.04	5.50^{b}±0.07	5.16^{a}±0.04	5.22^{a}±0.03	<0.001 **

*a,b,c,d Means bearing uncommon superscripts in a row differ significantly. **, P<0.01; *, P<0.05; NS (Non-significant), P>0.05; BW= Body weight, BWG= Body weight gain, FCR= Feed conversion ratio and value indicate- Mean± Standard Deviation (SD)*

Figure 8 shows the FCR of four heritage female turkeys under semi-intensive system. The result obtained from the present study shows that the Bronze color type female turkey had lower FCR value (3.95) as compared to Royal Palm (4.09) and Black (4.10). However, the FCR value of White plumage color female turkey under semi-intensive system was higher (4.20) than the other color types, which may be due to poor feed efficiency.

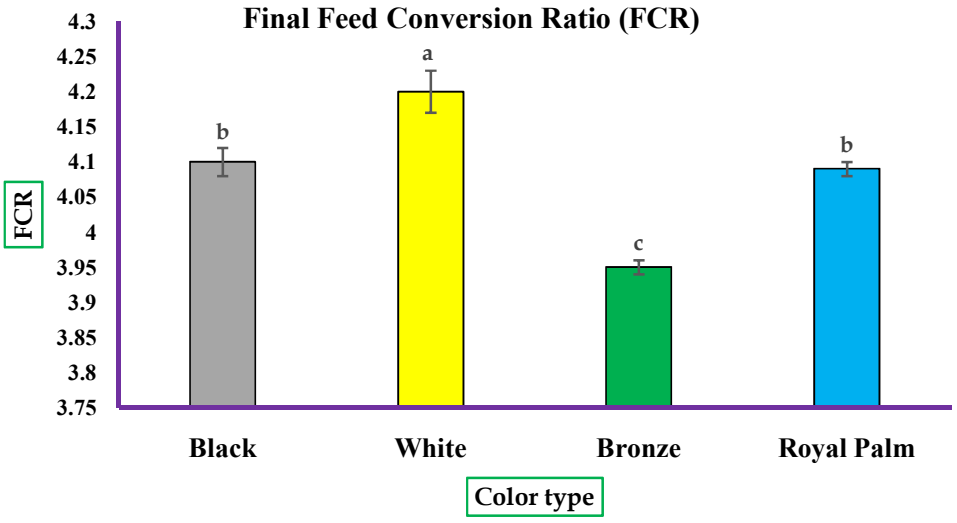

Figure 8: Final FCR of four heritage female turkeys under semi-intensive system

C. Comparison of growth performances of male turkeys between intensive and semi-intensive system of rearing

a) Black male heritage turkey

The comparison of growth performance including weekly live body weight, live weight gain, feed conversion ratio (FCR) and also final body weight and FCR of Black plumage color type male heritage turkey between intensive and semi-intensive system of rearing is shown in the Table 14. The weekly body weight of Black male heritage turkey significantly differed ($p<0.05$) in both system in all weeks except first two (5^{th} and 6^{th}) weeks. The results indicate that the Black male heritage turkey under semi-intensive system attained higher body weight in all weeks and at 20 weeks of age the final body weight was 3954 g/bird and 4171 g/bird under intensive and semi-intensive system respectively. Table 16 also indicates that the weekly body weight gain of Black male heritage turkey under semi-intensive system was better than intensive system in all weeks except 7^{th}, 8^{th}, 9^{th}, 15^{th} and 20^{th} weeks where no significant differences were observed. But, in case of final body weight gain significant differences were observed between intensive system and the semi-intensive system of rearing and the semi-intensive system showed the best result in terms of body weight gain (3758 g/bird) as compared to intensive system (3544 g/bird).

The Black male under semi-intensive system showed increasing trend of body weight and body weight gain. Those attributes may be due to the outdoor access of pasturing, low stocking density better care and management. When considered the FCR, there was a significant difference in two rearing systems. The semi-intensive system showed better result than the intensive system in all weeks except 7^{th} and 9^{th}week of age. In both system, FCR of initial couple of weeks were lower but with the passage of time the FCR increased due to higher feed consumption and relatively lower growth rate and this result also resembled with the study of Sampath *et al.* (2012) who observed that the feed conversion ratio of turkey was very high and tends to increase from 1.3 to 3.4 as the birds continue to grow. However, the final FCR obtained from intensive and semi-intensive system were 3.40 and 3.20 respectively.

Table 14: Comparison of growth performance of Black male heritage turkey between intensive and semi-intensive system of rearing

Age (week)	Body weight (g/bird)			Body weight gain (g/bird)			FCR		
	Intensive	Semi-intensive	P-value	Intensive	Semi-intensive	P-value	Intensive	Semi-intensive	P-value
5	410±4.75	412±7.97	0.677 NS	-	-	-	-	-	-
6	612±6.64	623±8.01	0.141 NS	202±2.21	211±0.68	0.003 **	2.07±0.02	1.99±0.01	0.003 **
7	812±3.86	832±7.77	0.015 *	199±10.07	208±1.17	0.188 NS	2.29±0.12	2.18±0.01	0.201 NS
8	1057±4.01	1081±8.70	0.014 *	245±1.35	248±1.48	0.060 NS	1.99±0.01	1.97±0.01	0.060 NS
9	1338±1.87	1366±6.75	0.002 **	280±2.35	285±2.40	0.101 NS	2.12±0.02	2.09±0.02	0.101 NS
10	1546±3.63	1587±9.34	0.002 **	207±1.92	221±2.85	0.003 **	3.20±0.03	3.01±0.04	0.002 **
11	1829±5.51	1876±8.16	0.001 **	282±4.62	288±2.36	0.116 NS	2.48±0.04	2.42±0.02	0.115 NS
12	2117±6.40	2168±9.71	0.002 **	288±1.77	292±1.57	0.029 *	2.67±0.02	2.63±0.01	0.029 *
13	2381±13.87	2446±10.13	0.001 **	263±7.46	277±1.40	0.035 *	3.19±0.09	3.03±0.02	0.041 *
14	2627±7.65	2703±11.31	<0.001 **	245±6.22	257±2.42	0.041 *	3.70±0.09	3.54±0.03	0.042 *
15	2887±9.85	2970±9.70	<0.001 **	260±4.56	267±2.29	0.099 NS	3.63±0.06	3.54±0.03	0.101 NS
16	3102±7.42	3217±14.75	<0.001 **	214±2.88	246±5.10	0.001 **	4.57±0.06	3.98±0.08	0.001 **
17	3312±5.85	3470±13.58	<0.001 **	209±2.39	253±1.66	<0.001 **	4.84±0.06	4.01±0.03	<0.001 **
18	3528±7.48	3712±14.74	<0.001 **	216±1.92	242±1.58	<0.001 **	4.85±0.04	4.33±0.03	<0.001 **
19	3741±9.77	3951±16.19	<0.001 **	212±3.23	238±1.67	<0.001 **	5.10±0.08	4.54±0.03	<0.001 **
20	3954±11.58	4171±11.63	<0.001 **	213±1.84	219±4.95	0.113 NS	5.25±0.05	5.10±0.11	0.109 NS
Final	-	-	-	3544±16.29	3758±4.97	<0.001 **	3.40±0.02	3.20±0.00	<0.001 **

*Where, **, P<0.01; *, P<0.05; NS (Non-significant), P>0.05; BW=Body weight, BWG=Body weight gain, FCR=Feed conversion ratio and value indicate- Mean± Standard Deviation (SD)*

b) White male heritage turkey

Table 15 shows the comparisons of the growth performances of White color type male heritage turkey between intensive and semi-intensive system. There was a significant difference ($p<0.05$) in weekly body weight gain of White male heritage turkey in both system in all weeks except first couple of weeks (5-11weeks). The results obtained from the study indicates that the White male heritage turkey under semi-intensive system attained higher body weight in all the weeks and the final body weight under intensive and semi-intensive system was 3848g/bird and 3994 g/bird respectively. However, Isguzar (2003) found the average body weights of White turkey at 18^{th} week of age to be 15844 g/bird. The result of the current study also indicates that the weekly body weight gain of White male heritage turkey under semi-intensive system did not have any significant differences during the first few weeks (6^{th}, 9th, 10^{th} and 11^{th} weeks) and finally at 20^{th} week, indicating that after the 11^{th} week to up to 19^{th} week White male turkey grew better in semi-intensive system. But, in the case of final body weight gain significant difference was observed between intensive and semi-intensive system, and the semi-intensive system of rearing showed the best result in terms of body weight gain (3602 g/bird) as compared to in intensive system (3456 g/bird). Better result that obtained from the study in terms of weight gain may be due to the low density of rearing, provision of green grass, green leaf and management practices. The feed conversion ratio (FCR) in both the system for first couple of weeks and last week of the experimental period had no significant difference ($p<0.05$). The final FCR recorded from the study was 3.34 and 3.48 in semi-intensive and intensive system of rearing respectively. However, Waibel *et al.* (2000) observed that the feed to gain ratio to be 2.729 up to 20 weeks of age for large white male turkey in their experiment, carried out at the University of Minnesota.

Table 15: Comparison of growth performance of White male heritage turkey between intensive and semi-intensive system of rearing

Age (week)	Body weight (g/bird)			Body weight gain (g/bird)			FCR		
	Intensive	Semi-intensive	P-value	Intensive	Semi-intensive	P-value	Intensive	Semi-intensive	P-value
5	391±5.67	392±2.99	0.948 NS	-	-	-	-	-	-
6	595±7.28	599±2.50	0.432 NS	203±4.10	207±1.37	0.221 NS	2.06±0.04	2.03±0.01	0.219 NS
7	785±9.55	801±3.33	0.055 NS	190±3.25	202±1.66	0.005 **	2.39±0.04	2.25±0.02	0.005 **
8	980±8.45	998±6.48	0.047 NS	194±2.83	196±3.47	0.535 NS	2.52±0.04	2.50±0.04	0.540 NS
9	1201±8.80	1224±10.92	0.046 NS	221±1.27	226±6.35	0.199 NS	2.69±0.02	2.62±0.07	0.195 NS
10	1472±7.62	1492±13.59	0.092 NS	271±1.38	267±3.00	0.151 NS	2.45±0.01	2.49±0.03	0.151 NS
11	1745±5.75	1770±15.06	0.055 NS	273±2.41	278±2.37	0.055 NS	2.56±0.02	2.51±0.02	0.056 NS
12	2014±6.54	2046±12.39	0.017 *	268±2.46	275±2.94	0.040 *	2.86±0.03	2.79±0.03	0.041 *
13	2283±5.55	2321±11.02	0.006 **	268±0.99	275±1.49	0.002 **	3.13±0.01	3.05±0.02	0.002 **
14	2557±8.65	2607±10.99	0.003 **	273±3.66	285±1.92	0.009 **	3.32±0.04	3.19±0.02	0.010 *
15	2802±7.64	2863±13.43	0.002 **	245±1.18	256±2.45	0.003 **	3.85±0.02	3.69±0.04	0.002 **
16	3013±5.81	3090±16.64	0.002 **	211±3.46	227±5.18	0.011 *	4.65±0.08	4.32±0.10	0.010 *
17	3243±12.37	3344±19.28	0.002 **	229±7.51	254±7.64	0.016 *	4.43±0.15	3.99±0.12	0.017 *
18	3455±10.95	3578±21.19	0.001 **	211±1.57	234±1.91	<0.001 **	4.95±0.04	4.48±0.04	<0.001 **
19	3645±5.93	3790±23.84	0.001 **	190±5.01	211±2.74	0.003 **	5.70±0.15	5.12±0.07	0.003 **
20	3848±16.02	3994±24.63	0.001 **	203±10.45	204±2.90	0.937 NS	5.51±0.28	5.49±0.08	0.897 NS
Final	-	-	-	3456±10.36	3602±23.62	0.001 **	3.48±0.01	3.34±0.02	0.001 **

*Where, **, P<0.01; *, P<0.05; NS (Non-significant), P>0.05; BW= Body weight, BWG= Body weight gain, FCR= Feed conversion ratio and value indicate- Mean± Standard Deviation (SD)*

c) Bronze male heritage turkey

The comparison of growth performances of Bronze color plumage type male heritage turkey between intensive and semi-intensive system of rearing is shown in the Table 16. Results indicate that the weekly body weight of Bronze male heritage turkey differed significantly ($p<.05$) in both the systems in all weeks except first two (5^{th} and 6^{th}) weeks of age. The results obtained from the study revealed that the Bronze male heritage turkey under semi-intensive system gained higher body weight and the final body weight was 4206g/bird and 4433 g/bird under intensive and semi-intensive system respectively. Isguzar (2003) found the average body weights of Bronze to be 7495 g/bird at 18^{th} week of age. Table 18 also shows that the weekly body weight gain of Bronze male heritage turkey under semi-intensive system was higher than intensive system in all weeks except 7^{th}, 8^{th}, 10^{th}, 14^{th} and 20^{th} weeks, where no significant differences were observed. But, when final body weight gain was compared, significant difference between intensive and semi-intensive system was observed and the semi-intensive system of rearing showed the best result in terms of body weight gain (3997 g/bird) as compared to intensive system (3772 g/bird). Additionally, the Bronze male under semi-intensive system showed increasing trend of body weight and body weight gain.

Table 16 also indicates significant difference in case of feed conversion ratio (FCR) among the two systems of rearing. Where, FCR value of first couple of weeks and last weeks were similar in both the system. But the final FCR of Bronze male was lower in semi-intensive system (3.01) than intensive (3.19) system. The result obtained from the study was similar to the published research work of Havenstein *et al.* (2007), who also indicated that the FCR of heritage turkey increased with the advancement of age.

Table 16: Comparison of growth performance of Bronze male heritage turkey between intensive and semi-intensive system of rearing

Age (week)	Body weight (g/bird)			Body weight gain (g/bird)			FCR		
	Intensive	Semi-intensive	P-value	Intensive	Semi-intensive	P-value	Intensive	Semi-intensive	P-value
5	434±3.98	436±4.12	0.600 NS	-	-	-	-	-	-
6	640±5.87	652±7.87	0.103 NS	206±2.09	216±3.95	0.017 *	2.03±0.02	1.94±0.04	0.017 *
7	841±5.47	865±6.52	0.008 **	200±9.07	212±1.37	0.082 NS	2.27±0.10	2.14±0.01	0.084 NS
8	1094±3.65	1126±6.48	0.002 **	253±7.50	260±0.79	0.150 NS	1.94±0.06	1.88±0.01	0.157 NS
9	1387±5.11	1425±6.74	0.001 **	292±3.27	299±0.65	0.030 *	2.03±0.02	1.99±0.00	0.033 *
10	1616±7.35	1657±9.65	0.004 **	229±3.78	232±3.00	0.352 NS	2.90±0.05	2.86±0.04	0.354 NS
11	1905±6.65	1955±13.68	0.005 **	288±1.03	297±4.18	0.028 *	2.42±0.01	2.36±0.03	0.026 *
12	2232±3.02	2290±13.19	0.002 **	327±3.63	335±0.87	0.017 *	2.35±0.03	2.29±0.01	0.019 *
13	2504±6.02	2570±10.92	0.001 **	271±3.25	279±2.56	0.025 *	3.10±0.04	3.00±0.03	0.026 *
14	2796±3.24	2866±8.36	<0.001 **	292±4.57	296±2.83	0.281 NS	3.11±0.05	3.07±0.03	0.277 NS
15	3067±11.38	3154±5.07	<0.001 **	270±8.15	288±4.55	0.031 *	3.50±0.10	3.28±0.05	0.034 *
16	3293±6.20	3418±10.47	<0.001 **	226±5.30	263±5.96	0.001 **	4.32±0.10	3.72±0.08	0.001 **
17	3526±6.35	3686±8.41	<0.001 **	232±4.01	267±2.06	<0.001 **	4.37±0.08	3.79±0.03	<0.001 **
18	3764±9.32	3945±13.26	<0.001 **	237±3.07	259±4.85	0.003 **	4.41±0.06	4.05±0.08	0.003 **
19	3981±6.04	4203±15.31	<0.001 **	216±3.31	257±3.59	<0.001 **	5.00±0.08	4.21±0.06	<0.001 **
20	4206±8.13	4433±10.67	<0.001 **	225±2.14	230±4.75	0.182 NS	4.97±0.05	4.87±0.10	0.185 NS
Final	-	-	-	3772±4.45	3997±6.61	<0.001 **	3.19±0.00	3.01±0.00	<0.001 **

*Where, **, P<0.01; *, P<0.05; NS (Non-significant), P>0.05; BW= Body weight, BWG= Body weight gain, FCR= Feed conversion ratio and value indicate- Mean ± Standard Deviation (SD)*

d) Royal Palm male heritage turkey

The comparison of growth performances and FCR of Royal Palm plumage color type male heritage turkey under intensive and semi-intensive rearing system is presented in the Table 17. Results of the weekly body weight of Bronze male heritage turkey showed significant difference ($p<0.05$) between both the systems. In this study, Royal Palm male heritage turkey under semi-intensive system showed better body weight excepting the first two (5^{th} and 6^{th}) weeks and at the end of the experimental period the final body weight was 4248.85g/bird and 3931.39 g/bird for semi-intensive and intensive system respectively. Marked difference in body weight gain was found for all the weeks between the rearing systems excepting 6^{th}, 9^{th} and 12^{th} week when no significant difference was observed between the intensive and semi-intensive rearing system. Rapid growth rate was found from 9^{th} to 15^{th} weeks for both the system. However, the Royal Palm male turkey reared under semi-intensive showed better growth rate. The final weight gain in intensive and semi-intensive system was 3522 g/bird and 3837g/bird respectively.

Table 17 also shows the weekly FCR of Royal Palm male turkey under intensive and semi-intensive system. At the beginning the FCR was lower but with the lapse of time the FCR value increased. There was a significant difference in FCR between both the system of all weeks, excepting 6^{th}, 9th and 12^{th} week when no significant difference was observed. The current study revealed that, under semi-intensive system of rearing Royal Palm male showed lower feed conversion ratio (FCR) in terms of body weight gain. The final FCR of Royal Palm male under intensive and semi-intensive system were 3.42 and 3.14 respectively.

Table 17: Comparison of growth performance of Royal Palm male heritage turkey between intensive and semi-intensive system of rearing

Age (week)	Body weight (g/bird)			Body weight gain (g/bird)			FCR		
	Intensive	Semi-intensive	P-value	Intensive	Semi-intensive	P-value	Intensive	Semi-intensive	P-value
5	409±3.60	411±5.37	0.544 NS	-	-	-	-	-	-
6	631±4.44	631±7.08	0.977 NS	222±3.59	219±1.92	0.379 NS	1.89±0.03	1.91±0.02	0.378 NS
7	820±2.04	839±8.16	0.019 *	189.63±6.47	207.90±1.12	0.009 **	2.40±0.08	2.19±0.01	0.011 *
8	1005±6.71	1086±6.87	<0.001 **	184±5.06	247±1.73	<0.001 **	2.65±0.07	1.98±0.01	<0.001 **
9	1257±10.18	1362.±6.22	<0.001 **	251±16.38	276±1.28	0.059 NS	2.37±0.16	2.15±0.01	0.077 NS
10	1513±16.16	1586±13.38	0.004 **	255±7.65	223±7.69	0.007 **	2.60±0.08	2.97±0.10	0.007 **
11	1802±17.16	1880±12.94	0.003 **	289±1.27	294±0.58	0.003 **	2.42±0.01	2.38±0.00	0.004 **
12	2087±18.92	2177±12.76	0.002 **	284±9.01	296±0.71	0.094 NS	2.71±0.08	2.60±0.01	0.095 NS
13	2323±12.80	2443±12.22	<0.001 **	236±7.73	266±1.75	0.003 **	3.56±0.12	3.15±0.02	0.004 **
14	2607±7.98	2739±13.54	<0.001 **	284±5.17	295±1.65	0.022 **	3.20±0.06	3.08±0.02	0.024 **
15	2865±10.60	3018±11.29	<0.001 **	257±2.65	278±2.83	0.001 **	3.67±0.04	3.39±0.03	0.001 **
16	3076±6.85	3269±12.65	<0.001 **	211±3.76	251±3.33	<0.001 **	4.64±0.08	3.90±0.05	<0.001 **
17	3302±12.12	3525±16.68	<0.001 **	225±5.72	255±4.24	0.002 **	4.50±0.12	3.97±0.07	0.002 **
18	3516±12.25	3774±17.39	<0.001 **	214±6.27	249±2.91	0.001 **	4.91±0.15	4.21±0.05	0.001 **
19	3723±11.14	4023±16.66	<0.001 **	206±1.88	248±2.47	<0.001 **	5.24±0.05	4.37±0.04	<0.001 **
20	3931±14.64	4248±17.76	<0.001 **	207±3.91	225±2.28	0.002 **	5.39±0.10	4.96±0.05	0.003 **
Final	-	-	-	3522±14.18	3837±12.44	<0.001 **	3.42±0.01	3.14±0.01	<0.001 **

*Where **, P<0.01; *, P<0.05; NS (Non-significant), P>0. 05; BW= Body weight, BWG= Body weight gain, FCR= Feed conversion ratio and value indicate- Mean ± Standard Deviation (SD)*

D. Comparison of growth performances of female turkeys between intensive and semi-intensive system of rearing

a) Black female heritage turkey

The comparison of growth performances and FCR of Black plumage color type female heritage turkey between intensive and semi-intensive system of rearing is shown in the Table 18. Results showed that the weekly body weight of Black female heritage turkey significantly differed ($p<0.05$) for both the systems in later stage of growth (14^{th} to 20^{th} weeks of age) and no significant difference was observed in earlier weeks. The results indicate that the Black female heritage turkey under semi-intensive system attained higher body weight at 20 weeks of age and that was 2601g/bird and for intensive system it was 2556g/bird. Djebbi *et al.* (2014) reported an adult Black female turkey to attain body weight of 3720 g. Table 20 also indicates that the weekly body weight gain of Black female heritage turkey under semi-intensive system was similar in intensive and semi-intensive system in all weeks excepting 12^{th}, 14^{th}, 16^{th}, 17^{th} and 20^{th} weeks when significant differences were observed in terms of body weight gain. Isguzar (2003) found that, in the first seven weeks of age turkeys attained a very low intensive growth rate. However, Hassan *et al.* (2014) found that the lower weight gain in the period between weeks 25- 28 for the birds kept under the extensive (400 g) and semi intensive (330 g) system of rearing. The present study also showed significant difference in the final body weight gain in intensive system and the semi-intensive of rearing and the semi-intensive showed the best result in terms of body weight gain (2303 g/bird) as compared to 2258 g/bird in intensive system. The higher growth rate may be due to access to the outdoors for pasturing or scavenging.

The weekly feed conversion ratio (FCR) and also final FCR is presented on Table 18. Results obtained from the present study indicate that the FCR of Black female turkeys in both the system had no significant difference during earlier few weeks of growth however, marked difference was observed in 12^{th}, 13^{th}, 14^{th}, 16^{th}, 17^{th} and 20^{th} week of age and in all cases semi-intensive rearing system showed lower FCR value and higher feed efficiency as compared to intensive system. The final FCR value acquired for the semi-intensive system was 4.10, which for the intensive system was 4.18.

Table 18: Comparison of growth performance of Black female heritage turkey between intensive and semi-intensive system of rearing

Age (week)	Body weight (g/bird)			Body weight gain (g/bird)			FCR		
	Intensive	Semi-intensive	P-value	Intensive	Semi-intensive	P-value	Intensive	Semi-intensive	P-value
5	297±5.76	298±5.03	0.886 NS	-	-	-	-	-	-
6	401±4.13	401±6.59	0.984 NS	104±4.81	103±4.38	0.848 NS	3.70±0.17	3.73±0.16	0.851 NS
7	573±5.20	578±1.64	0.173 NS	171±7.83	177±6.38	0.414 NS	2.45±0.11	2.37±0.08	0.409 NS
8	719±4.76	730±4.56	0.043 *	145±7.44	151±2.97	0.272 NS	3.13±0.16	3.00±0.06	0.260 NS
9	829±4.52	839±4.07	0.047 NS	110±1.69	109±1.25	0.396 NS	4.42±0.07	4.47±0.05	0.399 NS
10	937±4.15	944±4.90	0.109 NS	107±2.36	104±0.90	0.184 NS	4.90±0.11	5.00±0.04	0.179 NS
11	1051±8.37	1062±9.41	0.234 NS	114±4.25	117±4.56	0.514 NS	4.88±0.18	4.78±0.19	0.521 NS
12	1226±10.39	1243±10.34	0.122 NS	174±2.03	180±1.30	0.010 *	3.41±0.04	3.29±0.02	0.011 *
13	1404±6.60	1424±11.98	0.071 NS	178±3.96	181±1.63	0.338 NS	3.61±0.04	3.48±0.03	0.011 *
14	1566±5.53	1592±12.32	0.030 *	162±1.20	168±1.10	0.002 **	4.10±0.03	3.94±0.03	0.002 **
15	1734±5.20	1765±13.49	0.022 *	167±3.41	172±1.20	0.096 NS	4.17±0.09	4.06±0.03	0.101 NS
16	1898±5.85	1931±14.37	0.020 *	163±1.20	166±1.26	0.034 *	4.50±0.03	4.41±0.03	0.034 *
17	2060±6.59	2098±14.37	0.014 *	162±1.57	167±0.00	0.007 **	4.73±0.05	4.60±0.00	0.039 *
18	2227±5.22	2267±13.37	0.008 **	166±1.40	169±1.04	0.072 NS	4.83±0.04	4.76±0.03	0.079 NS
19	2397±5.90	2439±11.65	0.005 **	170±0.99	171±1.73	0.254 NS	4.94±0.03	4.89±0.05	0.253 NS
20	2556±6.92	2601±10.63	0.003 **	158±1.31	161±1.29	0.035 *	5.52±0.05	5.41±0.04	0.035 *
Final	-	-	-	2258±12.25	2303±8.93	0.007 **	4.18±0.02	4.10±0.02	0.007 **

*Where **, P<0.01; *, P<0.05; NS (Non-significant), P>0.05; BW=Body weight, BWG=Body weight gain, FCR=Feed conversion ratio and value indicate- Mean±Standard Deviation (SD)*

b) White female heritage turkey

Table 19 represents the comparison of growth performance and FCR of White plumage color type female heritage turkey between intensive and semi-intensive system of rearing. There was no significant difference ($p<0.05$) in weekly body weight of White female heritage turkey in both the system at earlier stage of growth from 5 to 13 weeks excepting 8^{th} and 12^{th} week. However, significant difference in body weight have been observed from 15^{th} to 20^{th} week and most of the cases better body weight gain was observed in White female reared under semi-intensive system. The result of the current study indicates that the White female turkey attained a body weight of 2461 g/bird and 2534 g/bird at 20^{th} weeks of age under intensive and semi-intensive system respectively. However, Karki (2005) showed an increasing trend of body weight up to 20 weeks of age in female turkey. The result of the current study also indicates that the weekly body weight gain of White female heritage turkey under semi-intensive system had no significant differences in first few weeks namely 6^{th}, 7^{th}, 8^{th} 11^{th} ,13^{th} 15^{th}, 18^{th} and finally 20^{th} week. Whereas, significant difference in weekly body weight gain observed for rest of the weeks. The final body weight gain in intensive and semi-intensive system was 2189 g/bird and 2250 g/bird respectively.

Table 19 also shows the weekly FCR as well as final FCR of White female heritage turkey under intensive and semi-intensive system. Significant difference in weekly FCR was found in all weeks excepting 6^{th}, 7^{th}, 8^{th}, 11^{th}, 15^{th}, 18^{th} and 20^{th} week. There was an increasing trend of FCR with the increase of age of the bird. According to Laudadio *et al.* (2009) the FCR value estimated for Nicholas Large White females was 2.98 for the period between 31 and 114 days of age and also that the FCR gradually increased with the age. However, the final FCR value of White female turkey under semi-intensive rearing system was 4.32 for intensive system and 4.20 for semi-intensive system

Table 19: Comparison of growth performance of White female heritage turkey between intensive and semi-intensive system of rearing

Age (week)	Body weight (g/bird)			Body weight gain (g/bird)			FCR		
	Intensive	Semi-intensive	P-value	Intensive	Semi-intensive	P-value	Intensive	Semi-intensive	P-value
5	271±6.51	284±15.68	0.266 NS	-	-	-	-	-	-
6	374±3.79	387±14.75	0.204 NS	103±3.17	103±0.93	0.749 NS	3.73±0.12	3.71±0.03	0.733 NS
7	552±3.60	556±13.95	0.631 NS	177±3.62	168±4.58	0.056 NS	2.36±0.05	2.49±0.07	0.057 NS
8	694±7.44	712±4.11	0.025 *	142±4.52	155±12.15	0.159 NS	3.20±0.10	2.94±0.22	0.141 NS
9	803±7.48	812±2.71	0.103 NS	108±2.53	100±2.17	0.017 *	4.53±0.11	4.88±0.11	0.017 *
10	911±10.70	929±3.15	0.052 NS	108±3.48	116±0.50	0.017 *	4.83±0.15	4.50±0.02	0.020 *
11	1019±12.55	1041±4.65	0.047 NS	107±2.20	111±1.52	0.049 NS	5.22±0.11	5.02±0.07	0.049 NS
12	1181±14.32	1214±6.22	0.021 *	162±2.33	173±1.62	0.002 **	3.66±0.05	3.43±0.03	0.003 **
13	1348±14.00	1384±5.79	0.014 NS	167±1.99	170±1.34	0.102 NS	3.88±0.06	3.63±0.03	0.009 **
14	1503±12.35	1551±9.36	0.006 **	155±1.84	166±3.94	0.010 *	4.29±0.05	3.99±0.10	0.009 **
15	1666±9.98	1718±8.49	0.002 **	162±2.69	166±1.19	0.088 NS	4.30±0.07	4.20±0.03	0.090 NS
16	1825±11.14	1881±7.87	0.002 **	158±1.21	163±0.79	0.006 **	4.63±0.04	4.50±0.02	0.006 **
17	1982±12.14	2042±8.31	0.002 **	156±1.34	160±0.45	0.008 **	4.91±0.04	4.79±0.01	0.009 **
18	2144±13.51	2207±9.80	0.003 **	162±1.52	165±1.52	0.048 NS	4.97±0.05	4.86±0.04	0.048 NS
19	2306±12.67	2375±10.06	0.002 **	162±1.57	167±0.67	0.009 **	5.17±0.05	5.02±0.02	0.010 *
20	2461±15.19	2534±11.18	0.003 **	154±2.53	159±2.06	0.053 NS	5.68±0.09	5.50±0.07	0.053 NS
Final	-	-	-	2189±19.40	2250±15.11	0.013 *	4.32±0.04	4.20±0.03	0.013 *

*Where, **, P<0.01; *, P<0.05; NS (Non-significant), P>0.05; BW=Body weight, BWG= Body weight gain, FCR=Feed conversion ratio and value indicate- Mean± Standard Deviation (SD)*

c) Bronze female heritage turkey

The comparison of growth performances and FCR of Bronze plumage color type female heritage turkey between intensive and semi-intensive system of rearing is shown in the Table 20. Results indicate that the weekly body weight of Bronze female heritage turkey significantly differed ($p<0.05$) for both the systems in all weeks excepting first few (5^{th}, 6^{th} and 7th) weeks. The results obtained from the study revealed that the Bronze female heritage turkey under semi-intensive system gained higher body weight in the rest of the weeks and at the end of the experimental period the final body weight was 2626 g/bird and 2699 g/bird under intensive and semi-intensive system respectively. However, Isguzar (2003) reported that the average body weight of Bronze at 18^{th} week of age was 4843 g/bird. Djebbi *et al.* (2014), also reported that the adult Black, Bronze and Red male turkey weigh 6250, 6230 and 6120 g respectively whereas, their female counterpart attained the weight of 3720, 3440 and 3590 g respectively.

Table 20 also shows that the weekly body weight gain of Bronze female heritage turkey under semi-intensive system was higher than intensive system in all weeks excepting 6^{th}, 7^{th}, 8^{th} and 13^{th} weeks, where no significant differences was observed. But, when the final body weight gain was compared, a significant difference between intensive and semi-intensive system was observed, and the semi-intensive system of rearing showed the best result in terms of body weight gain of Bronze female turkey 2391g/bird as compared to 2320 g/bird in intensive system. Furthermore, the Bronze female turkey under semi-intensive system showed increasing trend of body weight and body weight gain.

Table 20 also indicates significant difference in case of feed conversion ratio (FCR) among two systems of rearing. Where, FCR of first couple of weeks and last week were similar in both systems. But the final FCR value of Bronze male was lower in semi-intensive system (3.95) as compared to intensive system (4.07). Moreover, the result obtained from the present study resembled with the research report of Havenstein *et al.* (2007), who indicated that the FCR value of heritage turkey increased with the age.

Table 20: Comparison of growth performance of Bronze female heritage turkey between intensive and semi-intensive system of rearing

Age (week)	Body weight (g/bird)			Body weight gain (g/bird)			FCR		
	Intensive	Semi-intensive	P-value	Intensive	Semi-intensive	P-value	Intensive	Semi-intensive	P-value
5	306±6.81	308±5.95	0.679 NS	-	-	-	-	-	-
6	409±8.02	415±6.26	0.400 NS	103±1.98	106±3.60	0.246 NS	3.71±0.07	3.60±0.12	0.245 NS
7	585±5.14	594±4.86	0.111 NS	175±2.88	178±1.52	0.212 NS	2.39±0.04	2.35±0.02	0.212 NS
8	737±7.36	750±8.14	0.113 NS	152±2.28	156±3.28	0.123 NS	2.99±0.05	2.91±0.06	0.122 NS
9	848±5.21	862±2.38	0.014 *	110±2.17	111±5.77	0.824 NS	4.42±0.09	4.39±0.23	0.857 NS
10	950±4.90	972±3.37	0.003 **	102±0.62	109±2.64	0.007 **	5.14±0.03	4.78±0.12	0.006 **
11	1074±7.10	1102±4.45	0.004 **	123±2.21	130±2.35	0.023 *	4.54±0.08	4.31±0.08	0.023 *
12	1263±7.01	1296±2.95	0.002 **	189±0.81	193±2.46	0.044 *	3.14±0.01	3.07±0.04	0.043 *
13	1444±11.59	1483±3.88	0.005 **	180±4.59	187±1.00	0.060 NS	3.32±0.01	3.25±0.04	0.043 *
14	1617±10.56	1660±3.98	0.003 **	173±1.04	176±1.22	0.020 **	3.84±0.02	3.76±0.03	0.019 *
15	1785±10.96	1834±4.26	0.002 **	167±2.28	173±0.73	0.011 *	4.18±0.06	4.03±0.02	0.012 *
16	1950±10.65	2003±4.70	0.001 **	165±1.00	169±0.60	0.003 **	4.45±0.03	4.34±0.02	0.003 **
17	2118±10.89	2177±6.41	0.001 **	168±0.30	173±2.09	0.009 **	4.58±0.01	4.43±0.05	0.008 **
18	2290±10.98	2354.±6.27	0.001 **	172±1.06	176±1.04	0.011 *	4.67±0.03	4.57±0.03	0.011 *
19	2463±12.56	2530±5.92	0.001 **	172±1.91	176±0.84	0.043 *	4.86±0.05	4.77±0.02	.045 NS
20	2626±13.64	2699±7.15	0.001 **	162±1.33	169±1.41	0.004 **	5.37±0.04	5.16±0.04	0.004 **
Final	-	-	-	2320±7.01	2391±6.33	<.0001 **	4.07±0.01	3.95±0.01	<.0001 **

*Where, **, P<0.01; *, P<0.05; NS (Non-significant), P>0.05; BW= Body weight, BWG= Body weight gain, FCR= Feed conversion ratio and value indicate- Mean± Standard Deviation (SD)*

d) Royal Palm female heritage turkey

The comparison of growth performances and FCR of Royal Palm plumage color type female heritage turkey between intensive and semi-intensive system of rearing is presented in the Table 21. The results of the current study showed that the weekly body weight of Bronze female heritage turkey indicate significant difference ($p<0.05$) in both system i.e. intensive and semi-intensive system of rearing in all weeks excepting first couple of weeks (5^{th} to13^{th}). In this study, Royal Palm female heritage turkey reared under semi-intensive system showed better body weight during rest of the weeks and at the end of the experimental period the final body weight was 2538 g/bird and 2594 g/bird under intensive and semi-intensive system respectively. A marked difference in body weight gain was observed after 13^{th} week to end of the experimental period for both the system of rearing excepting first couple of weeks where no significant difference was observed in intensive and semi-intensive rearing system. However, the Royal Palm female turkey reared under semi-intensive showed better growth rate. The final body weight gain in intensive and semi-intensive system was 2255 g/bird and 2312 g/bird respectively found in the present study. Sogut *et al.* (2016), conducted an experiment and found the live weights of the turkeys for male and female to be 12285.71 and 10164.20 g in commercial groups, and 8438.18 g and 6985.29 g in free-Range groups at the end of the trail, respectively.

Table 21 also shows the weekly FCR of Royal Palm male turkey under intensive and semi-intensive system. At the beginning the FCR was lower but with the passage of time the FCR value increased. There was no significant difference in FCR in both systems up to 15^{th} weeks of age, after that significant difference was observed from 17^{th} week to end of the experimental period. Lower FCR value in semi-intensive system (4.09) was observed compared to intensive system (4.19). Turkey raised on semi-intensive system had an access to outdoor feeds or pasturing with different types of green grass or forages, insects and worms. As the turkey is the second largest poultry species, it requires higher amount of feed compared to other poultry species. At the same time the genetic potentiality of the heritage turkey bird is lower than hybrid turkey. So, feeding of the heritage turkey with commercial feed alone would not be feasible when we consider the price of commercial feed. Therefore, the partial supplementation of green forages i.e. water hyacinth, kolmishak, helencha, tender tree leaves more importantly allowing access for pasturing in semi-intensive system showed better result than intensive system of rearing.

Table 21: Comparison of growth performance of Royal Palm female heritage turkey between intensive and semi-intensive system of rearing

Age (week)	Body weight (g/bird)			Body weight gain (g/bird)			FCR		
	Intensive	Semi-intensive	P-value	Intensive	Semi-intensive	P-value	Intensive	Semi-intensive	P-value
5	282±3.38	281±5.99	0.900 NS	-	-	-	-	-	-
6	388±6.87	385±5.75	0.613 NS	105±4.81	103±1.40	0.471 NS	3.64±0.16	3.71±0.05	0.478 NS
7	578±4.63	582±5.98	0.378 NS	189±5.08	196±0.32	0.072 NS	2.22±0.06	2.14±0.00	0.074 NS
8	721±3.54	728±6.78	0.203 NS	143±1.10	145±1.06	0.053 NS	3.17±0.02	3.12±0.02	0.054 NS
9	826±9.87	832±3.77	0.331 NS	104±7.60	104±3.31	0.996 NS	4.69±0.35	4.68±0.15	0.949 NS
10	934±7.72	939±8.34	0.469 NS	107±2.24	106±4.58	0.638 NS	4.87±0.10	4.94±0.21	0.615 NS
11	1051±10.85	1064±10.82	0.218 NS	117±3.20	125±5.30	0.099 NS	4.77±0.13	4.48±0.19	0.093 NS
12	1225±13.32	1243±8.84	0.120 NS	173±2.52	179±1.97	0.046 NS	3.42±0.05	3.32±0.04	0.047 NS
13	1398±12.42	1420±10.03	0.078 NS	173±1.06	176±1.26	0.021 *	3.62±0.05	3.52±0.04	0.045 NS
14	1557±10.28	1585±13.61	0.044 *	158±2.16	165±3.59	0.046 NS	4.20±0.06	4.03±0.09	0.045 NS
15	1723±10.36	1756±12.66	0.025 *	165±1.35	170±0.97	0.009 **	4.22±0.03	4.11±0.02	0.013 **
16	1885±11.76	1922±13.29	0.023 **	162±1.99	166±1.34	0.067 NS	4.51±0.05	4.42±0.04	0.067 NS
17	2050±12.65	2091±13.07	0.018 **	164±1.02	168±0.55	0.003 **	4.68±0.03	4.56±0.01	0.003 **
18	2212±13.34	2259±13.64	0.013 **	162±0.69	168±0.93	0.001 **	4.95±0.02	4.78±0.03	<.0001 **
19	2376±14.86	2426±12.98	0.012 *	163±1.58	167±0.66	0.024 *	5.13±0.05	5.02±0.02	0.025 *
20	2538±14.86	2594±12.34	0.007 **	161±0.00	167±0.96	<.0001 **	5.43±0.00	5.22±0.03	<.0001 **
Final	-	-	-	2255±12.72	2312±6.35	0.002 **	4.19±0.02	4.09±0.01	0.002 **

*Where, **, P<0.01; *, P<0.05; NS (Non-significant), P>0.05; BW= Body weight, BWG= Body weight gain, FCR= Feed conversion ratio and value indicate- Mean± Standard Deviation (SD)*

11.1.2 Survivability of the birds

The survivability of four types of heritage turkey under intensive and semi-intensive system is shown in Table 22. In case of intensive system, 6 birds (four birds from Black group and two birds from Bronze group) out of 160 birds died during the experimental period and the overall survivability was 95.97%. Sampath (2012) reported the survivability of turkey to be 91.3% and that was within the range 95-70%. All the 6 birds died during the experimental period were sent to the Department of Pathology, BAU, Mymensingh for post-mortem examinations and the birds were found infected with Mycoplasma and Salmonella. The problem could be overcomes quickly with necessary treatment.

Table 22: Survivability of Black, White, Bronze and Royal Palm turkeys

Plumage color	**Intensive system**			**Semi-intensive system**		
	No. of birds	**No. of dead birds**	**Survivability (%)**	**No. of birds**	**No. of dead birds**	**Survivability (%)**
Black	34	4	88.24	38	2	94.74
White	42	0	100	33	0	100
Bronze	46	2	95.65	47	1	97.87
Royal palm	38	0	100	42	1	97.62
Total	160	6	**95.97% (avg.)**	160	4	**97.55% (avg.)**

Out of the four groups White and Royal Palm showed highest survivability. The overall survivability in semi-intensive system was 97.55%, only 4 birds died at earlier stage due to poor management practices and adaptability of turkey poults. Yilmaz *et al.* (2011) reported the mortality of the bird to be 2.43% (97.57% survivability) at 10-13 weeks of age.

11.1.3. Egg production performance of heritage turkeys

Table 23: Weekly egg production performance of heritage turkeys at BAU Poultry Farm

Week	No. of birds	Weekly total feed consummation (g)	Feed intake (g/b/d)	Total no. of eggs/week	% Hen day egg production	Avg. egg wt.(g/egg)	Egg Mass (g/b/d)	FCR
28	36	25200	100	22	8.73	51.50	4.50	22.24
29	36	25200	100	28	11.11	52.20	5.80	17.24
30	36	25200	100	60	23.81	53.10	12.64	7.91
31	36	26460	105	92	36.51	54.50	19.90	5.28
32	36	27720	110	114	45.24	55.80	25.24	4.36
33	36	28980	115	130	51.59	56.00	28.89	3.98
34	36	30240	120	126	50.00	57.68	28.84	4.16
35	36	31500	125	110	43.65	58.02	25.33	4.94
36	36	32760	130	102	40.48	57.92	23.44	5.55
37	36	34020	135	100	39.68	57.57	22.85	5.91
38	36	35280	140	112	44.44	57.78	25.68	5.45
39	36	35280	140	72	28.57	62.88	17.97	7.79
40	36	35280	140	68	26.98	65.80	17.76	7.88
41	36	35280	140	64	25.40	65.66	16.68	8.40
42	36	35280	140	66	26.19	64.00	16.76	8.35
43	36	35280	145	76	30.16	63.80	19.24	7.28
44	36	35280	150	76	30.16	64.70	19.51	7.17
45	36	35280	150	64	25.40	65.40	16.61	8.43
46	36	35280	150	46	18.25	65.60	11.97	11.69
47	36	36540	155	70	27.78	66.80	18.56	7.81
48	36	37800	155	86	34.13	67.30	22.97	6.53
49	36	39060	155	80	31.75	68.60	21.78	7.12
50	36	40320	160	92	36.51	69.80	25.48	6.28
51	36	40320	160	86	34.13	70.10	23.92	6.69
52	36	40320	160	90	35.71	70.68	25.24	6.34
53	36	40320	160	94	37.30	70.80	26.41	6.06
54	36	40320	160	98	38.89	71.23	27.70	5.78
55	36	40320	160	104	41.27	71.56	29.53	5.42
56	36	40320	160	116	46.03	72.30	33.28	4.81
57	36	40320	160	124	49.21	72.63	35.74	4.48
58	36	40320	160	120	47.62	73.15	34.83	4.59
59	36	40320	160	112	44.44	73.48	32.66	4.90

Weekly egg production performance including feed intake, weekly egg production, hen- day egg production, average egg weight, egg mass and feed conversion ratio (FCR) of heritage turkeys at BAU Poultry Farm from 28 to 59 weeks is shown in the Table 23. Egg laying of heritage turkeys usually started at 26-28 weeks of age. It has been observed that the number of egg production at initial few days was very low. In the present study, the egg production was started at 28 weeks of age and the production was started to increase from 30 weeks of age. Hen day egg production thereafter was kept continuing almost at the same level until the end of experimental period i.e. 59 weeks of age. Results indicate that

the overall weekly hen-day egg production ranged between 25-50%; although it was increased from the 30 to 38 weeks of age (Table 23). Afterwards, the egg production started decreasing from 39 to 49 weeks. However, the egg production again increased from 50 weeks to until end of the experimental period. According to Sampath *et al.* (2012), turkey attains sexual maturity at 30 weeks of age and produces 70-100 eggs annually and throughout the egg production period. Heritage turkey produces 80-100 eggs per year (Ahmed *et al.,* 2009). In the present study, since the experiment was not conducted to observe the egg production performance for one year, thus the total egg production from 28-59 weeks were recorded and the projected egg production of birds for one year were estimated that was resembled with the previous findings as mentioned above.

The trend of hen day egg production percentage is shown in the Figure 9 which shows that hen day egg production percentage was lower in first couple of weeks.

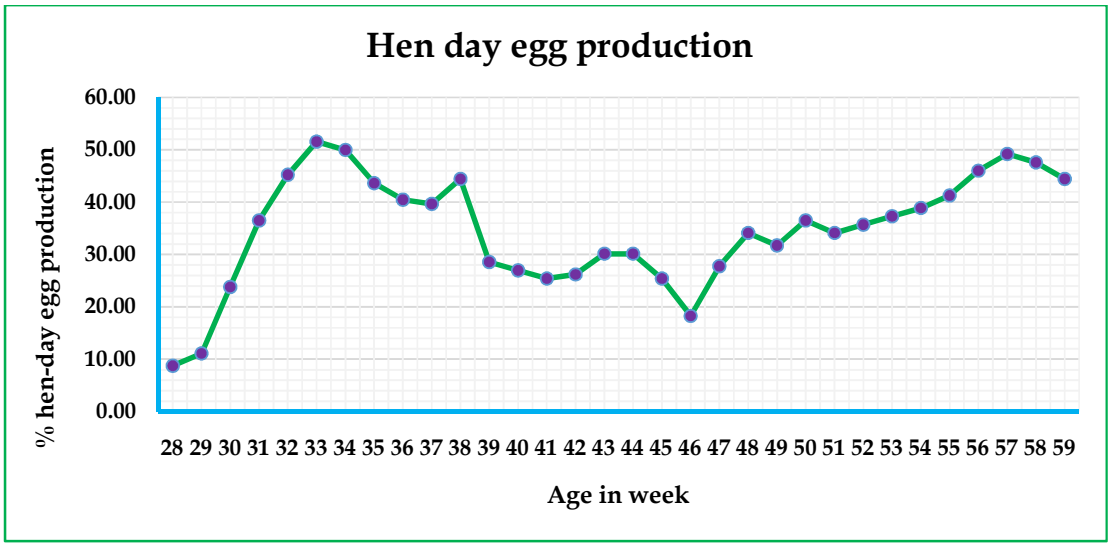

Figure 9: Hen day egg production

Hen day egg production showed an increasing trend from 28 to 35 weeks of age. After that, hen day egg production was decreased up to 46 weeks. However, hen day egg production tends to increase from 46 weeks to until the end of the experiment. While the birds were almost ready to start lay, commercial layer-layer 1 feed manufactured by Aman feeds Ltd. was supplied at the rate 100/g/bird/day. As the egg production was increasing day by day, the small amount of additional feed was added to daily allocation as mentioned in Table 23. After 50 weeks of age, the daily feed allocated was 160/g/bird and the amount was fixed for all the remaining period of experiment.

Table 23 also shows that the average egg weight continued to increase from the onset of egg production until the end of experiment. The initial average egg weight at 28 weeks was 51.50 g and at 59 weeks of age it reached to 73.48 g, and the average egg weight was 64.01 g. Ramlah (1996) also reported to increase egg weight in hens reared under intensive system of management as compared to semi-intensive system of management. In turkeys, egg weight increases significantly from 11.4 to 19.48 g/egg with the advancement of age (Onbasilar *et al.,* 2011; Mróz *et al.,* 2002). Asaduzzaman *et al.* (2017) reported the egg weight of turkey to be 66 g. The mean weight of turkey eggs was reported by Ozcelik*et al.* (2009) to be ranged from 67.4 to 70.3 g. Anandh *et al.* (2012) found the egg weight in the free range, semi-intensive and intensive system to be 68.72 g, 70.56 g and 72.70 g respectively. According to Mollah and Islam (2017) egg weight of turkey ranged from 69.87 g to 78.15g.

The egg mass (g/bird/day) was quiet lower at earlier few weeks due to low egg production (22-28 nos.) and also lower egg weight (51-53 g). However, it showed increasing trend at first few weeks i.e. 30 to 38

weeks and then gradually declined up to 49 weeks. The weekly egg mass output was thereafter increased in association with the increasing egg weight along with the higher egg production. Similar result was also found in case of feed conversion ratio that was higher at earlier stage, but it reduced with the increase of egg production. In the present study, the feed conversion ratio at 59 weeks of age was 4.90, which is almost similar to the previous report of Karki *et al.* (2005) who found FCR of female turkey to range from 4.5 to 6.8.

11.2. Growth performance of guinea fowl both at intensive and semi-intensive system:

Study of growth performances of guinea fowl could not be continued as the selected farmers lost their interest in raising the birds. The noise made by the guinea fowl was creating disturbance to the neighbors therefore, to avoid social problem the experiment was abandoned. For guinea fowl production, it may be recommended not going for rearing the birds at small scale in a locality with dense population. However, sporadic rearing of only few numbers of birds as like our *desi* chicken could be possible.

11.3. Analysis of economic feasibility of small scale turkey and guinea fowl rearing:

Analysis of economic feasibility of small scale turkey and guinea fowl rearing could not be done due time constraints.

12. Research highlight/findings:

- Under intensive rearing system, Bronze color type male turkeys attained highest body weight of 4206.55 g/bird followed by Black (3954.80 g/bird) and Royal Palm (3931.39 g/bird) turkeys.
- The lowest body weight was found, in White male turkey under intensive system, to be 3848.82 g/bird at the age of 20 week.
- The FCR under intensive system was better in Bronze plumage color type (3.19) as compared to Black (3.40), Royal Palm (3.41) and White male (3.48) turkeys.
- In case of semi-intensive rearing system Bronze male turkey attained the highest live weight of 4433 g/bird at the end of the experiment followed by Royal Palm (4248 g/bird), Black (4171 g/bird) and White (3994 g/bird) turkeys.
- Hen-day egg production of the turkey was ranged between 25-50%. The initial average egg weight at 28 weeks of age was 51.50 g/egg and at 59 weeks of age it reached to 73.48 g/egg, and the average egg weight was 64.01 g/egg.

B. Implementation Position

1. Procurement:

Sl. No	Items of Procurement	Achievements		% of achievements	Remarks
		Planned	Actual		
a.	Goods				
i.	Supplies of Birds: Guinea fowls & Turkeys	21/11/2017	January/18	100%	Completed
ii.	Supplies of Feeds	21/11/2017	March/18	100%	Completed
iii.	Supplies of Furniture: Almirah, Chair	21/11/2017	March/18	100%	Completed
iv.	Supplies of Equipment, Tools etc: Incubator.	21/11/2017	March/18	100%	Completed
b.	Works				
c.	Services (Not applicable)				

2. Establishment/renovation facilities:

Description of facilities	Newly established		Upgraded/refurbished		Remarks
	PP Target	Achievement	PP Target	Achievement	

3. Training/study tour/ seminar/workshop/conference organized: (Not applicable)

Description	Number of participant			Duration (Days/weeks/ months)	Remarks
	Male	Female	Total		
(a) Training					
(b) Workshop					

C. Financial and physical progress

Fig. in Tk.

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance/ unspent	Physical progress (%)	Reasons for deviation
A. Contractual staff salary	3,17,150	3,17,150	3,17,150	0	100	
B. Field research/lab expenses and supplies	9,97,850	9,41,926.50	9,97,850	0	94.39	
C. Operating expenses	25,000	25,000	25,000	0	100	
D. Vehicle hire and fuel, oil & maintenance	1,50,000	1,50,000	1,50,000	0	100	
E. Training/ workshop/ seminar etc.	0	0	0	0	100	
F. Publications and printing	1,00,000	30,000	1,00,000	0	30	
G. Miscellaneous	20,000	20,000	20,000	0	100	
H. Capital expenses	3,90,000	3,90,000	3,90,000	0	100	
Grand Total	20,00,000	18,74,076.50	18,69,168	4,908.50	100	

D. Achievement of Sub-project by objectives: (Tangible form)

Specific objectives of the sub-project	**Major technical activities performed in respect of the set objectives**	**Output (i.e. product obtained, visible, measurable)**	**Outcome (short term effect of the research)**
a) To observe the growth and egg production performances of turkeys under intensive and semi-intensive rearing system	• Brooding and rearing of turkeys on station at BAU and on farm at farmers field • Data collection on growth and egg production performances • Data analysis	• Under intensive rearing system, Bronze color type male turkey attained highest body weight 4206.55 g/bird followed by Black (3954.80 g/bird) and Royal Palm (3931.39 g/bird). The lowest body weight however was found in White male 3848.82 g/bird at the age of 20 week. The FCR was also better in Bronze (3.19) as	The knowledge will help selecting turkey type (Black, white, Bronze or royal palm plumage color) by the

		compared to Black (3.40), Royal Palm (3.41) and White male (3.48) turkey. • In case of semi-intensive rearing system Bronze male attained the highest live weight of 4433 g/bird at the end of the experiment followed by Royal Palm (4248 g/bird), Black (4171 g/bird) and White (3994 g/bird). • Hen-day egg production was ranged between 25-50%. The initial average egg weight at 28 weeks of age was 51.50 g/egg and at 59 weeks of age it reached to 73.48 g/egg, and the average egg weight was 64.01 g/egg.	farmers for rearing under semi-intensive system.
b) To observe the growth performances of guinea fowls under intensive and semi-intensive rearing system	• Rearing of gunea fowls on station and on farm • Data analysis on growth and egg production performances	The experiment could not be continued as the farmers were reluctant to raise guinea fowls to avoid social conflicts arouse from the noise pollution by the birds	
c) To analyze the economic feasibility of small scale turkey and guinea fowl rearing for poverty reduction	• Data collection for economic feasibility study of turkey and guinea fowl rearing • Data analysis	Could not be completed due to time constraints	

E. Materials Development/Publication made under the Sub-project:

Publication	Number of publication		Remarks (e.g. paper title, name of journal, conference name, etc.)
	Under preparation	Completed and published	
Technology bulletin/ booklet/leaflet/flyer etc.		1	
Journal publication	1	1	The Journal of Bangladesh Agricultural University
Information development			
Other publications, if any			

F. Technology/Knowledge generation/Policy Support (as applied):

i. Generation of technology (Commodity & Non-commodity)

None

ii. Generation of new knowledge that help in developing more technology in future

Out of the four color varieties (White, Black, Bronze and Royal Palm) of turkey, bronze showed better performance in terms of body weight gain both under intensive and semi-intensive system of rearing. Thus, farmers could be advised to raise bronze color variety of turkey for more profit. Further research is needed on the formulation of turkey feed both for semi-intensive and intensive system of rearing.

iii. Technology transferred that help increased agricultural productivity and farmers' income

None

iv. Policy Support

None

G. Information regarding Desk and Field Monitoring

i) Desk Monitoring (description & output of consultation meeting, monitoring workshops/seminars etc.):

2

ii) Field Monitoring (time& No. of visit, Team visit and output):

2

H. Lesson Learned (if any)

I. Challenges (if any)

Under the present study, approximately 500 guinea fowls were distributed to the farmers of a village near the Rajshahi University. The birds when became mature were very much noisy and people could not tolerate the piercing noise made by the birds. Therefore, to avoid social problems with neighbors rearing of the birds had to stop and the experiment with the guinea fowls was abandoned.

Signature of the Principal Investigator
Date ……
Seal

Counter signature of the Head of the organization/authorized representative
Date ……
Seal

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Pictures showing some activities of the project

Photo 1: Brooding of turkey poults at BAU Poultry Farm

Photo 2: Distribution of poults (turkey chicks) to the selected farmers

Photo 3: Turkeys at BAU poultry farm

Photo 4: PoulShot® LaSota (RDV) with diluent

Photo 5: Preparation of PoulShot® LaSota (RDV) for vaccination

Photo 6: IB+ND vaccination through eye drop

Photo 7: Mature turkeys are scavenging at BAU Poultry Farm

Photo 8: Measuring the height of yolk of turkey egg using micrometer