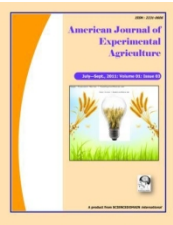

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Production Performance of Indigenous Chicken (*Gallus domesticus* L.) in Some Selected Areas of Rajshahi, Bangladesh

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Authors' contributions

This work was carried out in collaboration between all authors. Authors RKD and MAK jointly executed the study while author MSI designed the study, wrote the protocol, analyzed the experimental data and managed the literature searches. Author RKD wrote the first draft which was thoroughly edited by author MSI. All authors read and approved the revised and final version of the manuscript.

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ABSTRACT

Aims: The present study on management practices, productive performance and profitability of indigenous chickens evaluated the existing indigenous rearing practices with the objectives to pave the way for improvement of this variety into sustainable income in favour of the small-scale urban, semi-urban and rural households in the study areas.
Study Design: The current status of indigenous chicken householders of the urban, semi-urban and rural areas was surveyed. Availability of a large number of chickens and good communications facilitated data collection from the study areas.
Place and Duration of Study: The study areas included six Upazillas (Sub-Districts) of Rajshahi, Bangladesh *viz.,* Boalia, Godagari, Motihar, Mohonpur, Poba and Rajpara. Data were collected during the period from July 2010 to June 2011.
Methodology: Stratified random sampling techniques were used to collect the experimental data through direct interview schedules. A total of 150 households (6 Upazillas × 5 villages × 5 households per village) were selected where the average flock size was 30 birds, consisting of 12 chicks, 12 growers, 4 hens and 2 cocks.
Results: Management practices, production performance, associations between production parameters and profitability of indigenous chicken rearing in Rajshahi,

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Bangladesh were evaluated. The farmers raised their chickens in 6ft×4ft×4ft shed made of mud, straw, bamboo, wood and tin and they practiced traditional methods that included the uses of ash and lime to control ecto-parasites and floor disinfections, respectively. They also maintained regular vaccination programmes. The chickens of the study areas died of various diseases including bacillary white diarrhea (BWD, 39.56%), Newcastle disease (38.89%) and fowl cholera (32.29%). Moreover, disturbances from wild animals provided negative impact on rearing that caused appreciable mortality (3.15%) of the chicks. The indigenous poultry farmers opined that they are facing problems in terms of capital shortage, lack of institutional credit facilities, medicine and veterinary services. Weight of day-old chicks (WDC) was highest in Mohonpur and Rajpara and lowest in Boalia; growth rate (GR) was higher in Boalia and Mohonpur but lower in Godagari and Poba. The death rate (DR) was lower in all Upazillas except Boalia. The fertility rate (FR) and hatchability (HT) were higher in Boalia and Mohonpur and lowest in Poba. The higher first laying age (FLA) was found in Godagari and Mohonpur, whereas the average egg production (AEP) was found higher in Mohonpur, Poba and Rajpara but lowest in Boalia. The average chicken raised (ACR) was higher in Motihar and Poba while lower in Godagari and Mohonpur. The average marketable size (AMS) was highest in Boalia and lowest in Motihar. Most of the production parameters showed positive and significant correlations. With regards to rearing indigenous chickens, profitability calculated as cost-benefit ratio (CBR) was estimated to be 1.24 and 1.19 per family and per bird, respectively.

Conclusion: The study revealed some vital information on management practices and productivity of indigenous chickens where profits for rearing indigenous chickens per family and per bird were BDT 0.24 and BDT 0.19, respectively. The raising of indigenous chickens in urban, semi-urban and rural areas of Rajshahi, Bangladesh, therefore appeared to be an efficiently feasible enterprise which requires better understanding of the socio-economic aspects of the small-scale poultry farmers.

Keywords: Management practices; production parameters; average egg production; average marketable size; cost-benefit ratio.

1. INTRODUCTION

Chickens are considered as one of the most important and widely distributed avian species among poultry birds. It is a very good source of animal protein for human consumption. Of the four wild chicken species available on the Indian sub-continent *viz.,* red jungle fowl (*Gallus gallus*), gray jungle fowl (*Gallus sonnerati*), Ceylon fowl (*Gallus lafayettii*) and green jungle fowl (*Gallus rarius*), indigenous chickens locally known as *Deshi* (*Gallus domesticus*) are reported to be derived from *Gallus gallus* [1] whereas *Gallus bankiva* is believed to be the major contributor to the development of modern commercial breeds [2]. Among the native fowls there are some distinct categories such as hilly, naked neck, Aseel, Yasine, native dwarf and non-descriptive *Deshi*. Collection, evaluation and conservation of different genotypes are required due to future changes in the environment, management and food habits [3]. The major production system for the indigenous chickens is scavenging in nature and among the indigenous chickens non-descriptive Aseel and naked neck are noteworthy for genetic resources while *Deshi* is more acceptable to rural people as an important source of meat and eggs [4] due to low nutritional demand and high disease resistance. This free-range scavenging breed is being reared in Bangladesh for a long time and it has contributed about 19.75% and 25.06% of total meat and egg production [5]. In small-scale farming, production per bird is low, but it supports the landless as it costs less, requires little skills,

highly productive and is able to be incorporated into the household works [6]. A random mated and unselected indigenous chicken is a huge treasure of variable genotypes [7] and the birds can survive under harsh nutritional and environmental conditions. Its productivity under scavenging is low but intensive rearing yields the highest production potentialities [8].

However, poultry production is a promising sector for poverty reduction in Bangladesh. The role of poultry in poverty alleviation, food security and promotion of gender equality in developing countries is well documented [9-10]. Village poultry plays a key role in the home economy and its increased production has the potential to improve food security, assist in poverty alleviation and mitigate the adverse economic impacts of HIV/AIDS for rural people [11]. Village chickens are active in pest control; provide manure required for special festivals and essential for many traditional ceremonies [12]. In developing countries nearly all families at the village level, even poor and landless, are owners of poultry where production is feasible and low cost technology is needed to improve production considerably [13]. Major constraints are poultry diseases; especially the current outbreak of highly pathogenic avian influenza (HPAI or bird flu) in Asia, but small-scale poultry has the potential to make a substantial impact [14]. Though diseases are the prominent cause of mortality, predation and exposure to unfavourable environmental conditions are reported to be the major causes [15-17]. Productive and reproductive performances of the native chickens are relatively very low but genetic improvements by selective breeding, along with adequate nutrition and proper management, appeared to be promising and quite possible [18-19].

Smallholder family poultry is affected by many technical factors including low bio-security, inadequate sources of inputs and services, especially sources of technical information as well as lack of genetically improved breeds [20]. Crossbreds of indigenous naked neck with exotic can perform even better than that of exotic in respect of productive and reproductive traits [21]. The low productivity of indigenous is partly attributed to poor management practices, in particular the lack of proper healthcare, poor nutrition and housing [22-23]. Economic behaviour and attitude therefore should be considered in making any suggestion and recommendation for changing the existing level of small-scale farming [24] as there is substantial technical, allocative and economic inefficiency in poultry production [25]. Conversely, domestic chickens represent the most practical avian model for immune responses to viral infection and knowledge of the immune inflection of susceptibility to virus in birds is important for understanding taxonomic differences in infection outcomes and performance [26-27].

Rajshahi District occupies an important place in Bangladesh with respect to rearing indigenous chickens because of available natural feed during harvesting seasons in particular. The present study on management practices and various productive parameters of indigenous chicken is important to poultry growers and production system in view of adding valuable information to evaluate the existing indigenous rearing practices with the objectives to pave the way for improvement of this variety into sustainable income in favour of the small-scale urban, suburban and rural households.

2. MATERIALS AND METHODS

2.1 Experimental Design

Indigenous chicken (local name *Deshi*) householders of the urban, semi-urban and rural areas from six Upazillas (Sub-Districts) of the Rajshahi, Bangladesh, were surveyed. Data

were collected and recorded through direct interview schedules, which were prepared in accordance with the objectives of the study. Stratified random sampling techniques were used to collect the experimental data.

2.2 Selection of the Study Areas

A total of 150 households (6 Upazillas × 5 villages × 5 households per village) were selected randomly from six Upazillas of Rajshahi District *viz.,* Boalia, Godagari, Motihar, Mohonpur, Poba and Rajpara (Fig. 1). The average flock size was 30 birds, comprising 12 chicks, 12 growers, 4 hens and 2 cocks. Availability of a large number of chickens and good communications facilitated data collection from the study area. Data were collected during July 2010 through June 2011.

Fig. 1. A map of Rajshahi District, Bangladesh, showing the study areas

2.3 Parameters Studied

Management practices including chicken sheds, feed types, bio-security measures, outbreak of diseases, and problems and opinions of the farmers for improving their productivity were studied. Data on such vital production parameters as weight of day-old chick (WDC, g), growth rate (GR, %), death rate (DR, %), fertility (FR, %), hatchability (HT, %), first laying age (FLA, wks), average egg production (AEP, month), average chicken raised (ACR, month), average marketable size (AMS, g) and cost-benefit ratio (CBR) in Bangladeshi Taka (BDT) were collected from the selected households. In addition, annual gross cost and their returns per family and per bird, and profitability of raising the indigenous chickens were also estimated.

2.4 Statistical Analyses

Mean, standard error of the mean (SEM) and one-way analysis of variance (ANOVA) followed by the least significant differences (LSD) between the parameters were calculated using SPSS (version 11.5 for Windows, 2003), where the significant effects were started when $P<0.05$. The cost-benefit ratios (CBR) were computed following the methods described earlier [28]. In addition, co-efficient of correlation (r) values were calculated between the relevant production parameters.

3. RESULTS AND DISCUSSIONS

3.1 Management Practices Adopted by the Backyard Poultry Farmers

Management practices including chicken sheds, feed types, bio-security measures, outbreak of diseases, and problems and opinions of the farmers for improving their productivity were studied to evaluate the present status of indigenous chicken farming in the study areas.

3.1.1 Chicken sheds

The village people reared their chickens in 6ft × 4ft × 4ft sheds made of mud, straw, bamboo, wood and tin. This is similar to an earlier finding where village chickens were not kept in specialized housing, rather they were often provided with simple structure to protect them from weather elements [29]. Farmers collected the chicks from their own villages or local bazaars and reared in the sheds up to 72 weeks for dual (eggs and meat) purposes.

3.1.2 Feed types

The poultry farmers provided a mixture of concentrate feed composed of rice polish, wheat polish and broken rice to increase the growth, meat and egg yield of the chickens. Moreover, they used wheat, paddy, and broken rice and allowed their flocks for free scavenging. The differences in feed types, composition of the mixed feed and the amount of feed supplied are shown in Fig. 2, which reveal that most of the farmers used mixed feed but only 4% of them fed extra rice to their chickens. The rest fed either wheat alone, wheat in addition to paddy or broken rice alone. Free-range scavenging prevailed throughout the year for all chickens. Similar findings have been reported where farmers in rural areas offered a mixture of concentrated feed composed of rice polish and wheat polish mixed with water to increase performance and growth of their livestock [30].

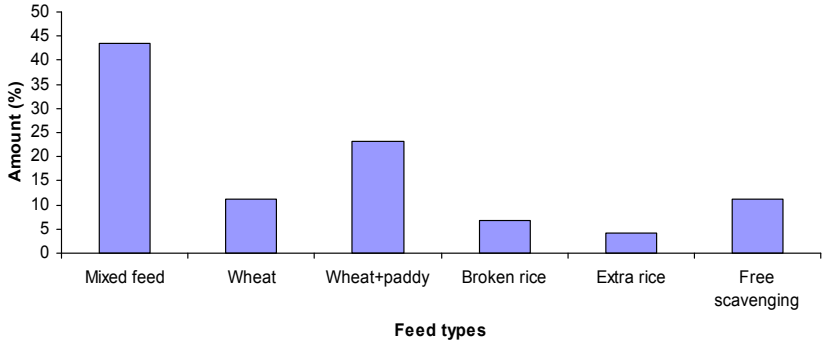

Fig. 2. Feed types provided to the indigenous chickens in Rajshahi, Bangladesh

3.1.3 Bio-security measures

Instead of commercial bio-security measures, farmers of the study areas practiced traditional methods that included the uses of ash and lime to control ecto-parasites and floor disinfections, respectively. They also maintained regular vaccination programmes against prevailing poultry diseases. This is consistent with a couple of reports, where poultry litter aged for six weeks supported increased *E. coli* densities [31] and housing system had adverse effect on eggshell contamination with specific groups of bacteria [32]. Factors those are responsible for low productivity included genotype, high cost of feeds [33], poor nutrition, diseases and management practices [34]. Development and adoption of effective bio-security measures therefore would require a multidisciplinary and participatory approach working with backyard poultry communities, producers, intermediaries and the consumers [35].

3.1.4 Outbreak of diseases

The chickens died of various diseases like bacillary white diarrhea (BWD, 39.56%), Newcastle disease (38.89%) and fowl cholera (32.29%). In addition, disturbances from wild animals provided negative impact on rearing that caused appreciable mortality (3.15%) of the chicks. The mortality rate was highest due to BWD. The potential source of infection was reported to be the water [36], by which the pathogen is transmitted through the flock following initial infection. The farmers claimed that owing to these troubles their interests on indigenous rearing was declining. The present pronouncement showed resemblance with the reports that fowl cholera, Newcastle disease, BWD, gumboro, coccidiosis, salmonellosis, fowl pox and eimeriasis were the focal diseases prevailing in Bangladesh [37-38]. Since economic losses in terms of costs and gross returns due to the outbreak of the diseases [39] and incidence of predators [17,40-42] are massive, it has been recommended that poultry diseases and their control require effective co-operation and communication between the poultry producers, their veterinary surgeon, other professional scientists and experts [43].

3.1.5 Problems and opinions of poultry farmers

The indigenous poultry farmers opined that they are facing problems in raising their birds in terms of capital shortage, lack of institutional credit facilities, medicine and veterinary services, and their birds were suffering from Newcastle disease, salmonellosis, gumboro and coccidiosis diseases causing high mortality of their chicks. Salmonellosis in poultry resulted severe economic losses caused by high mortality during the first four weeks of the chick age [39]. Chickens are most sensitive to their feeding and their body mechanism is so much rapid with faster circulation [44]. Therefore, more attention should be paid to the smallholder producers together with interventions in housing [45] and sanitation, nutrition and immunological response [19,46]. These would greatly increase the output and would have a positive impact on human health and nutrition [47].

The present findings are consistent with those of a previous report [48] where the poultry production was found controlled by the integrated functions of the breeders, hatchers, rearers, feed sellers and the vaccinators. The productions were interrupted or hampered owing to incompetent marketing system of poultry, poultry products and non-availability of the high priced quality feed. The supplementary feed was found essential for an enhanced output of the poultry. Conversely, the farmers claimed that an appropriate inoculation curriculum, low priced feed and subsidy on the poultry items were indispensable for the expansion of poultry venture in the study areas.

3.2 Production Performance of the Indigenous Chickens

Performance in productivity of indigenous chickens in the study areas in terms of several important parameters is presented in Table 1. The results revealed that WDC was found highest in Mohonpur and Rajpara and lowest in Boalia; GR was found higher in Boalia and Mohonpur but lower in Godagari and Poba. The DR was found lower in all Upazillas except Boalia. This finding is in well agreement with a previous report [49]. The farmers of the study area exclusively used broody hens. The number of eggs set for incubation varied from 10 to15 per hen. The FR and HT were found higher in Boalia and Mohonpur and lowest in Poba. The present results are comparable with an observation [50] where 85.0-89% HT for backyard chickens was recorded. The reduction in FR and HT might be due to the interaction of season, breed, flock age and flock disease-vaccination status, which also affected egg safety and quality [51]. The higher FLA was found in Godagari and Mohonpur, whereas the AEP was found higher in Mohonpur, Poba and Rajpara but lowest in Boalia.

The ACR was found higher in Motihar and Poba while lower in Godagari and Mohonpur. The lower ACR might be due to higher FLA as found in the study areas. On the contrary, the lower AEP could be due to the effects of broodiness [52] and rearing methods [53] as reported previously [45], where lower laying rate was observed for outdoor layers. Furthermore, AMS was found to be the highest in Boalia and lowest in Motihar. Variations in WDC and AMS in the present study could be due to the strong effect of the chicken variety as reported previously [54]. It has therefore been recommended earlier that proper housing design, provision of quality and adequate feeds and proper timing of the laying period were the prerequisites for better performance [55]. The present findings on the productive performance of the indigenous chickens nicely corroborate to the earlier results in that this breed showed relatively low economic values such as 35-40 eggs and 1-1.5 kg meat per bird per year [18]. Consequently, genetic improvements by selective breeding along with adequate nutrition and proper management should be emphasized.

Table 1. Production performance of the indigenous chickens in Rajshahi, Bangladesh

Parameters*	Boalia	Godagari	Motihar	Mohonpur	Poba	Rajpara	SEM	Probabilities
WDC	32.5^{c}	35.0^{b}	33.0^{b}	38.0^{a}	33.3^{b}	37.0^{a}	0.57	0.009
GR	4.77^{a}	2.94^{c}	3.07^{b}	4.63^{a}	2.70^{c}	3.15^{b}	0.18	0.000
DR	0.29^{a}	0.18^{c}	0.25^{b}	0.19^{c}	0.25^{b}	0.20^{c}	0.01	0.117
FR	95.0^{a}	93.0^{b}	94.0^{b}	96.0^{a}	91.0^{c}	94.0^{b}	0.64	0.316
HT	87.0^{a}	84.0^{b}	86.0^{b}	88.0^{a}	84.0^{b}	85.0^{b}	0.71	0.522
FLA	20.0^{c}	24.0^{a}	19.0^{c}	23.0^{a}	22.0^{b}	22.0^{b}	0.38	0.000
AEP	2.92^{c}	3.17^{b}	3.04^{b}	3.83^{a}	3.75^{a}	3.50^{a}	0.08	0.000
ACR	2.08^{a}	1.85^{c}	2.12^{b}	1.50^{c}	2.92^{a}	2.06^{b}	0.09	0.000
AMS	750^{a}	600^{b}	550^{c}	600^{b}	625^{b}	700^{a}	16.8	0.001

*Note: *Values are Mean SEM; WDC=Weight of day-old chick (g); GR=Growth rate (%); DR=Death rate (%); FR=Fertility (%); HT=Hatchability (%); FLA=First laying age (wk); AEP=Average egg production (month); ACR=Average chicken raised (month); AMS=Average marketable size (g); Values (N=25 for each) with different superscripts for a parameter in the same row differ significantly (P<0.05) by LSD.*

3.3 Associations between Various Production Parameters

Co-efficient of correlation (r) values shown in Table 2 demonstrate that associations between GR *vs.* DR and FLA *vs.* FR of indigenous chickens were negative and insignificant (*P*>0.05) in all cases, while FR *vs.* HT had significant association only in Godagari, Poba (P<0.05) and Motihar (P<0.01). This might be due to the scavenging habit, which makes the indigenous chicken environmentally more adapted. The WDC *vs.* AMS showed negative correlation for all the cases except Mohonpur (P<0.01). Similar to the present results, correlations between body weight and morphometric traits (*e.g*. WDC) were positive and highly significant in three genetic groups of chickens *viz.* normal, frizzle and naked-neck [56-57]. AEP *vs.* ACR exhibited highly significant correlations in Boalia, Godagari and Rajpara (*P*<0.001) but insignificant one in Motihar. Highly significant association was also found for FLA *vs.* HT in Rajpara (*P*<0.001) while others showed negative and insignificant associations. This is similar to a recent finding in which the storage period was found to have no significant effect on the hatchability in partridges *Alectoris graeca* [58]. The present results, however, will be of much use in implementing successful and intensive breeding programmes for upgrading indigenous chicken.

Table 2. Correlations between various productive parameters of indigenous chickens in Rajshahi, Bangladesh

Upazillas	GR *vs*. DR	FR *vs*. HT	WDC *vs.* AMS	AEP *vs.* ACR	FLA *vs.* FR	FLA *vs.* HT
Boalia	0.44ns	-0.99	-0.02ns	0.96***	-0.52ns	0.64ns
Godagari	-0.73*	0.72*	-0.27ns	0.99***	0.04ns	-0.44ns
Motihar	-0.81ns	0.89**	-0.05ns	0.24ns	-0.10ns	0.21ns
Mohonpur	-0.55ns	0.51ns	0.86**	0.83**	0.18ns	0.27ns
Poba	-0.13ns	0.76*	0.01ns	0.77*	0.00	0.04ns
Rajpara	-0.52ns	-0.35ns	0.58ns	0.83**	-0.17ns	0.96***

*Note: ns = not significant; * = P<0.05; ** = P<0.01 and *** = P<0.001 (N=25 for each); GR=Growth rate; DR=Death rate; FR=Fertility; HT=Hatchability; WDC=Weight of day-old chick; AMS=Average marketable size; AEP=Average egg production per month; ACR=Average chicken raised per month; FLA=First laying age.*

3.4 Profitability of Rearing Indigenous Chickens

Gross annual costs and their returns per family and per bird for rearing indigenous chickens are presented in Tables 3 and 4, respectively, whereas profitability of indigenous chicken rearing in terms of production cost, their returns and CBR are shown in Table 5. The results showed average annual expenditures and financial earnings from indigenous chicken rearing in the study areas. Most of the farmers reared their own chickens, as family labour was the prime source of employment for the purpose of backyard poultry management. The farmers faced no problems in procuring or selling chickens in their villages or nearby markets. The selling price per egg was BDT 4.5-5.0 in the study area, to some extent majority of selling was done within the village itself. However, the figures indicate that the average costs for DOC, litter, feed, medication, housing and equipment was 40.8±3.49, 2.31±0.24, 58.2±7.70, 2.39±0.37, 0.35±0.06 and 0.34±0.06, respectively. Conversely, returns from the sell of eggs, spent hen and manure were 211±22.5, 165±4.12 and 8.03±1.32, respectively. Total income per family and per bird was BDT 10569±1967 and BDT 384±9.31, respectively which was higher than the corresponding per family and per bird net costs (BDT 2822±183 and BDT 104±1.50, respectively). Finally, CBR was estimated to

be 1.24 and 1.19 for per family and per bird, respectively, indicating that farmers had to spend BDT 1.0 for earning BDT 1.24. In other words, profits for rearing indigenous chickens per family and per bird were BDT 0.24 and BDT 0.19, respectively.

The present findings lend support to a previous report [50] where family-wise and bird-wise total income was BDT 2124.00 and BDT 223.95, respectively, which was higher than the net cost of BDT 1324.23 and BDT 138.70, respectively, giving family-wise and bird-wise CBR values of 1.60 and 1.61, respectively. Gross earnings of BDT 3310 from a flock of 18 chickens with an average of 3.9 layers suggested that improved management practices not only increased egg production but also contributed to higher household income, up to BDT 23964 per year [59]. In another study, gradual income scheme from poultry eggs resulted in a net gain of US$64-70 annually (1US$=80BDT) while quick return scheme from poultry meat produced a net income of US$96 for village women [60]. Total maintenance cost per RIR layer on average was BDT 429.88 and net return BDT 101.47 [28] whereas the total maintenance cost per layer for small farms was found to be BDT 620.00 [61]. Differences in total maintenance cost with respect to the present study might be due to a longer period of rearing (*i.e*. 78 wks), which increased the production cost. Also improper management practices by the farmers in small production units might have contributed to the increased total maintenance cost. Conversely, CBR values of the present study are quite analogous with the previous findings [28,62] where the values were 1.10 and 1.39, respectively.

Market prices of the indigenous chickens and their monthly fluctuations revealed that the selling prices were not same in different markets throughout the year. The present findings are very much similar to an earlier study [63] where intermediaries and retailers were found to make higher profits compared to the farmers. For this reason, sustainable growth of poultry industry demands formulation and implementation of a national poultry development policy with poultry production and its marketing system [64]. The farmers urged that for the development of indigenous chicken farming, low-cost feed, proper breeding facilities and improvement of indigenous breeds by crossing with exotic breeds would be worth considering. In addition, the smallholder farmers in the study areas also expressed their need for capital and institutional credit facilities for changing from small-scale to large-scale production units.

Table 3. Gross annual costs per family and per bird for rearing indigenous chickens in Rajshahi, Bangladesh

Particulars	Annual cost (BDT) per family		Total cost	Annual cost (BDT) per bird		Total costs
	Gross cost (BDT)	Depreciation cost (10%)	(BDT)	Gross cost	Depreciation cost (10	(BDT)
DOC cost*	1147±671	-	1147±671	40.8±3.49	-	40.8±3.49
Litter cost	64.2±36.3	-	64.2±36.3	2.31±0.24	-	2.31±0.24
Feed cost	1527±703	-	1527±703	58.2±7.70	-	58.2±7.70
Medication cost	64.4±33.2	-	64.4±33.2	2.39±0.37	-	2.39±0.37
Total gross cost	2803±361	-	2803±361	103±2.95	-	103±2.95
Housing cost	91.6±40.1	9.16±4.01	9.16±4.01	3.55±0.56	0.35±0.06	0.35±0.06
Equipment cost	97.5±61.6	9.75±6.16	9.75±6.16	3.36±0.60	0.34±0.06	0.34±0.06
Total net cost	2803±361	18.9±5.08	2822±183	103±2.95	0.69±0.06	104±1.50

Note: **DOC= Day-old chick; Total net cost is the sum of total gross cost and 10% depreciation of housing and equipment cost.*

Table 4. Gross annual returns per family and per bird for indigenous chickens in Rajshahi, Bangladesh

Particulars	Return per family (BDT)	Return per bird (BDT)
Sale of eggs	5797±3230	211±22.5
Sale of spent hen	4539±2499	165±4.12
Sale of manure	233±172	8.03±1.32
Total income	10569±1967	384±9.31
Gross cost over gross return*	7776±1606	281±6.36
Net cost over annual return	7747±1601	280±4.86

*Note: * Gross cost over gross return is the deduction of total gross cost from total income while net cost over annual return is the deduction of total cost from total income.*

Table 5. Estimation of cost-benefit ratios showing profitability of rearing indigenous chickens per family and per bird in Rajshahi, Bangladesh

Particulars	Per family (BDT)	Per bird (BDT)
A. Total cost of maintenance	2822±183	104±1.50
B. Returns from other products*	233±172	8.03±1.32
C. Net cost of maintenance (A-B)	2589±10.8	96.4±0.18
D. Returns from egg	5797±3230	211±22.5
E. Net returns (profit) (D-C)	3207	115
F. Cost-benefit ratios (E÷C)	1.24	1.19

*Note: *Other products include manure and excreta*

4. CONCLUSIONS

Information on management practices, production performance, associations between production parameters and profitability of indigenous chicken rearing in Rajshahi, Bangladesh, revealed the cost-benefit ratios of 1.24 and 1.19, respectively per family and per bird, suggesting that profits for rearing indigenous chickens per family and per bird were BDT 0.24 and BDT 0.19, respectively. The raising of indigenous chickens in the study areas therefore appeared to be an efficiently feasible enterprise which requires better understanding of the socio-economic aspects of the small-scale poultry farmers. The study further indicated that there are great potentials for the improvement of indigenous chicken productivity in the urban, semi-urban and rural areas of Rajshahi, Bangladesh.

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COMPETING INTERESTS

The authors have declared that no competing interests exist.

REFERENCES

1. Beede W. Pheasant, their lives and homes. Vol. I. New York: Doubleday Doran; 1931.
2. Lush JL. Animal breeding plans 3rd ed. Iowa State University Press; 1945.
3. Crawford RD. Assessment and conservation of animal genetic resources in Canada. Canadian J Anim Sci. 1984;64(2):235-51.
4. Barua A, Howlider MAR. Prospect of native chickens in Bangladesh. Poultry Adv. 1990;23:57-61.
5. Haque QME. Duck production system in Bangladesh. Asian Livestock 1991;16(2):18-23.
6. Huque QME. Rural poultry in Bangladesh economy proceeding: Fourth national conference. Bangladesh Anim Husbandry Association; 1992.
7. Yeasmin T, Howlider MAR. Comparative physical features egg production and egg quality characteristics of normal and dwarf indigenous (*Deshi*) hens. Bangladesh J Anim Res. 1998;13:191-96.
8. Haque QME, Chowdhury SA, Haque ME, Sil BK. Poultry research in Bangladesh: Present status and its implication for future research, poultry as a tool in poverty eradication and promotion of gender equality. Proc Workshop March 22-26, 16-28. Tune Landboskole Denmark; 1999.
9. Gueye EF. The role of family poultry in poverty alleviation, food security and the promotion of gender equality in rural Africa. Outlook Agric. 2000a;29(2):129-36. Available: http://www.fao.org/ag/againfo/projects/en/pplpi/docare/wp10.pdf.
10. Gueye EF. Women and family poultry production in Africa. Dev Practice 2000b;10:98-102.
11. Harun M, Cambaza A, Alemao L, Maxhuza G, Joaquim M, Macanza G, Namaneque A, Lobo O, Alders R. Community based experiences in controlling Newcastle disease in rural areas of Mozambique to achieve food security, poverty alleviation and HIV/AIDS mitigation. Mozambique AusAID Southern Africa Newcastle Disease Control Project (SANDCP); 2001.
12. Alders R, Cambaza AB, Harun M. Village chickens, food security and HIV/AIDS mitigation [Online] Australia. AusAID Southern Africa Newcastle Disease Control Project, Maputo; 2003.
13. Upton M. The role of livestock in economic development and poverty reduction. Rome [Italy] FAO. Accessed August 9 2012; 2004.
14. Macka S, Hoffmann D, Otte J. The contribution of poultry to rural development. World's Poultry Sci J. 2005;61:7-14.
15. Baarendse PJJ, Kemp B, Brand HVD. Early-age housing temperature affects subsequent broiler chicken performance. British Poultry Sci. 2006;47:125-30.
16. Aengwanich W. Effects of high environmental temperature on the productive performance of Thai indigenous, Thai indigenous crossbred and broiler chickens. Int J Poultry Sci. 2007;6(5):349-53.
17. Henning J, Pym R, Hla T, Kyaw N, Meers J. Village chicken production in Myanmar-Purpose, magnitude and major constraints. World's Poultry Sci J. 2007;63:308-22.
18. Das SC, Chowdhury SD, Khatun MA, Nishibori M, Isobe N, Yoshimura Y. Poultry production profile and expected future projection in Bangladesh. World's Poultry Sci J. 2008;64:99-118.
19. Niranjan M, Sharma RP, Rajkumar U, Reddy BLN, Chatterjee RN, Battacharya TK. Comparative evaluation of production performance in improved chicken varieties for backyard farming. Int J Poultry Sci. 2008;7(11):1128-31.
20. Sonaiya EB. Some technical and socioeconomic factors affecting productivity and profitability of smallholder family poultry. World's Poultry Sci J. 2009;65:201-06.

21. Islam MA, Nishibor M. Indigenous naked neck chicken: A valuable genetic resource for Bangladesh. World's Poultry Sci J. 2009;65:125-38.
22. Kingori AM, Tuitoek JK, Muiruri HK, Wachira AM. Effect of dietary crude protein levels on egg production, hatchability and post-hatch offspring performance of indigenous chickens. Int J Poultry Sci. 2010a;9(4):324-29.
23. Alamal J, Giasuddin M, Samad MA, Taimur MJFA. Recent evidence of avian influenza in Bangladesh: A review. World's Poultry Sci J. 2010;66:455-65.
24. Islam MS, Takashi S, Chhabi KQN. Current scenario of the small-scale broiler farming in Bangladesh: Potentials for the future projection. Int J Poultry Sci. 2010;9(5):440-45.
25. Begum A, Buysse J, Alam MJ, Huylenbroeck GV. Technical, allocative and economic efficiency of commercial poultry farms in Bangladesh. World's Poultry Sci J. 2010;66:465-76.
26. Fair JM, Nemeth NM, Taylor-McCabe KJ, Shou Y, Marrone BL. Clinical and acquired immunologic responses to West Nile virus infection of domestic chickens (*Gallus gallus domesticus*). Poultry Sci. 2011;90:328-36.
27. Haunshi S, Niranjan M, Shanmugam M, Padhi MK, Reddy MR, Sunitha R, Rajkumar U, Panda AK. Characterization of two Indian native chicken breeds for production, egg and semen quality, and welfare traits. Poultry Sci. 2011;90:314-20.
28. Nair BC, Ghadoliya MK. Economic viability of RIR farming in the state of Goa. Indian J Poultry Sci. 2000;35(1):73-76.
29. Abubakar MB, Ambali AG, Tamjdo T. Rural Chicken Production: Effects of gender on ownership and management responsibilities in some parts of Nigeria and Cameroon. Int J Poultry Sci. 2007;6(6):413-16.
30. Saadullah M, Hossain MM. Quantification of available feed resources and feeding systems of animal in different regions of Bangladesh. A project report submitted to the Bangladesh Agricultural Research Institute (BRAC), Dhaka, Bangladesh; 2000.
31. Wilkinson KG, Tee E, Tomkins RB, Hepworth G, Premier R. Effect of heating and aging of poultry litter on the persistence of enteric bacteria. Poultry Sci. 2011;90:10-18.
32. Reu KD, Messens W, Heyndrickx M, Rodenburg TB, Uyttendaele M, Herman L. Bacterial contamination of table eggs and the influence of housing systems. World's Poultry Sci J. 2008;64:5-19.
33. Ja'afar-Furo MR, Gabdo BH. Identifying major factors of poultry production as sustainable enterprise among farmers using improved methods in rural Nigeria. Int J Poultry Sci. 2010;9(5):459-63.
34. Kingori AM, Wachira AM, Tuitoek JK. Indigenous chicken production in Kenya: A review. Int J Poultry Sci. 2010b;9(4):309-16.
35. Bleich EG, Pagani P, Honhold N. Progress towards practical options for improving biosecurity of small-scale poultry producers. World's Poultry Sci J. 2009;65:211-16.
36. Sparks NHC. The role of the water supply system in the infection and control of *Campylobacter* in chicken. World's Poultry Sci J. 2009;65:459-74.
37. Hossain MA, Alam MS, Islam MF. Incidence of diseases of livestock and its economic loss among the selected rural households of Bangladesh. Bangladesh J Anim Sci. 1996;25(1-2):11-17.
38. Bell JG. Factors limiting production efficiency and profitability from smallholder poultry production. World's Poultry Sci J. 2009;65:207-10.
39. Hafez HM. 2001 *Salmonella* infection in poultry: Diagnosis and control. Per Biolog. 2001;103:103-13.
40. Alexander DJ. Newcastle disease, other avian *paramyxoviruses* and *pneumoviruses* infections. In: Saif YM, Barnes HJ, Glisson JR, Fadly AM, McDougald LR, Swayne DE editors. Diseases of poultry. pp. 63-87. Iowa State Press: Blackwell; 2003.

41. Rahman MM, Rahman AZ, Islam MS. Bacterial diseases of poultry prevailing in Bangladesh. Res J Poultry Sci. 2007;1(1):1-6.
42. Nwanta JA, Abdu PA, Ezema WS. Epidemiology, challenges and prospects for control of Newcastle disease in village poultry in Nigeria. World's Poultry Sci J. 2008;64:119-27.
43. Lister SA. Poultry diseases – their control and effects on nutritional requirements. World's Poultry Sci J. 2010;66:633-38.
44. Parkhurst CR, Mountney GJ. Poultry meat and egg production. New Delhi: CBS Publ. & Distributors; 2004.
45. Wang XL, Zheng JX, Ning ZH, Qu LJ, Xu GY, Yang N. Laying performance and egg quality of blue-shelled layers as affected by different housing systems. Poultry Sci. 2009;88:1485-92.
46. Tactacan GB, Guenter W, Lewis NJ, Rodriguez-Lecompte JC, House JD. Performance and welfare of laying hens in conventional and enriched cages. Poultry Sci. 2009;88:698-707.
47. Wilson RT. Poultry production and performance in the federal democratic republic of Ethiopia. World's Poultry Sci J. 2010;66:441-54.
48. Saleque MA, Mustafa S. Landless women and poultry: The BRAC Model in Bangladesh. In: Dolberg F, Petersen PH, editors, Integrated farming in human development. pp. 38-55. Proc Workshop March 25-29; Tune Landboskole, Denmark; 1996.
49. Khondoker MAMY, Faruque MO, Howlider MAR, Ali A. Performance of upgraded indigenous deshi chicken under farm condition. Bangladesh J Anim Sci. 1996;25(1-2):85-89.
50. Sumy MC, Khokon MSI, Islam MM, Talukder S. Study on the socio-economic condition and productive performances of backyard chicken in some selected areas of Pabna district. J Bangladesh Agric Univ. 2010;8(1):45-50.
51. Holt PS, Davies RH, Dewulf J, Gast RK, Huwe JK, Jones DR, Waltman D, Willian KR. The impact of different housing systems on egg safety and quality. Poultry Sci. 2011;90:251-62.
52. Jiang RS, Chen XY, Geng ZY. Broodiness, egg production, and correlations between broody traits in an indigenous chicken breed. Poultry Sci. 2010;89:1094-96.
53. Faruque S, Siddiquee NU, Afroz MA, Islam MS. Phenotypic characterization of native chicken reared under intensive management system. J Bangladesh Agric Univ. 2010;8(1):79-82.
54. Aernia V, Brinkhofa MWG, Wechslera B, Oestera H, Frohlicha E. Productivity and mortality of laying hens in aviaries: a systematic review. World's Poultry Sci J. 2005;61:130-42.
55. Yakubu A, Salako AE, Ige AO. Effects of genotype and housing system on the laying performance of chickens in different seasons in the semi-humid tropics. Int J Poultry Sci. 2007;6(6):434-39.
56. Yakubu A, Ogah DM, Barde RE. Productivity and egg quality characteristics of free range naked neck and normal feathered Nigerian indigenous chickens. Int J Poultry Sci. 2008;7(6):579-85.
57. Yakubu A, Kuje D, Okpeku M. Principal components as measures of size and shape in Nigerian indigenous chickens. Thai J Agric Sci. 2009;42(3):167-76.
58. Caglayan T, Alaahan S, Krkc K, Gunlu A. Effect of different egg storage periods on some egg quality characteristics and hatchability of partridges (*Alectoris graeca*). Poultry Sci. 2009;88:1330-33.

59. Sarkar K, Golam M. A move from subsistence to semi-commercial family poultry farming with local chickens: Effective strategies for family poultry in Bangladesh. World's Poultry Sci J. 2009;65:251-59.
60. Khan AG. Indigenous breeds, crossbreds and synthetic hybrids with modified genetic and economic profiles for rural family and small-scale poultry farming in India. World's Poultry Sci J. 2008;64:405-15.
61. Begum S. A comparative analysis of broiler and layer production in some selected areas of Mymensingh District. Unpub MS Thesis, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh; 2000.
62. Bhuiyan MU. An economic analysis of smale-scale poultry farming of Kowari Thana in Mymensingh District. Unpub MS Thesis, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh; 1999.
63. Jahan H, Sabur SA, Ahmed S. Marketing system and price behaviour of egg in selected areas of Bangladesh. Bangladesh J Anim Sci. 2003;32(1-2):71-79.
64. Raha SK. Marketing systems of poultry: The case of Bangladesh. Proc. 6th Int Poultry Show and Seminar (WPSA-BB) pp. 15-22; March 5-7; Dhaka, Bangladesh; 2009.

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