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Laying performance of indigenous *(desi)* scavenging ducks in response to supplementation of different nutrient density diets

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Abstract
The experiment was undertaken to study the effect of different nutrient density diets on laying performance of indigenous ducks under scavenging system of rearing in two coastal districts of Bangladesh. The experiment was conducted at Ramgati and Raipur upazilas of Lakshmipur district and Begumgonj and Subarnachar upazilas in Noakhali district. A total of 60 farmers were randomly selected from two districts who had six ducks of 22 weeks of age. In the study areas, the control group was reared under traditional feeding practices as followed by the farmers. In addition to scavenging, the birds belonged to supplementary feeding groups received a layer ration either BR+RP (50:50), LND diet (14% CP and 2500 kcal ME/kg), MND diet (16% CP and 2700 kcal ME/kg) or HND diet (18% CP and 2900 kcal ME/kg). The final body weight and body weight gain of birds having HND and MND diet were significantly (P<0.01) higher than LND, BR+RP and control groups. There was a significant difference (P<0.01) in egg production (%), egg mass production (g/b/d) and total egg mass production (kg) among different treatment groups and the maximum egg production was observed in ducks receiving HND diet (46.71%) followed by those receiving MND diet (45.82%), LND (36.99%), BR+RP (26.85%), and control (15.75%) groups, respectively. Similarly, the egg mass production (g/b/d) and total egg mass production (kg) was highest in HND and MND diet groups followed by other groups, respectively. Among the locations the highest egg production was found in Ramgati intermediate in Subarnachar and Begumgonj and lowest in Raipur upazila. Diets and interaction between diet and location had a significant (P<0.05) effects on egg production (%), egg mass production (g/b/d) and total egg mass production (kg). Considering the feed cost the percent profit and BCR were found highest in MND (82.6 and 1.83 respectively) diet although total income was highest in HND diet group.

Keywords*: Indigenous ducks, supplementary feeding, nutrition, performance, scavenging system.*

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I. Introduction

Family poultry production in Bangladesh mainly depends on scavengable feed resource base (SFRB). Although, chicken is the principal species of poultry and dominant to all others, ducks occupy second place for the production of meat and eggs (Das *et al*., 2008). Duck population in the country has been reported to be 47.25 million (BER, 2013). According to a report of Food and Agricultural Organization, the position of Bangladesh with respect to duck meat and egg production is 11th and 4th respectively among the Asian countries (Pingle, 2011). Bhuiyan (2011) reported that in Bangladesh, the commercial to family poultry ratio in terms of egg production is almost equal (50:50) and that of meat production is 60:40. Duck rearing provides subsidiary income to the landless, marginal and small farmers (Islam *et al*., 2003). Over 85-87% ducks are being reared under scavenging condition (Amin, 1999) approximately 90% of which are indigenous (*desi)* type (Hoque *et al*., 2001). Both duck meat and eggs from indigenous birds are very popular in many regions and therefore, play a pivotal role in the socio-economic structure of the country. The geographical location, climate and environmental condition and natural feed resources in northern and southern parts of the country, coastal areas in particular, are quite favorable for successful duck production.

Although high yielding exotic duck breeds are kept in Government and some private farms, most of the duck eggs and meat in Bangladesh are still produced by the indigenous ducks kept as scavengers. Recent research results on indigenous chicken showed that small intervention in their traditional husbandry practices particularly quality and quantity of feed may increase tangible production potential. The egg production of

indigenous chickens could more than double if some changes are made in their husbandry practices (Sarkar and Bell 2006). Ducks may respond in a way similar to chicken if they have access to improved diets and feeding practices. Recently, Pervin *et al.* (2013) reported that the growth performance of *desi* ducklings could be improved by supplementation of improved diets under scavenging system of rearing. So, there is a great prospect to improve the productivity of indigenous ducks through improvement of their diets and feeding practices. This feeding experiment was undertaken to investigate the laying performance of scavenging indigenous (*desi*) laying ducks in response to diets of varying nutrient concentrations.

II. Materials and Methods

Source of ducks, location of study areas and duration of experiment

Sixty farmers from two districts (Lakshmipur and Noakhali) each of 30 who have six ducks of 22 weeks of age in each house were considered. There were two upazilas each of 15 farmers. The laying ducks were reared for a period of 52 weeks (01 June 2011 to 31 May 2012) by providing supplementary feeding of different nutrient dense diets in addition to scavenging. Two villages, each of Ramgati, Raipur, Begumganj and Subornachar upazilas were considered for the feeding trial. The villages are: Char Laurence, Char Kalkini, Char Baga, Rakhalia, Tafader Bazaar, Rajgonj, Char Bagha, Char Bazlul Karim.

Experimental design and treatments

Five dietary treatments were compared. Each treatment had three replications each of six ducks (one male and five female). Male was considered to ensure the production of fertile eggs. In the laying period, the control group was reared under traditional feeding practices as followed by the farmers and the remaining four groups received (supplemental diets) a layer ration in addition to scavenging feeds.

Composition of experimental diets

The feed ingredient and nutrient composition of the layer diets are shown in Table 1.

Table 1: Ingredient and nutrient composition of the layer ration (%)

Feed ingredients/ Nutrients	Layer ration		
	LND	MND	HND
Ingredients (%)			
Maize	16.00	35.80	58.50
Broken rice	37.00	30.60	10.00
Rice polish	11.50	1.40	--
Wheat bran	10.50	--	--
Mustard oil cake	8.50	9.00	6.90
Soybean meal	8.00	14.90	8.00
Protein concentrate	--	--	10.00
Limestone	5.70	5.50	4.40
DCP	2.05	2.05	1.30
Vitamin-mineral premix	0.25	0.25	0.25
Salt	0.5	0.5	0.5
Total	**100**	**100**	**100**
Nutrient composition			
Metabolizable energy (kcal/kg)	2499	2700	2890
Crude protein (%)	14.02	16.02	18.02
Calcium (%)	2.82	2.79	2.79
Total phosphorus (%)	0.82	0.77	0.80
Available phosphorus (%)	0.51	0.51	0.48
Lysine (%)	0.75	0.72	0.76
Methionine (%)	0.39	0.53	0.46

* The treatment which contained 50% rice polish and 50% broken rice contained 9.5% CP and 2850 kcal ME/kg. Control group= scavenging + minimum amount of supplementation (such as rice polish, broken rice and boiled rice).

Method of feeding

Fifty percent of the daily feed requirement of the birds (70g) was supplied through supplementary feeding assuming that the remaining quantities will be fulfilled from scavenging (Rahman, 2010).

The experimental ducks were allowed to scavenge freely in the natural water bodies (agricultural fields, ponds, ditches etc) in and around the farmers house approximately for 9 hours daily from 8.00 am to 5.00 pm except during sowing and harvesting time. Daily recommended amount of supplementary feeds were divided into two parts and supplied twice daily; first in the morning and second time on return from scavenging. Feeds were supplied in the bowls in the form of dry mash and bowls were cleaned properly before each time of feeding and sufficient fresh and clean drinking water were also supplied in separate bowls in each feeding time.

Immunization

All ducks were vaccinated against duck plague and duck cholera as per recommendation of the manufacturer (details are shown in Table 2).

Table 2: Vaccination schedule

Name of vaccines*	Age (days)	Name of diseases	dose	Route	Remarks
Duck Plague	18-20	Duck Plague	1 ml	Intramuscular	Initial dose
	33-35	Duck Plague	1 ml	Intramuscular	Booster dose
	180	Duck Plague	1 ml	Intramuscular	Once in 6 month
Duck Cholera	40-45	Duck Cholera	1 ml	Subcutaneous	Initial dose
	55-60	Duck Cholera	1 ml	Subcutaneous	Booster dose
	180	Duck Cholera	1 ml	Subcutaneous	Once in 6 month

Manufactured by: Livestock Research Institute, DLS, Mohakhali, Dhaka, Bangladesh.

Growth performance

Live weight of individual bird was recorded initially and then at monthly (30 days) interval in the morning before feeding time. Final live weight was recorded at the end of the experiment and weight gain was calculated by deducting the initial weight from the final weight. Survivability of birds was computed by subtracting the dead birds from the number of birds considered at the start of the trial. Live birds were then divided by the initial live birds and expressed as percent. The survivability percent of the birds was calculated separately for each replication at the end of the experiment.

Laying performance

Daily egg production of individual replication was recorded and egg production performance was calculated as percent production on live bird basis. All the eggs obtained from each treatment group were individually weighed. Egg mass production was measured for each replication. Feed consumption was calculated by deducting the amount retained at the end of each month from the amount supplied and expressed as g/bird. Feed conversion ratio (FCR) was calculated as weight of feed consumed divided by total egg mass. The egg production and egg mass production were calculated using following a formula.

$$\text{Hen-day egg production (\%)} = \frac{\text{Total no. of eggs laid}}{\text{No. of days in lay} \times \text{No. of live birds}} \times 100$$

$$\text{Egg mass production (g/duck/day)} = \frac{\text{Total egg weight (g)}}{\text{No. of ducks} \times \text{total days in lays}} \times 100$$

Benefit cost ratio (BCR)

Costs that were incurred due to dietary intervention and output in terms of egg production performance were measured. Benefit cost ratio was calculated by following formula:

$$\text{Benefit cost ratio (BCR)} = \frac{\text{Total income}}{\text{Total cost}}$$

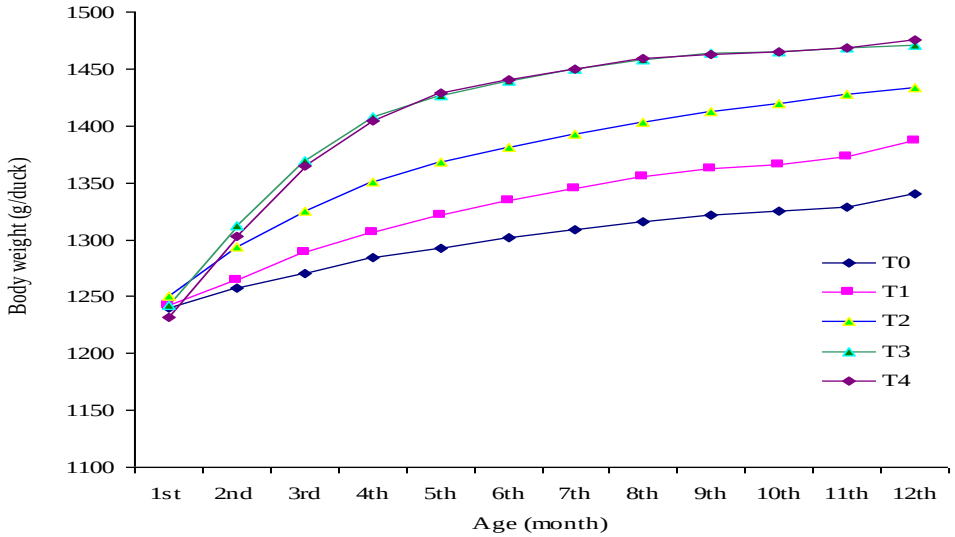
Statistical analysis

Data collected and calculated for different variables were subjected to analysis of variance in accordance with the procedures of 4 × 5 factorial experiment using a statistical package of SAS (2007).

III. Results and Discussion

Growth performance

The growth performance of experimental laying ducks is presented in Table 3. The initial body weight was not statistically significant ($P>0.05$) among the treatments, location and for their interaction. The final body weight increased significantly ($P<0.01$) with increasing density of nutrients in the diet. Ducks that received HND and MND diet showed body weight very close to each other (1475g and 1471g respectively) and could be considered as highest followed by those fed on LND diet (1433g) and BR + RP diet (1387g), respectively.



*T0= Control group, T1= A mixture of broken rice and rice polish (50:50), T2= Low nutrient density diet (LND), T3= Moderate nutrient density diet (MND) and T4= High nutrient density diet (HND).

Fig. 1: Body weight of indigenous ducks fed on different nutrient density diets

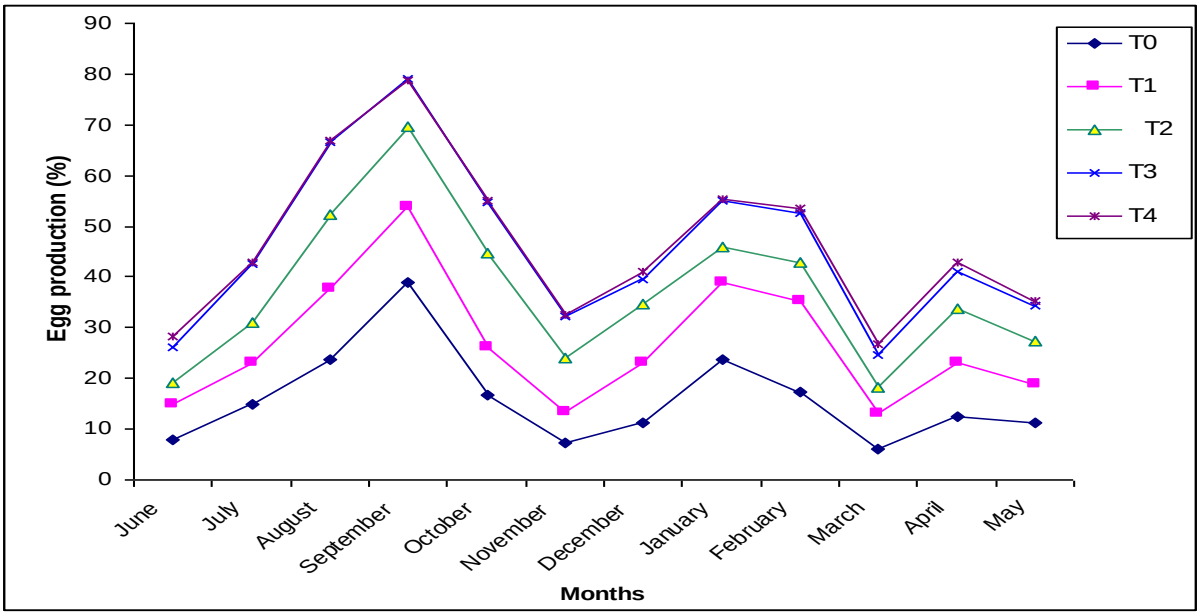
The birds of the control group had the lowest weight (1340g). The final body weight of ducks increased by 10.2% for HND and 9.9% for MND than that of control group since nutrient intake from total feed intake was higher in HND and MND diet groups. This finding was in well agreement with the previous finding obtained from cross-bred (Sonali) chicken experimentation of Dhar *et al*. (2007) who stated that body weight was highest which received HND diet (CP 16% and ME/kg 2950 kcal). Rahman *et al*. (2007) found the highest body weight of Jinding ducks at 12 months of age when ducks received 70g feed under scavenging system of rearing. They also reported that the live weights of Jinding ducks significantly ($P<0.01$) increased by feeding standard ration (body weight, 1680g) and broken rice (body weight, 1635g) than those of a mixture of rice polish and broken rice (body weight, 1576g), a mixture of rice polish, broken rice and wheat bran (body weight, 1650g), only rice polish (body weight, 1540g) (supplementation was same amount**)** and the control (body weight, 1511g) group (only scavenging). The nutrient composition of standard ration was 2664 kcal ME/kg and 18.03% CP. The nutrient composition of MND diet in the present study was more or less similar to standard ration fed by Rahman *et al*. (2007). Figure 1 shows that body weight was increased almost in a linear fashion with increasing nutrient density. No effects were found for variation in location and interaction of locations and diets in case of final body weight (Table 3).

The results of weight gain also differed significantly ($P<0.01$) among the treatment groups. The highest body weight gain was found in HND diet (243g) followed by MND (229g), LND (183g), BR + RP diet (145.5g) and control group (99.5g), respectively (Table 3). Resembling with final body weight, the live weight gain was also increased by supplementation. This result was close to the observation of Zhou *et al.* (2001) and Dhar *et al*. (2007). They reported that body weight gain was increased by increasing of dietary ME and CP contents of the diets. Several researcher (Nahid, 1992; Huque, 1999 and Men *et al*., 2003) found significantly higher live weight gain in ducks fed supplemented diets to compare to only scavenging groups irrespective of breed and types. In a previous work by Huque *et al*. (1994) concluded that scavenging feeds are lacking in nutrients to support the optimum growth of ducks. However, location and the interaction of location and treatment (T X L) had no effect on body weight gain.

Laying performance

Laying performance in terms of egg production, total egg mass production and daily egg mass output increased ($P<0.01$) linearly with increasing nutrient density (Table 4). The egg production was more or less similar in HND and MND (46.71% and 45.82%) diet groups followed by LND (36.99%), BR+RP (26.85%) and control (15.75%) groups, respectively. The control group showed the lowest production performance because of insufficient feed and nutrient intake from scavenging sources. Poor nutrition had a much greater effect on production performance than the genetic influence reported by Sazzard *et al*. (1988). Awad *et al*. (2011) found that Domyati ducks at 20-44 weeks of age with different levels of ME (2750, 2850 and 2950 kcal/kg) and CP (15, 17 and 19% CP) showed the highest egg production by feeding the diet containing 2750 kcal ME/kg and 19% CP. In the present study, the highest egg production was observed by the supplementation of the diet containing 2900 kcal/kg ME and 18% CP. Correspondingly, Maogao *et al*. (1996) stated that egg production

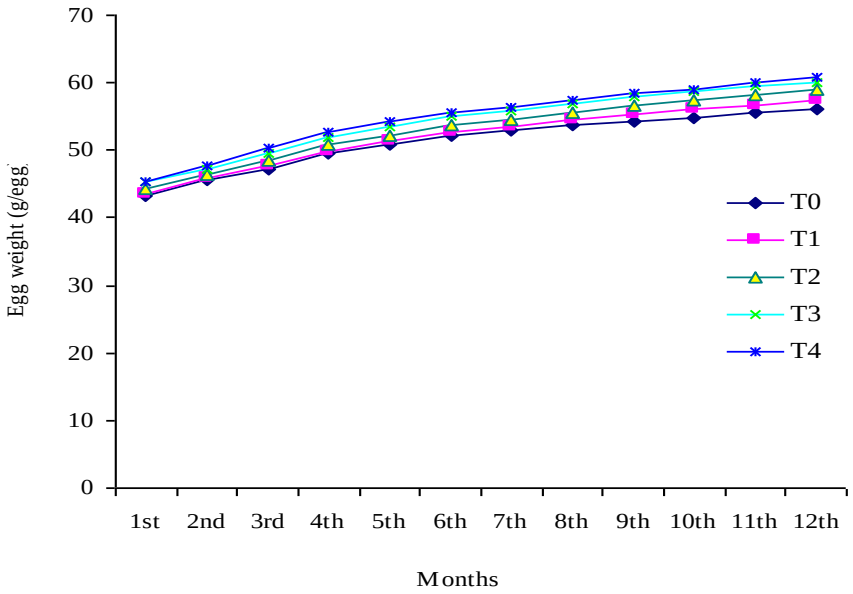
was significantly increased (P<0.05) when dietary ME increased from 10.67 to 11.30 MJ/kg. The present study was well agreement with the study of Huque *et al.* (1991) who found that the significantly (P<0.05) higher egg production with supplementary feeding as compared to only scavenging. Accordingly, Huque and Ukil (1993) reported that supplementation of laying family duck with fifty percent feed containing 19.89% CP showed the double egg production than that of non-supplemented group under scavenging condition. In another experiment, Rashid *et al.* (1995) conducted an experiment with and without supplementary feeding with three genotypes of ducks under scavenging condition. They found that supplementary feeding group showed improved production performance irrespective of breed. Similar trend of egg production was observed by Huque and Hossain (1991); Huque *et al.* (1993); Ketaren (1998); Rahman *et al.* (2007) and Kabir *et al.* (2007). The results of these studies clearly demonstrated that the supplementary feeding in local ducks had positive effect on egg production irrespective of breed. The egg production differed significantly among locations and the highest value of egg production was reported in Ramgati (38.35%) followed by Subarnachar (36.55%), Begumgonj (32.66%) and Raipur upazila (30.14%), respectively. The interaction effect of locations and treatments (T × L) was significant (P<0.05) for egg production, daily egg mass and total egg mass production. Figure 2 indicated that the monthly egg production increased from July to September. Production then gradually declined to November and after November, egg production showed a further increase up to February and then declined again with the shortage of scavenging feed resources. Figure 2 also shows that there are differences in egg production among the diets but egg production increased with increasing nutrient density.



T0= Control group, T1= A mixture of broken rice and rice polish (50:50), T2= Low nutrient density diet, T3= Moderate nutrient density diet and T4= High nutrient density diet.

Fig. 2: Monthly egg production of indigenous ducks receiving varying nutrient density diets

Although no interaction was found between treatment and location (T × L) for egg weight, a linear increase (P<0.01) was found among all treatments compared to control group (Table 4 and Figure 3). The increase in egg weight due to dietary intervention agreed well with Huque *et al.* (1993) who observed higher egg weight in supplemented group (59g) than that of non-supplemented (57g) group. It is well known that egg weight increased with the advancement of birds' age. The present study also showed that the egg weight was increased with increase of bird's age but undoubtedly diets had a profound effect. Gous *et al.* (2000) stated that egg weight was increased with the advancement of age and supply of supplementary feed of laying ducks in all genotypes they studied. The present finding agreed with the findings of Yin *et al.* (2000a) who reported that as CP level is increased, average egg weight also gradually increased and CP levels had significant effect on egg weight of laying Shao ducks. Similar to egg production, egg weight was the highest in Ramgati (59.37 g/egg) followed by Raipur (58.86 g/egg), Subarnachar (58.33 g/egg) and Begumgonj upazila (58.31 g/egg). Figure 3 also showed that the egg weight was increased with increasing nutrient density and the advancement of age.



T0= Control group, T1= A mixture of broken rice and rice polish (50:50), T2= Low nutrient density (LND) diet, T3= Moderate nutrient density (MND) diet and T4= High nutrient density (HND) diet.

Fig. 3: Egg weight of indigenous ducks fed on varying nutrient density diets

Diets interacted among the locations to alter the overall productivity (P<0.01). Egg mass production in terms of total and daily output showed similar trends for the treatments and for the locations. For both parameters, the highest values of daily egg mass production (23.01 g/b/d) and total egg mass production (8.40 kg) were observed in Ramgati upazila and the lowest values were found in Raipur upazila (17.93 g/b/d and 6.54kg, respectively). The effect of treatments were also significant (P<0.01) for both total egg mass production (kg) and daily egg mass output and the values increased linearly from the control group to HND diet (Table 4). The egg production, egg mass production and total egg mass production differed significantly among the locations. Ramgati and Subarnachar upazilas showed highest productive performance because of the availability of a greater amount of scavengeable feeds such as green forages, small fishes, snails, duckweeds, various types of vegetables; a good number of aquatic fishes, weeds and cereal grains. These were available from different kinds of marshy land, agriculture field, canals, roadsides ditches, dogi, ponds, rivers etc. On the other hand, Begumgonj and Raipur upzilas were semi-urban areas, thus scavenge-able areas were limited. In two upazilas, there were no river and cannels nearby the research areas and a relatively small number of ponds, *dogi* and available agricultural fields. The variations in egg production probably arose from differences in nutrient concentration of the supplementary feeds and SFRB.

Feed conversion ratio (FCR) was highly significant (P<0.01) for both treatment and locations. The best FCR was found in HND (2.48) and MND (2.56) diet followed by LND (3.26) and BR + RP (4.62) groups, respectively (P<0.01). HND and MND diets showed statistically similar results. While the FCR of the control group was not calculated as the birds belonging to this group were dependent on scavenging feeds only. Rahman *et al*. (2007) also found that the best FCR (3.95) was in the standard ration containing 2664 kcal ME/kg and 18.03% CP than those of broken rice (4.84), a mixture of broken rice and rice polish (5.10), a mixture of broken rice, rice polish and wheat bran (5.25) and only rice polish (5.59), respectively. Several workers reported that supply of supplementary feed increased egg production as well as the FCR in ducks (Rahman *et al*., 2006; Huque *et al*., 1993; and Kabir *et al*., 2007). Increasing dietary protein concentration showed the improvement in feed efficiency (Oluyemi and Fetuga, 1978; Awad *et al*., 2011). Lower protein content of the supplementary feeds resulted low egg productivity which ultimately resulted in poor FCR. For egg production, the best FCR was found in Ramgati upazila (2.25) followed by Subarnachar (2.39), Begumgonj (2.75) and Raipur (2.94) upazila, respectively and the differences in values were highly significant (P<0.01) among locations (Table 4)**.** However, all FCR values are based on supplementary feeds only since the exact amount of feeds that the birds received from scavenging could not be ascertained.

The survivability results differed numerically during the experimental period, and the survivability was higher in improved diet groups because of sufficient nutrient intake through the supplementary feed provided than the ducks of control groups. Previous workers, (Huque *et al*., (1993); Sarker *et al*., 2003 and Islam *et al*. 2003) also reported a result similar to the results of present study. In another experiment, Rashid *et al*. (1995)

observed percent survivability of ducks as 92.67% and 88.67% with supplementary feeding and without supplementary feeding groups, respectively. However, the interaction of location and treatment did not show any significant differences (P>0.05) on survivability (Table 4).

Economic analysis

The expenditure for rearing indigenous ducks for egg production for a period of 12 months and profit margin are given in Table 5. The expenditure incurred for feed, vaccines and miscellaneous and total income means price of total egg. The highest cost of rearing ducks was observed in HND diet (Tk. 711.15) group and the lowest was in control (Tk. 315.00) group in which ducks were maintained traditionally method without supplementary feed. However, farmers supply simultaneously little amount of supplementary feed as usual, in addition to scavenging. As the other costs were similar for all treatments, the difference of cost was due to the supplemental feeds. There was a great variation in determining the total income of ducks which ranged between Tk. 377.00 and Tk. 1131.00 among the treatment groups. Although the income was highest in HND and MND diet, profit margin and benefit cost ratio (BCR) were lower in HND diet than those of MND and LND diets. The high cost was involved in the preparation of HND diet which reduced profit margin and benefit of the farmers. The present study was in well agreement with the findings of Rahman *et al*. (2007) who reported that total rearing cost and total income was highest in standard ration supplemented group however, BCR was highest in only broken rice supplemented group. The feed cost, total cost, total income, profit margin, the percent profit margin and BCR of ducks differed significantly (P<0.01) among the treatment groups. Considering the feed cost, the highest net profit was obtained from the supplementation of MND diet in comparison with other diets (Table 5).

IV. Conclusion

Although both MND and HND diets for laying ducks showed highest but more or less similar laying performance, the highest net profit was obtained from the supplementation of MND diet in comparison with other diets. Since the duck farmers are resource poor, it would be best to initially supply LND diet which would require less financial involvement. MND diet may also be consider for feeding although cost involvement is more but still would be profitable.

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