Evaluation of Productivity, Disease Incidence and Profitability of Three Chicken Breeds (*Gallus domesticus* L.) Under Smallholders’ Farm Conditions in Rajshahi, Bangladesh

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Abstract. A sustainable poultry enterprise is largely dependent on, among others, productivity and profitability of the reared chicken breeds in relation to combating diseases in the flocks under farm conditions. Keeping these vital features of poultry management in mind, the present study assessed the productivity, disease incidence and profitability analysis of a government, 10 private and 10 backyard smallholders’ poultry farms for rearing and marketing three available chicken breeds viz., indigenous (*Deshi*), Fayoumi (an exotic) and *Sonali* (a crossbred) in 10 Upozillas or Police Stations of Rajshahi district viz. Baghmara, Boalia, Godagari, Mohonpur, Mothar, Paba, Puthia, Rajpara, Shahmokdum and Tanor. The investigation was conducted from January to December 2014 during which data were collected twice a month. In terms of producing live chickens for marketing, productivity of the farms varied significantly during both January-June and July-December rearing seasons (P<0.001). The private farms always outnumbered the government and backyard counterparts in producing chickens. The study identified nine parameters on disease incidences on the poultry production system from elevated (score 5) to absence of acceptable practices (score 1), which exhibited significant variation (P<0.05) except viral, fungal and bacterial diseases and the rate of disease occurrence per rearing period. The mean scores for disease incidences declined during July-December period of rearing. Results on the profitability analyses showed highly significant difference between the farms (P<0.001) where it appeared that strict bio-safety oriented management practices, coupled with the selection of fast growing and heavy laying breeds of chickens could ensure profitability of the poultry farms in the study area.

Keywords: Chicken breeds, Disease incidence, *Gallus domesticus*, Poultry, Productivity, Profitability

1. INTRODUCTION

Being a Southeast Asian agro-based developing country, Bangladesh offers an immense opportunity for poultry enterprise as a source of cheap protein in the region (FAO, 2003). Poultry is one of the best tools for poverty reduction where smallholders’ backyard chicken production represents subsistence activities, providing egg and meat for family consumption and cash income (Farooq et al., 2004). In comparison to other livestock, poultry requires less investment to start the farming. Persons from low-income group may also start the business on a small scale. Recently, *The Financial Express* Bangladesh (FEB) has published two reports which observed that poultry industry of the country is growing fast and it can play a vital role in the economic development of the country (FEB, 2015).

Productivity of poultry farms in the country has no official estimates. Literature survey revealed that there are only about 52,000 registered farms in Bangladesh although there exists some 3 lacs farms in the country (Islam, 2008), which support overall 1.6% of the GDP (Parvez, 2008a, b). According to an estimate, Bangladesh needs from 4.5 to 5 metric tons of processed broiler chicken as meat per day, where poultry can provide 90% protein in which the percentage of processed chicken is only 15%, and about 1.75-2.00 lacs chickens are consumed by human per day only in Dhaka City (Billah, 2008). In subsequent studies, production performance of the naked neck (Islam and Nishibori (2009), indigenous (Hossen, 2010), several poultry breeds (Dutta et al., 2012a), and *Sonali* chickens (Hossen et al., 2012) were reported. However, a recent study revealed that the progress of the family poultry production in the country was not satisfactory (Billah et al. (2013). Production performance of non-descriptive indigenous (*Deshi*), naked neck (NN) and hilly (HL) genotypes in Bangladesh was compared by Faruque et al. (2013). Significance (Shamsuddoha et al., 2013) and challenges (FEB, 2013) of poultry productivity,
coupled with effects of climate change on the poultry enterprise of the country (Ahmed et al., 2013) have been emphasized. Dutta et al. (2013) reported the productivity of the small-scale poultry farmers in Northern part of the country. Very recently, Sambo et al. (2015) demonstrated that the chicken production in India has a major role in the economy of the country where backyard production is particularly important to women.

Varied incidences of poultry diseases in Bangladesh have been reported in earlier papers (Sil et al., 2002; Alam et al., 2003; Islam et al., 2003; Islam and Samad, 2004). The presence or absence of avian influenza (AI) virus was detected at 17 primary laboratories in the country (Haque, 2008). Rahman et al. (2007), Sarkar et al. (2008) and Ahmed et al. (2009) reported incidences of various diseases in poultry farms while Hasib (2010a, b) cautioned about the coming back of bird flu because occasional recurrent attacks of this disease were found in several poultry farms in the country. Reports by Hossain et al. (2010), Uddin et al. (2010, 2011), Dutta et al. (2012b) and Islam et al. (2014) suggest that disease prevalence in poultry farms in Bangladesh mostly occurred on rainy, summer and winter seasons.

The cost-benefit or profitability analyses in poultry are crucial for sustainability of the enterprise in Bangladesh as well as elsewhere in the world. Poultry researchers in the country (Begum, 2005; Akhter and Rashid, 2008; Sarkar et al., 2008; Zaman et al., 2008; Dutta et al., 2012a; 2013; Masud and Real, 2013; Uddin et al., 2013, 2014; Islam and Dutta, 2014); and those from Pakistan (Maqbool and Bukhsh, 2007; Bano et al., 2011), Iran (Heidari et al., 2013), Nigeria (Alabi and Aruna, 2005; Nworgu, 2007; Ike and Ugwumba, 2011; Adetola and Simeon, 2013) and Swaziland (Siyaya, 2013) have reported various aspects of the poultry farm economics and components of beneficial poultry raising.

Keeping the aforesaid works and literature survey in mind, the present work was aimed to evaluate the present status of the productivity, disease incidence and cost-benefit analyses of the available chicken breeds from one regional government farm, 10 randomly selected commercial private poultry farms and 10 backyard smallholders’ farms in Rajshahi Metropolitan areas. The present report therefore focuses on the following aspects: (a) farm- and breed-wise productivity performance of the chickens under study; (b) comparisons of existing disease incidences in the poultry farms; and (c) analyses of cost-benefit with regards to the profitability index (PI) of rearing the chicken breeds in the study area.

2. MATERIALS AND METHODS

2.1. Selection of study area

Ten Upozillas (former Police Stations) of Rajshahi District, namely Baghmara, Boalia, Godagari, Mohonpur, Motihar, Paba, Puthia, Rajpara, Shahmokdum and Tanor, were selected for the study (Fig. 1). The main considerations in selecting the study area were: (a) a large number of poultry farms are raised in these areas; (b) no study of this nature was conducted previously; (c) the study areas are well-communicated; (d) co-operation from the farm owners was highly satisfactory; and (e) occasional outbreaks of bird flu (avian influenza, AI) and other poultry diseases, if any, are reported.

2.2. Selection of poultry farms

A total of 61 poultry farms, consisting of one government, 30 private, and 30 backyard smallholders’ [i.e. 1 + (10×3) + (10×3) = 61] were selected for the study. The poultry farm owners and/or officials were interviewed personally and data were collected using an interview schedule. The main consideration in selecting the poultry farms was: (a) the selected poultry farms were located in Rajshahi District; (b) a large number of indigenous chickens were raised in these areas; and (c) the indigenous (Deshi), Fayoumi and Sonali chickens were available in the selected poultry farms.

2.3. Selection of chicken breeds

Three available chicken breeds in the study area viz., indigenous (Deshi), Fayoumi, and Sonali (a hybrid derived from Fayoumi♀ × RIR♂) were selected for the present study.

2.4. Frequency of data collection

The study areas were visited twice a month during the study period from January 2014 to December 2014. Relevant information on productivity, disease incidences and cost-benefit components were updated from time to time using a structured questionnaire. Moreover, incidences of bird flu, if any, and other poultry diseases were recorded during each visit. Overall hygienic conditions and preventive measures were monitored from the beginning to the end of the investigation.
2.5. Parameters studied

2.5.1. Productivity

Farm- as well as breed-wise number of chickens produced in all 61 poultry farms during the study period was recorded. Data were collected fortnightly from January 2014 to December 2014.

2.5.2. Disease incidence

By using a 5-scale scoring system (Dutta et al., 2012b; Dutta et al., 2013), nine major such parameters on disease incidence as bacterial diseases (BD) i.e., bacillary white diarrhea (BWD), fowl typhoid, fowl cholera, infectious coryza, colibacillosis, omphalitis and mycoplasmosis; viral diseases (VD) i.e., Newcastle disease (ND), gumboro, fowl pox, bird flu, Marek’s disease, EDS’76, avian leucosis, infectious bronchitis and hydropericardium-hepatitis syndrome; fungal diseases (FD) i.e., brooder pneumonia or aspergillosis; infectious diseases including AI (bird flu) (ID/AI); diseases caused by botulism (DCB); monthly and yearly disease frequencies (MYDF); flock-wise disease commonness (FDC); seasonal disease prevalence (SDP) and rate of disease occurrence per rearing period (RDRP) were considered to rank the farms under study, where score 5 was considered as elevated, 4 as severe, 3 as gross, 2 as mild and 1 as absent.

2.5.3 Profitability analyses

The cost-benefit analyses, in terms of return on investment, were calculated from the data provided by the selected farms under study. Seven parameters such as TCP =Total cost of production i.e., amount spent for rent of the land/houses, purchase of day-old chicks, feed, medicine and wages, electricity and water bills, caring and depreciation; TR =Total revenue i.e., amount received from sales of chicken, eggs and poultry waste products; NP =Net profit i.e., NP =TR-TCP; CBR=Cost-benefit ratio i.e., CBR =TR÷TCP; RRI=Rate of return on investment i.e., RRI =NP÷TCP×100; GR =Gross ratio i.e., GR =TCP÷TR; and PI=Profitability index i.e., PI =NP÷TR, were studied to evaluate the cost and benefit of the farms in the study area. Return on investment from both Government and private farms and smallholders were analyzed by deducting the expenditure from sales of poultry and poultry products. Costs included rent of the land/houses, purchase of day-old chicks, feed, medicine and wages, electricity and water bills, caring and depreciation. Returns came from sales of chicken, eggs and waste products. The profits or losses of individual farms were calculated and finally return on investment and profitability indices (PI) were estimated according to Alabi and Aruna (2005) and Nworgu (2007) with slight modifications where necessary.
2.6 Statistical analyses

Data on productivity, management practices, disease incidences and feed supplement experiments were compiled, tabulated and analyzed in accordance with the objectives of the research. Analysis of variance (ANOVA), t-test and significant differences among treatment means were identified by Fisher’s least significant difference (LSD) tests (Steel and Torrie, 1984). All statistical analyses were performed using SPSS version 16.0 for Windows.

3. RESULTS

3.1. Productivity

The actual number of live chickens produced by the three categories of poultry farms during the study period from January 2014 to December 2014 is presented in Fig. 2 (Table 1). Results showed that breed-wise differences in production between the poultry farms are statistically significant (P<0.001) both during the first half (January-June) and the second half (July-December) of the study. However, it was interesting to note that the production of Fayoumi and Sonali chickens in both government and private farms declined, whereas the yield of the indigenous (Deshi) chickens in the backyard smallholders’ farms increased slightly. On average, the government farm produced 833 Fayoumi and 1917 Sonali, while the private farms produced 2335 Fayoumi and 2957 Sonali chickens, and the backyard farm owners produced 20 Deshi chickens during January-June, 2014 rearing. The production of the government farm declined to 667 Fayoumi and 1633 Sonali, compared to 1925 Fayoumi and 2495 Sonali by each private farm, whereas the backyard owners produced a mean of 21 Deshi chickens during July-December, 2014 season.

3.2. Disease incidence

The mean disease incidences in terms of nine parameters of the poultry farms of the study area along with their significance tests are shown in Fig. 3. The mean ±SD scores of the government, private and backyard farms during January-June rearing season were 2.96±1.17, 2.23±0.79 and 2.05±0.71, respectively. The prevalence of bacterial diseases (BD) was highest compared to other diseases in all three farm types in order of government > private > backyard, while the rate of disease occurrence per rearing period (RDRP) showed mean scores in order of private > backyard > government. The overall differences in poultry disease incidence scores between the farms were statistically significant (F_{2, 62} = 5.14; P<0.05).
Table 1: Productivity of the government, private and backyard smallholders’ poultry farms during January-December, 2014 in Rajshahi, Bangladesh

<table>
<thead>
<tr>
<th>Farms</th>
<th>FAY</th>
<th>SON</th>
<th>IND</th>
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</thead>
<tbody>
<tr>
<td>January-June</td>
<td></td>
<td></td>
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<tr>
<td>Government</td>
<td>833.33±76.38</td>
<td>1916.67±175.59</td>
<td>0.00±0.00</td>
</tr>
<tr>
<td>Private</td>
<td>2335.00±1508.95</td>
<td>2957.33±1991.64</td>
<td>0.00±0.00</td>
</tr>
<tr>
<td>Backyard</td>
<td>0.00±0.00</td>
<td>0.00±0.00</td>
<td>19.53±6.59</td>
</tr>
<tr>
<td>F-values</td>
<td>37.30</td>
<td>34.34</td>
<td>142.59</td>
</tr>
<tr>
<td>Level of sig.</td>
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</table>

| July-December |             |              |              |
| Government    | 666.67±92.79 | 1633.33±88.19 | 0.00±0.00   |
| Private       | 1925.00±158.16 | 2495.00±216.79 | 0.00±0.00   |
| Backyard      | 0.00±0.00    | 0.00±0.00    | 21.30±3.535 |
| F-values      | 76.78        | 68.75        | 590.35      |
| Level of sig. | ***          | ***          | ***         |

FAY, SON and IND refer to Fayoumi, Sonali and indigenous (Deshi) chicken breeds, respectively; all F-values were at 62 df; ***=P<0.001.

The disease prevalence scenario of the poultry farms changed during the second half of the rearing period from July to December, 2014 (Table 2). Here, the mean ±SD scores of the government, private and backyard farms were 2.22±0.67, 1.78±0.55 and 1.76±0.54, respectively, suggesting that the disease incidences declined remarkably. The prevalence of bacterial diseases (BD) was still highest compared to other diseases in all three farm types in order of government > private > backyard, while the rate of disease occurrence per rearing period (RDRP) showed mean scores in order of backyard > private > government. The overall differences in poultry disease incidence scores between the farms were significant (F2, 62 = 4.24; P<0.05). These findings could be interpreted by arguing that the improved management practices mentioned above might have contributed to the decline in poultry diseases in the poultry farms under investigation.
Table 2: Mean ±SD scores for disease incidence in the study area during January-December, 2014 in Rajshahi, Bangladesh

<table>
<thead>
<tr>
<th>Farms</th>
<th>BD</th>
<th>VD</th>
<th>FD</th>
<th>ID/AI</th>
<th>DCB</th>
<th>MYDF</th>
<th>FDC</th>
<th>SDP</th>
<th>RDRP</th>
<th>Mean scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan-June</td>
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<td></td>
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</tr>
<tr>
<td>Government</td>
<td>3.67 ±0.58</td>
<td>3.33 ±0.58</td>
<td>1.33 ±0.58</td>
<td>4.33 ±0.58</td>
<td>3.67 ±0.58</td>
<td>4.33 ±0.58</td>
<td>2.33 ±0.58</td>
<td>2.96 ±1.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>3.00 ±0.83</td>
<td>2.83 ±0.79</td>
<td>1.13 ±0.35</td>
<td>1.33 ±0.48</td>
<td>2.67 ±0.80</td>
<td>2.77 ±0.85</td>
<td>2.57 ±0.63</td>
<td>2.23 ±0.79</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Backyard</td>
<td>2.57 ±0.73</td>
<td>2.53 ±0.68</td>
<td>1.07 ±0.25</td>
<td>1.23 ±0.43</td>
<td>2.53 ±0.68</td>
<td>2.60 ±0.73</td>
<td>2.57 ±0.63</td>
<td>2.05 ±0.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F-values</td>
<td>4.20</td>
<td>2.38</td>
<td>1.11</td>
<td>27.14</td>
<td>0.37</td>
<td>8.10</td>
<td>2.73</td>
<td>7.87</td>
<td>0.78</td>
<td>5.14</td>
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<tr>
<td>Level of sig.</td>
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<td>***</td>
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<td>ns</td>
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<td>ns</td>
<td>*</td>
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<tr>
<td>July-Dec</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td>3.00 ±0.00</td>
<td>2.33 ±0.58</td>
<td>1.33 ±0.58</td>
<td>1.67 ±0.58</td>
<td>1.33 ±0.58</td>
<td>2.67 ±0.58</td>
<td>2.67 ±0.58</td>
<td>3.00 ±0.00</td>
<td>2.00 ±0.00</td>
<td>2.22</td>
</tr>
<tr>
<td>Private</td>
<td>2.37 ±0.49</td>
<td>2.23 ±0.43</td>
<td>1.10 ±0.30</td>
<td>1.13 ±0.43</td>
<td>1.23 ±0.45</td>
<td>2.27 ±0.55</td>
<td>2.20 ±0.43</td>
<td>2.23 ±0.30</td>
<td>2.10 ±0.30</td>
<td>1.87</td>
</tr>
<tr>
<td>Backyard</td>
<td>2.10 ±0.40</td>
<td>2.00 ±0.35</td>
<td>1.00 ±0.00</td>
<td>1.00 ±0.38</td>
<td>1.17 ±0.48</td>
<td>2.20 ±0.38</td>
<td>2.17 ±0.30</td>
<td>2.10 ±0.35</td>
<td>2.13 ±0.43</td>
<td>1.76</td>
</tr>
<tr>
<td>F-values</td>
<td>7.06</td>
<td>2.37</td>
<td>3.38</td>
<td>9.40</td>
<td>0.35</td>
<td>1.36</td>
<td>1.51</td>
<td>8.37</td>
<td>0.27</td>
<td>4.24</td>
</tr>
<tr>
<td>Level of sig.</td>
<td>**</td>
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<td>***</td>
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</table>

BD= bacterial diseases, VD= viral diseases, FD= fungal diseases, ID/AI= infectious diseases/avian influenza, DCB= disease caused by botulism, MYDF= monthly and yearly disease frequencies, FDC= flock-wise disease commonness, SDP= seasonal disease prevalence, RDRP= rate of disease occurrence per rearing period; all F-values were at 62 df; *=P<0.05, **=P<0.01, ***=P<0.001; ns= not significant; 1Score indices: 5=Elevated; 4=Severe; 3=Gross; 2=Mild; 1=Absent.

Fig. 4: Profitability indices of the poultry farms (GOV= government; PRI= private; BAC= backyard) during January-December, 2014 in Rajshahi, Bangladesh

3.3. Profitability

The estimation of profitability indices (PI) from six cost-benefit components of the poultry farms of the present study is presented in Fig. 4. Analyses demonstrated that the government farm, having a PI value of -0.009, was a losing concern compared to both private (PI= 0.161) and backyard (PI= 0.666) poultry farms in the study area during January-June rearing period. All the cost-benefit components differed highly significantly (F^2, 62= 355.22; P<0.001) between the farm types. However, owing to some obvious reasons like increased customer demand, coupled with decreased disease incidences and feeble management practices, profitability of the Deshi chickens reared in backyard smallholdings was the highest compared to its private and government counterparts.

During the second half of the rearing season from July to December, 2014, the PI values of the government, private and backyard poultry farms were 0.008, 0.162 and 0.651, respectively. The results on
cost-benefit analyses were essentially similar to that of the first half of rearing stated earlier. Here also, all the cost-benefit components differed significantly (F₂,�² = 285.36; P<0.001) between the farm categories and the PI values were in order of backyard > private > government farms (Table 3).

Table 3: Cost-benefit components of the government, private and backyard smallholders’ poultry farms in the study area during January-December, 2014 in Rajshahi, Bangladesh

<table>
<thead>
<tr>
<th>Farms</th>
<th>TCP</th>
<th>TR</th>
<th>NP</th>
<th>CBR</th>
<th>RRI</th>
<th>GR</th>
<th>PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan-June</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Government</td>
<td>7099812.67</td>
<td>7042997.67</td>
<td>-56815.00</td>
<td>0.991</td>
<td>-853</td>
<td>1.009</td>
<td>-0.009</td>
</tr>
<tr>
<td>Private</td>
<td>3431601.07</td>
<td>3892559.43</td>
<td>460958.37</td>
<td>1.215</td>
<td>21.475</td>
<td>0.839</td>
<td>0.161</td>
</tr>
<tr>
<td>Backyard</td>
<td>3477.10</td>
<td>10498.73</td>
<td>7021.63</td>
<td>3.039</td>
<td>203.974</td>
<td>0.334</td>
<td>0.666</td>
</tr>
<tr>
<td>F-values</td>
<td>61.87</td>
<td>64.73</td>
<td>97.29</td>
<td>280.11</td>
<td>280.11</td>
<td>355.22</td>
<td>355.22</td>
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<tr>
<td>Level of sig.</td>
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<tr>
<td>July-Dec</td>
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<td></td>
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</tr>
<tr>
<td>Government</td>
<td>5899650.00</td>
<td>5854750.00</td>
<td>-49000.00</td>
<td>0.997</td>
<td>-792</td>
<td>1.008</td>
<td>-0.008</td>
</tr>
<tr>
<td>Private</td>
<td>3103338.33</td>
<td>3534098.33</td>
<td>430760.00</td>
<td>1.216</td>
<td>21.635</td>
<td>0.838</td>
<td>0.162</td>
</tr>
<tr>
<td>Backyard</td>
<td>4130.37</td>
<td>11675.70</td>
<td>7545.33</td>
<td>2.943</td>
<td>194.268</td>
<td>0.349</td>
<td>0.651</td>
</tr>
<tr>
<td>F-values</td>
<td>63.06</td>
<td>65.39</td>
<td>85.99</td>
<td>202.97</td>
<td>202.97</td>
<td>285.36</td>
<td>285.36</td>
</tr>
<tr>
<td>Level of sig.</td>
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</tbody>
</table>

TCP= total cost of production, TR= total revenue, NP= net profit; CBR= cost-benefit ratio, RRI= rate of return on investment, GR= gross ratio, PI= profitability index; all F-values are at 62 df; ***= P<0.001.

4. DISCUSSION

There are several published works on the productivity of poultry breeds in the country and elsewhere in the world. Islam and Nishibori (2009) was the first to recognize that indigenous naked neck (NN) chickens are suitable for production in a hot and humid climate of Bangladesh. The breed was found highly resistant to diseases and superior to indigenous full-feathered and exotic egg-type counterparts in terms of growth rate, egg production, egg quality and meat yield traits. Hossen (2010) determined the production performance of indigenous (Deshi) chickens under scavenging management, where average 3 clutches of eggs, about 45 eggs produced per year and about 124 days were needed to complete a production cycle. Subsequently, Dutta et al. (2012a) found satisfactory productivity of the broiler (Cobb 500), ISA brown, Sonali, Fayoumi and RIR chickens breeds in Rajshahi by private poultry farmers.

The high productivity of Sonali was studied in detail by Hossen et al. (2012) in five Upozillas of Joypurhat district. Studies by Ahmed et al. (2013) showed that livestock including poultry is likely to be affected by rapid climate change in Bangladesh whereas Billah et al. (2013) assessed that approximately 64% of the farmers were low producers compared to 30% for medium and 6% for higher producers in the country. Dutta et al. (2013) examined the production performance of indigenous chickens reared by small-scale poultry farmers which appeared to be an efficiently feasible enterprise in the country. Subsequently, Faruque et al. (2013) compared the production performance of the Deshi, NN and hilly (HL) genotypes where the NN was found genetically superior to Deshi and HL in terms of production and reproductive parameters. A report by FEB (2013) indicated that the poultry productivity of the country was facing three challenges: firstly, the lack of access to credit, secondly, competition from imports and thirdly, outbreaks of diseases, including avian flu. In addition, Shamsuddoha et al. (2013) arrived at a conclusion that there was a significant scope to establish and produce more poultry meat, eggs and chickens to balance the protein supply and intake in the country. In a very recent study, however, Sambo et al. (2015) observed that the backyard and semi-intensive chicken production in Ethiopia was influenced by the constraints to production, perceptions of disease risk factors and biosecurity measures. The aforesaid findings mostly corroborate to those reported here. The present results on productive performances of the indigenous, Fayoumi and Sonali chickens in Rajshahi, therefore are very
encouraging, perhaps owing to the fact that improved management practices and biosafety measures, coupled with timely vaccination programmes and increased awareness of the poultry farmers in the study area have improved the overall productivity of the chicken breeds.

In an earlier report Sil et al. (2002) observed that infectious bursal disease (IBD) caused 28.57% mortality; moreover, morbidity and mortality of yolk sac infection (YSI), hypovitaminosis-E, coccidiosis and miscellaneous conditions were recorded at variable percentages. Islam et al. (2003) diagnosed diseases like IBD (24.26%), Newcastle disease ND (6.73%), infectious bronchitis (0.29%), omphalitis (2.81%), fowl cholera (0.44%), salmonellosis (6.73%), colibacillosis (5.17%), necrotic enteritis (0.44%), aspergillosis (17.53%), infectious corzya (0.37%), chronic respiratory disease (CRD) or mycoplasmosis (5.32%), coccidiosis (9.46%) and deficiency disorders or stress conditions (1.03%). According to this report, however, poultry diseases in Bangladesh occur mostly in rainy season (56.36%), followed by summer (28.11%) and winter season (15.53%). Another report by Islam and Samad (2004) showed that about 12.87% chicks died within 60 days of age; and diseases associated with mortality in layer chicks included IBD (37.6%), coccidiosis (13.28%), CRD (13.28%) and other conditions (35.84%).

Rahman et al. (2007) studied 10 flocks from five farms where salmonellosis (53.90%), omphalitis (28.42%), colibacillosis (13.36%), mycoplasmosis (2.55%), necrotic enteritis (1.18%) and infectious corzya (0.59%) were prevalent. According to the findings of Sarkar et al. (2008), the highest mortality (8.3%) was found in the crossbred Sonali chickens when reared up to target weight of 1250g. The mortality of broiler was 1.4% and no bird died in the cockerel group. In Gazipur district, Ahmed et al. (2009) diagnosed colibacillosis (52.26%), mycoplasmosis (12.56%), salmonellosis (1.01%), omphalitis (11.56%), coccidiosis (4.52%), gumboro (11.06%), mycotoxicosis (5.53%), and mixed infections of gumboro and coccidiosis (1.51%). In Rajshahi and surrounding districts, Hossain et al. (2010) recorded 30.4% salmonellosis in summer and 61.6% mycoplasmosis in winter. On the other hand, in Narasingdi district Uddin et al. (2010) found IBD (24.96%), CRD (9.87%), ND (8.92%), aspergillosis (7.98%), salmonellosis (7.68%), coccidiosis (7.32%), colibacillosis (5.70%), ascites (5.45%), omphalitis (2.64%), deficiency diseases/stress conditions (1.34%), necrotic enteritis (0.40%), infectious corzya (0.32%), fowl cholera (0.24%) and infectious bronchitis (0.24%); where rainy season (47.09%), summer (27.53%) and winter (25.38%) had various disease prevalence in the poultry farms. In Mymensingh district also rearing seasons were found to influence poultry diseases (Uddin et al., 2011) where summer (8.57%), winter (6.51%) and rainy season (6.22%) had different disease prevalence. They recorded bacterial (7.08%), viral (5.81%), fungal (2.81%) diseases; and the major ones included salmonellosis (3.14%), colibacillosis (2.51%), nutritional disorders/others (2.48%), mycoplasmosis (1.89%), parasitic diseases (1.83%), necrotic enteritis (0.59%), fowl cholera (0.46%), and infectious corzya (0.41).

In a recent report from Rajshahi district, Dutta et al. (2012b) reported no incidence of bird flu but bacillary white diarrhea BWD (39.56%), omphalitis (57.40%) and hypervitaminosis (55.56%) were the most frequent diseases, whereas common cold (10.16%), BWD (39.56%) and BWD (27.62%) were the least frequent diseases for indigenous, Fayoumi and Sonali chickens, respectively. Investigation by El-Wahab et al. (2013) from Nigeria, however, revealed that coccidiosis is one of the most prevalent diseases in poultry. Back in the country, Islam et al. (2014) found majority chickens (55.83%) seropositive for mycoplasmosis in Bhola district. Moreover, they noted higher prevalence in backyard chickens (62.5%) than in commercial layers (53.61%); pullets (60.63%), adults (55.63%) and aged chickens (51.25%) were affected differently; and winter had more infections (60.42%) than the summer (51.25%). In the present results, BD, ID/AI, MYDF and SDP were identified as the major diseases that differed significantly between the poultry farms under study.

A lot of literature is available on cost-benefit analyses in poultry industries. Begum (2005) assessed gross margin of Tk. 18.19 per bird, net return of Tk. 17.18 per bird; and the rare of return in poultry was 0.32. Akhter and Rashid (2008) estimated mean technical efficiency of 90 broiler farms in Dhaka to be 94.06%; no significant difference existed between a large commercial farm (94.49%) and an owned-managed small farm (93.66%), which appeared to be quite different from the present results. In Kustia, Sarkar et al. (2008) estimated that the profitability of cockerel (Tk. 21.63) > broiler (Tk. 21.11) > Sonali (Tk. 8.43). In Chittagong, Zaman et al. (2008) examined the cost-benefit ratios of NN × RIR, NN × FAY, RIR × FAY and FAY were 1.65, 1.30, 3.49 and 1.98, respectively, suggesting that the crossbred Sonali (RIR × FAY) was the best chicken for commercial raising, which lend support to ours. In an earlier study, Dutta et al. (2012a) estimated cost-benefit ratios of the cockerel of ISA brown, Sonali, Fayoumi, RIR and Cobb 500 (broiler) to be 1.58, 1.54, 1.33, 1.29 and 1.17, respectively, in the Northern districts of Bangladesh. However, the present findings corroborate to earlier results by Islam et al. (2012)
who analyzed profitability indices (PI) of government farm (-0.09-0.13) and private farms (0.18-0.52) where Cobb 500 was the commonest but the least profitable breed and Sonali was the most popular and cheapest breed, but the farm owners achieved the maximum profit from Fayoumi chickens.

Dutta et al. (2013) examined the production performance of indigenous chickens reared by small-scale poultry farmers which appeared to be an efficiently feasible enterprise in the Northern districts of the country. Whereas in Thakurgaon district, layers were more profitable than the broilers where the total net return per bird were Tk. 263.81 and 13.82, respectively, and the yielding cost-benefit ratios for the breeds were 1.15 and 1.10, respectively (Masud and Real, 2013). Moreover, Uddin et al. (2013) evaluated gross return/day (Tk. 34.04), net return/day (Tk. 27.93) and benefit-cost ratio (5.57), indicating a poultry highly profitable enterprise in Noakhali, Patuakhali and Satkhira districts. In another study, the mean gross margin per 1000 birds (Tk. 57,240), mean gross return per 1000 birds (Tk. 52,059) and benefit-cost ratio for Sonali chickens (1.4) was calculated by Uddin et al. (2014) in Gazipur, Bangladesh.

Cost-benefit analyses on poultry farming carried out abroad show slightly different pictures. Thus, technical efficiency of family poultry in Nigeria ranged between 0.9 and 0.63; with a mean of 0.22, which can be increased by the use of more feed, capital, medicine/vaccination and adoption of more innovations (Alabi and Aruna, 2005). In the same country, Nworgu (2007) estimated RRI, BCR, GR and PI values of 106.04%, 2.06:1, 0.48: 1 and 0.52, respectively in broiler chickens; Ike and Ugwumba (2011) evaluated the net margin-cost ratio of 0.42 for small-scale broiler production, and Adetola and Simeon (2013) estimated three strains of broiler chickens such as Marshall (MS), Harvard (HV) and Arbor Acre (AA) which had gross margins of N$ 51.8, 30.4 and 26.7, respectively; and the benefit-cost ratio, PI and RRI values for MS strain were 1.17, 0.15 and 17.5%, respectively. In Pakistan, on the other hand, Maqbool and Bukhsh (2007) observed that the total profit in poultry industry was divisible into commission agents (47%), retailers (28%) and producers (25%), and Bano et al. (2011) analyzed fixed cost of 7% and variable cost of 93%; and PI of 0.24 and RRI of 42.4%. Headari et al. (2013) analyzed the benefit-cost ratio of 1.39 and the technical efficiency of 0.92 for poultry farms in Iran, whereas Siyaya (2013) estimated the profitability of indigenous chickens to be 0.40 per 1.00 feed cost in Swaziland, both of which were much less than those of ours.

The present results fit nicely with those of Islam and Dutta (2014), who assessed the PI of vitamin A and essential amino acid supplemented chickens that ranged between 0.13-0.23. In the present report, however, the estimated PI values of -0.009, 0.161 and 0.666 during January-June, 2014, and -0.008, 0.162 and 0.651 during July-December, 2014, for the government, private and backyard smallholders’ farms respectively, thus suggest an attractive feasibility of rearing poultry chickens in the study areas.

5. CONCLUSIONS

The present report assessed the productivity, disease prevalence and cost-benefit analysis of a government, 10 private and 10 backyard smallholders’ poultry farms that rear and market three available chicken breeds i.e., indigenous (Deshi), Fayoumi and Sonali in 10 Upozillas of Rajshahi district, Bangladesh. The productivity of all three breeds of chicken in different types of farms showed highly noticeable variations in numbers. On average, private farms always outnumbered the chicken productivity compared to its government and backyard counterparts in both January-June and July-December rearing seasons of the year 2014. The study identified nine parameters on disease incidences on the poultry production system from elevated (score 5) to absence of acceptable practices (score 1), which exhibited significant variation (P<0.05) except for viral, fungal and bacterial diseases and the rate of disease occurrence per rearing period. The cost-benefit components of the farms, especially the profitability indices (PI), were highest for the backyard indigenous poultry, followed by the private and government farms, the latter being always a losing concern in the poultry sector. So, it is concluded that strict bio-safety oriented management practices, appropriate vaccinations against prevalent diseases throughout the rearing seasons, coupled with the selection of fast growing and heavy laying breeds of chickens, would ensure profitability of the poultry farms in the study area. Findings of this study therefore will enrich our understanding for better and healthy poultry enterprise in the region.

Conflicts of interest

The authors declare that there is no conflict of interest.

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