Assessment of the production performance and economic efficiencies of available chicken breeds (*Gallus domesticus* L.) in Rajshahi, Bangladesh

**Ripon Kumar Dutta, M. Saiful Islam** and Md. Ashraful Kabir

Department of Zoology, University of Rajshahi, Rajshahi 6205, Bangladesh

*Present address: Department of Biology, Holy Land College, Dinajpur 5200, Bangladesh;*  
*Corresponding author: saifulzoo@yahoo.co.uk*

**Abstract:** Production performance and economic efficiencies of broiler of Cobb 500, cockerel of ISA Brown, Fayoumi, and RIR (Rhode Island Red) and Sonali (derived from RIR♂ × Fayoumi♀) available in Rajshahi were investigated. Identical care and management practices were provided to chickens of all genetic groups reared for meat and egg production. Performance of four meat purpose chickens viz., Cobb 500, ISA Brown, Fayoumi and Sonali were evaluated in terms of such important parameters as initial body weight (IBW), 5-wk rearing period (RP), achieved body weight (ABW), feed intake (FI), body weight gain (BWG) and feed conversion ratio (FCR). Performance of three egg purpose chickens viz. Fayoumi, RIR and Sonali included weight of day-old chick (WDOC), growth rate (GR), death rate (DR), fertility (FR), hatchability (HT), first laying age (FLA) and monthly egg production (MEP). Economic efficiency parameters viz., total cost (TC), gross return (GRR), net return (NR) and cost-benefit ratio (CBR) were calculated for both types. In terms of FI, FCR and BWG values, broiler of Cobb 500 was the best preferred and cockerel of ISA Brown the least preferred chicken. Conversely, in terms of the CBR values for meat producers, the cockerel of ISA White (1.58) was the best and the broiler of Cobb 500 (1.15) the worst. Taking the FLA and MEP into account, RIR topped the list (19.1 wks and 23 eggs per month) whereas Cobb 500 ranked at the bottom (25.2 wks and 16 eggs per month). CBR for egg productivity, on the other hand, was highest in Sonali (1.11) followed by RIR and Fayoumi (1.10 each) and Cobb 500 (1.09). As regards the meat productivity, significant correlations existed between TC and NR for all chickens except Sonali, which exhibited a negative correlation between the traits. Negative and non-significant associations prevailed for egg productivity in all the chickens. Although broiler of Cobb 500 was found to be the most popular for meat and RIR for egg, the cockerel of ISA Brown was the chicken that earned the maximum CBR.

**Key words:** Production performance, chicken breeds, meat and egg producers, economic efficiency, cost-benefit ratio

**Introduction**

Bangladesh is an agro-based developing country in the Southeast Asian region and livestock especially poultry is a promising sector for employment generation and poverty reduction in this country (GOB, 1999). The contribution of poultry to the total animal protein was about 22 to 27 percent in the country (Ahmed & Haque, 1990). About 89% of the rural households that rear livestock were also found to rear poultry (BBS, 1996). Poultry meat and eggs are used chiefly as human food and poultry meat alone contributed 29% of the total meat production in Bangladesh (BBS, 2001). FAO (2003) estimated the status of poultry production in the country to be 140 million chickens and 13 million ducks. Studies on productive and reproductive performance of chickens under intensive management (Islam et al., 2003) and a comparative assessment of hatchability of different strains of broiler parent stock (Mamum, 2005) provide important guidelines for the poultry enterprise in the country.

Islam (2005) described the comparative performance of the broiler parent stocks of Fayoumi and studied their fertility and hatchability, while Rashid et al. (2005) studied the reproductive and meat yield parameters of crossbred chickens. Further reports on the production performance of Fayoumi (Khan et al., 2006), commercial broiler (Nahar et al., 2007) and the hybrid Sonali (Sarkar, 2007) verified that these breeds are suitable for the environment of Bangladesh. Quantitative data on the White Leghorn (WLH), Rhode Island Red (RIR) and indigenous chicken revealed that RIR was the superior breed where the egg was heavier in size and the indigenous breed was famous for its flavour and meat quality (Islam & Nahar, 2008).

The most popular poultry genetic resources of the country include chicken, duck and pigeon (Faruque et al., 2009) and broiler is a specially preferred breed for commercialization in Bangladesh (Islam et al., 2010). From the current situation of small-scale production units, it has become essential to get some clear-cut conception on financial statement of poultry production scenario in the country. So, the present study was designed to evaluate the production performance and economic efficiencies of different genetic group of chickens available in Rajshahi. These findings would be valuable to the policy makers and extension workers in order to guide policies towards increasing efficiency of the poultry enterprise in Bangladesh.

**Materials and Methods**

**Experimental design:** Day-old chicks of Cobb 500, ISA Brown and Fayoumi were procured from the hatchery of Index Group, Rajendrapur, Gazipur and were reared at Basit Poultry and Hatchery, Tetulia, Darusa of Rajshahi District. For obtaining day-old Sonali chicks, RIR cocks...
Selection of chicken breeds: Four meat producers (Cobb 500, ISA Brown, Fayoumi and Sonali) and three egg producers (Fayoumi, RIR and Sonali) were considered for this study. Cobb 500 is the parental broiler stock in Bangladesh which is raised specifically for meat production. It was introduced in the sub-continent from USA during 1930s and became a dominant breed nowadays. Before the development of commercial poultry breeds, the males were slaughtered for meat and the females were kept for egg production. The standard body weight of the cock is 2.3-3.0kg and hen 1.5-2.0kg. The cockerels of ISA Brown are characterized by their white plumages. Average weight of the chicks is 0.55kg. Fayoumi, originated in Egypt and has been present in the West since 1940, is a light-weight fowl which has upright tail and forward breast and neck. Fayoumi cock is around 2kg and hen 1.6kg, which produces about 200 eggs per year. The RIR originated from New England of the USA by hybridization of Leghorn (Malay wild fowl) and Asian local variety. RIR cocks weigh approximately 4kg, hens 3kg, cockerels 3.4kg and pullets 2.5kg. The hybrid Sonali is derived from the cross between RIR cock and Fayoumi hen. The average body weight of the cock is 2.5kg and hen is 2kg. This breed is popular for its light weight, body colour and taste resembling that of indigenous chicken.

Selection of study area: A total of six private farms situated in the urban, semi-urban and rural areas of Rajshahi District were selected randomly from six Upazillas viz., Boalia, Godagari, Motihar, Mohonpur, Poba and Rajpara. The average flock size of each farm was 500 chickens. All the five breeds had considerable customer demand either for meat or egg characteristics and are available in the selected farms and local markets. Data were collected during the period of July 2009 and June 2010.

Poultry management system: The poultry management of the selected farms varied according to prevailing weather conditions of the locality and system of poultry rearing. However, poultry keepers practice three general systems (Prasad, 2000) that include (i) free-range system, (ii) semi-intensive system and (iii) intensive systems viz. cage or battery system and deep litter system. However, the cage system is the latest invention for the poultry entrepreneurs. In this system, the birds are confined in a cage just large enough to permit very limited movement and allow the bird to stand and sit comfortably. The usual floor space of the cage is 14 by 16 inches and the height is 17 inches. The floor is made with strong galvanized wire and a tray is fixed underneath the floor for collection of droppings. The feeder and waterer remain outside of the cage. Cage system can be used for birds of all age groups and in all climate conditions while, the deep litter system is widely used for scientific and successful poultry farming in all over the world. Here the poultry birds are kept in large pen up to 250 birds each in a house, whose floor is covered with dry litter up to a depth of 20 to 30 cm. Rice husk, saw dust, dried leaf, chopped straw and ground nutshell, depending upon their availability, can be used as litter materials. Since deep litter resembles dry compost, ammonia gases come out of this litter so it needs to be cleaned regularly.

Parameters studied: Meat production performance of the chickens were investigated in terms of several important production parameters (Juli, 1952) such as initial body weight (IBW in g), 5-wk rearing period (RP in wks), achieved body weight (ABW in g), feed intake (FI in g), body weight gain (BWG in g) and feed conversion ratio (FCR). Egg productivity was evaluated, according to Ketelaere et al. (2002), in terms of weight of day-old chick (WDOC in g), growth rate (GR in g), death rate (DR in %), fertility (FR in %), hatchability (HT in %), first laying age (FLA in wks), and monthly egg production (MEP in numbers). The economic efficiencies (all in Tk.) for the rearing of meat and egg purpose chickens were evaluated following Nair & Ghadoliya (2000) and Alabi & Aruna (2005) by estimating total cost (TC), gross return (GRR), net return (NR) and cost-benefit ratio (CBR). Expenses involved for dead birds were also included in TC, whereas NR was calculated on the basis of live weights of the birds ready for selling.

Statistical analyses: For computing analysis of variance (ANOVA), a completely randomized design involving 5 chicken breeds, each with three replications was used. Treatment means for each parameter were compared using the least significant difference (LSD) tests. Moreover, co-efficient of correlation (r) values between the economic efficiency parameters excepting CBR were also calculated for both meat and egg productivity. SPSS version 11.0 for Windows was used for the statistical analyses.

Results and Discussion
Meat productivity: Results clearly demonstrate that broiler of Cobb 500 attained the highest BWG as well as FCR (Table 1, Fig. 1) compared to the rest of the breeds whereas Fayoumi showed the lowest value for BWG and ISA Brown for FCR. However, a similar trend was reflected in terms of FI where Cobb 500 showed the highest and ISA Brown the lowest. The gain in body weight was statistically significant between the breeds (F3, 11=7.96; P<0.001), although insignificant difference in BWG existed between Sonali and ISA Brown.

The present findings are logical as rearing temperatures and genotypes influenced the productive performance of broilers chickens (Aengwanich, 2007). The supplementary feed like blood meal not only increased the growth performance of broiler chicks but also enhanced the growth and feed conversion efficiencies significantly (Shahidullah et al., 2008; Habib et al., 2009).
Table 1. Production performance parameters of the chicken breeds in Rajshahi reared for meat.

<table>
<thead>
<tr>
<th>Breeds</th>
<th>IBW</th>
<th>ABW</th>
<th>FI</th>
<th>BWG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cobb 500</td>
<td>41.5±0.85a</td>
<td>1390.4±5.24b</td>
<td>2347.7±8.86b</td>
<td>1348.9±4.86b</td>
</tr>
<tr>
<td>ISA Brown</td>
<td>32.2±1.47c</td>
<td>417.9±3.78c</td>
<td>1177.9±15.04c</td>
<td>365.7±5.24c</td>
</tr>
<tr>
<td>Fayoumi</td>
<td>32.1±1.55c</td>
<td>359.5±7.44d</td>
<td>1405.7±10.06b</td>
<td>327.4±6.78d</td>
</tr>
<tr>
<td>Sonali</td>
<td>33.3±2.36c</td>
<td>407.5±23.17c</td>
<td>1395.3±8.56b</td>
<td>374.2±24.86c</td>
</tr>
</tbody>
</table>

Rearing period of 5 wks for all breeds; values are mean±SD of three replicates; IBW= initial body weight (g); ABW= achieved body weight (g); FI= feed intake (g); BWG= body weight gain (g); different superscripts for a parameter in the same column differ significantly by LSD (P<0.05).

Fig. 1 Feed conversion ratio (FCR) for different chicken breeds reared for meat production in Rajshahi.

Moreover, Paul (2010) observed that multivitamin and enzyme supplementation significantly increased body weight in broiler chickens and the deficiency of vitamin C was related to meat yield reduction of broilers in a hot humid environment (Ali et al., 2010). Under intensive management system, on the other hand, chicken genotypes showed distinct physical variations for both qualitative and quantitative traits (Faruque et al., 2010). Growth parameters were also significantly affected by genotypes where male breeds exhibited higher average body weights than the female breeds and on average, hybrids consumed more feed compared to the purebreds (Ilori et al., 2010). The present variations in meat productivity parameters were likely due to the differences in genetic make-up and feeding and management practices of the chicken breeds under study.

Egg productivity: In terms of GR, RIR showed the highest value whereas Sonali exhibited the highest DR and HT values (Table 2). With respect to FLA, a highly significant difference existed between the chicken breeds (F3,11 = 14.74; P<0.001) but Sonali and Fayoumi showed almost similar FLA characteristics. Data on overall egg productivity parameters revealed that RIR had the shortest FLA but the highest MEP while Fayoumi attained the highest FLA and Sonali the lowest MEP (Table 2, Fig 2). These inconsistencies in egg productivity might be due to genetic make-up and housing system (Aemia et al., 2005) as they also affect laying performance in poultry breeds (Sonaiya, 2009; Wang et al., 2009; Banga et al., 2010).Stocking density has been shown to influence egg production and performance of broiler breeder hens as higher density produced fewer eggs (Mileni et al., 2007). In addition, egg storage periods may affect fertility and hatchability in poultry chicken species (Babiker & Musharaf, 2008; Caglayan et al., 2009), and feed restrictions (Sarica et al., 2009) season, flock age and disease-vaccination conditions (Turkyilmaz et al., 2010; Holt et al., 2011) were also found to interact growing and laying performance in chickens. Recent studies have demonstrated that although maternal dietary protein level had no effect on hatchability and growth rate (Kingori et al., 2010), but age (Bekele et al., 2010) and phenotype (Haunshi et al., 2011) affected production performances of laying hens. These crucial parameters need to be taken into account for commercial poultry egg productivity in the country.

Table 2. Production performance parameters of the chicken breeds in Rajshahi reared for eggs.

<table>
<thead>
<tr>
<th>Breeds</th>
<th>WDOC</th>
<th>GR</th>
<th>DR</th>
<th>FR</th>
<th>HT</th>
<th>FLA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fayoumi</td>
<td>32.6±1.06c</td>
<td>11.7±0.04c</td>
<td>1.68±0.20d</td>
<td>91.2±0.64a</td>
<td>82.9±0.40b</td>
<td>22.4±0.20b</td>
</tr>
<tr>
<td>RIR</td>
<td>33.8±1.34b</td>
<td>13.8±0.10b</td>
<td>2.82±0.15c</td>
<td>89.5±2.65b</td>
<td>83.1±1.66b</td>
<td>19.1±0.33c</td>
</tr>
<tr>
<td>Sonali</td>
<td>33.8±1.86b</td>
<td>13.7±0.10b</td>
<td>3.82±0.15a</td>
<td>91.2±0.30a</td>
<td>83.3±1.41b</td>
<td>21.1±0.61b</td>
</tr>
</tbody>
</table>

Rearing period of 72 wks for all breeds; values are mean±SD of three replicates; WDOC= weight of day-old chick (g); GR= growth rate (%); DR= death rate (%); FR= fertility (%); HT= hatchability (%); FLA= first laying age (wk); different superscripts for a parameter in the same column differ significantly by LSD (P<0.05).
Fig. 2 Monthly egg production (MEP) of three chicken breeds reared for egg production in Rajshahi.

Table 3. Economic efficiency of chicken breeds per bird reared for meat production and their correlation values

<table>
<thead>
<tr>
<th>Breeds</th>
<th>TC</th>
<th>GRR</th>
<th>NR</th>
<th>CBR</th>
<th>Co-efficient of correlation values (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TC vs. GRR</td>
<td>TC vs. NR</td>
<td>GRR vs. NR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cobb 500</td>
<td>83.4±1.67a</td>
<td>97.3±4.32b</td>
<td>13.9±2.81d</td>
<td>1.17a</td>
<td>0.939*</td>
</tr>
<tr>
<td>ISA Brown</td>
<td>49.2±3.35b</td>
<td>77.9±2.66a</td>
<td>28.8±0.85a</td>
<td>1.58a</td>
<td>0.985**</td>
</tr>
<tr>
<td>Fayoumi</td>
<td>45.8±1.85c</td>
<td>61.0±1.38b</td>
<td>15.2±3.22b</td>
<td>1.33c</td>
<td>-0.987ns</td>
</tr>
<tr>
<td>RIR</td>
<td>48.6±0.52b</td>
<td>63.0±2.30b</td>
<td>14.4±2.32c</td>
<td>1.29d</td>
<td>0.068ns</td>
</tr>
<tr>
<td>Sonali</td>
<td>41.9±2.64c</td>
<td>64.2±3.99c</td>
<td>22.3±6.63b</td>
<td>1.54b</td>
<td>-0.997ns</td>
</tr>
</tbody>
</table>

Values of the cost items are mean±SD of three replicates; cost items included the cost (in Tk.) of chick, feed, litter, vitamins, vaccine, labour, electricity and miscellaneous expenses; TC= total cost; GRR= gross return; NR= net return; CBR= cost-benefit ratio; different superscripts for a parameter in the same column differ significantly by LSD (P<0.05); ns= not significant; *= P<0.05; **= P<0.01 and ***= P<0.001.

Economic efficiencies for egg producers: For a 72-wk egg purpose rearing, TC was the highest in RIR the lowest in Sonali, consequently, NR was the highest in RIR and the lowest Fayoumi (Table 4). However, it was interesting to note that CBR became the highest in Sonali and identical in RIR and Fayoumi. In addition, negative and non-significant associations prevailed for egg productivity in all the chickens, suggesting that egg purpose rearing of chicken breeds was not profitable in the study area. Although broiler of Cobb 500 was found to be the most popular for meat and RIR for egg, the cockerel of ISA Brown was the chicken that earned the maximum CBR.

Table 4. Economic efficiency of chicken breeds per bird reared for egg production and their correlation values

<table>
<thead>
<tr>
<th>Breeds</th>
<th>TC</th>
<th>GRR</th>
<th>NR</th>
<th>CBR</th>
<th>Co-efficient of correlation values (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TC vs. GRR</td>
<td>TC vs. NR</td>
<td>GRR vs. NR</td>
<td></td>
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</tr>
<tr>
<td>Fayoumi</td>
<td>1062.4±42.76a</td>
<td>1166.1±16.92b</td>
<td>103.7±40.14c</td>
<td>1.10b</td>
<td>0.348ns</td>
</tr>
<tr>
<td>RIR</td>
<td>1122.4±14.2c</td>
<td>1243.3±35.44a</td>
<td>120.9±48.66a</td>
<td>1.10b</td>
<td>-0.904ns</td>
</tr>
<tr>
<td>Sonali</td>
<td>1060.9±32.16a</td>
<td>1175.4±36.32b</td>
<td>114.5±43.96c</td>
<td>1.11a</td>
<td>0.180ns</td>
</tr>
</tbody>
</table>

Values of the cost items are mean±SD of three replicates; cost items included the cost (in Tk.) of chick, feed, litter, vitamins, vaccine, labour, electricity and miscellaneous expenses; TC= total cost; GRR= gross return; NR= net return; CBR= cost-benefit ratio; different superscripts for a parameter in the same column differ significantly by LSD (P<0.05); ns= not significant; *= P<0.05; **= P<0.01 and ***= P<0.001.

In agreement with the observations of Gordon et al. (2009), it became evident from the present results that profits associated with lighter hens like ISA Brown and Sonali were higher than those associated with heavy hens such as RIR and Cobb 500 and the increased profitability of lighter hens was largely due to their improved feed conversion, because lighter hens produced predominately larger or extra large eggs. Broiler farming with Cobb 500 was reported profitable because of lower investment, less space requirement, utilization of family
labour and quick returns as examined by Islam et al. (2010). This contradicts with the present findings because cockerel of ISA Brown was found to be earning the maximum CBR. Substantial technical, allocative and economic inefficiency for egg purpose rearing of the poultry breeds might be the cause of loosing concern and/or marginal profits compared to that for meat purpose rearing which lend support to the findings of Begum et al. (2010). The present results therefore emphasize the need for adequate knowledge on poultry productivity and profitability to the government policy makers, producers and marketers, thus suggesting for an integrated approach to genetically improved chicken breeds and strict bio-security poultry farming in the country.

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