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Performance of three meat type chicken farms maintained at different bio-security levels

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Abstract

Because of the high density of the poultry flocks in current commercial production operations and the inherent disease risks associated with this type of production, proper bio-security practices are very important for successful poultry farming. The study was undertaken to investigate the productive and economic performances of poultry farms keeping three different meat types chickens under good, fair and poor bio-security conditions in south western regions of Bangladesh. The three meat type chickens under consideration were Cobb 500 broiler strain, cockerel and Sonali (RIR x Fayoumi crossbred). According to obtained marks each of one hundred (total three hundred) surveyed farms were divided into good (≥ 80%), fair (61-79%) and poor (≤ 60%) bio-secured categories. Results revealed that market body weight, total feed intake, efficiency of feed utilization, survivability, gross return and net return of Cobb 500 broiler, cockerel and Sonali farms showed higher trends from poor to good bio-secured farms. The survivability was significantly ($p<0.01$) higher under good than that of fair and poor bio-secured level. The highest survivability was observed in farms kept Sonali followed by cockerel and Cobb 500. The result revealed that the Sonali was the highly benefited chicken farms than Cobb 500 broiler strain and cockerel. The broiler farms were more bio-security sensitive than Sonali and cockerel farms. Hence, good bio-security practices had significant impact on productive and economic performances of all three categories of meat type chickens. It can be concluded that the meat type chickens are more sensitive to the bio-security measures of the farms and Sonali farms are more beneficial from economic point of view as compared to cockerel and Cobb 500 farms.

Keywords: broiler, cockerel, economic performance, productive performance, Sonali

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Introduction

Rapid migration to urban areas, income growth, diversification in food demand patterns and a dietary shift towards high-value protein are increasing the demand for foods of animal origin. Poultry meat is one of the most acceptable protein sources for many population groups in the world. Under these circumstances to meet up the growing demand of meat the government and private organizations are putting efforts together to produce commercial broiler, cockerel (immature male chick) and Sonali (crossbred). The modern broilers are fast growing, efficient and can rapidly fulfill the shortage of protein requirement since it can be produced at least possible time as compared to other meat producing animals. Cockerels are the male part of layer strains of chickens that constitute 50% of day-old chicks. The scope for utilizing these cockerels as a source of poultry meat is high because many consumers prefer cockerel equally to that of indigenous chicken and many people consider that it is tastier than the broiler meat. The Sonali is the F_1 crossbred of Rhode Island Red (RIR) cocks and Fayoumi hens. It has been taking place besides the indigenous chicken due to their similar phenotypic appearance, adaptability and acceptability in the climatic conditions of Bangladesh (Anisuzzaman, 1988).

Bio-security is taking measures to protect poultry from harmful biological agents, like viruses, bacteria, parasites, etc. In commercial poultry production, this generally means total confinement operations with strict rules to maintain flock health such as shower-in and out systems, special clothing, disinfection, and other measures. Implementing bio-security procedures and practices on poultry farms plays an important role in preventing or minimizing the introduction and spread of an infectious disease. Practicing sound bio-security procedures every day as part of a best management program will help reduce

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the possibility of contracting a disease and will reduce the spread of disease. The most severe challenge facing the commercial poultry sector over the last few years has been the widespread and recurring onset of avian influenza (Al). The subtype H_5N_1 of Highly Pathogenic Avian Influenza (HPAI) was first reported in Southeast Asia in late 2003. The outbreaks have had serious economic impact to the affected countries, with millions of birds either killed by the disease or mandatory culled in an effort to limit the spread of virus (Rushton *et al.,* 2005; Alders *et al.,* 2014). One of the factors responsible for outbreaks and the persistence of the virus in domestic poultry populations are cited to be the widespread practice of small holder backyard poultry farming and associated live bird markets (Alders *et al.,* 2014; Henning *et al.,* 2009). This is mainly because basic bio-security measures are rarely implemented in backyard poultry farming systems allowing HPAI to circulate within poultry populations resulting in a perpetual virus source to other poultry flocks (Paul *et al.,* 2011; FAO, 2016). Therefore, one of the most effective forms of protection against HPAI and other poultry diseases is bio-security, which is principally the implementation of measures to prevent the introduction of infectious agents into the farm/environment. Bio-exclusion or containment measures to prevent spread of infectious agents from existing in the event of outbreaks (FAO, 2016). The early age of poultry farming, some commercial chicken farmer are using bio-security practices which resulted increase productive performance as well as profitability. But very little research has conducted to measure the performance of Sonali, cockerel and broiler farms under three dimension of bio-security like conceptual, structural and operational system at farm level. Therefore, the study was undertaken to investigate the productive and economic performances of poultry farms keeping three different meat types chickens taken good, fair and poor bio-security measures in south western regions of Bangladesh.

Materials and Methods

Population and sampling

A list of commercial broiler, cockerel and Sonali chicken farms were prepared with the help of Department of Livestock Service (DLS) and Aftab Bahumukhi Farms Ltd (ABFL). The owners of the farms were treated as population of the study. The size of the sample was determined following the formula postulated by Kothari (2004). A multi-stage sampling technique was adopted. At the first stage, a purposive sampling technique was used to select only Khulna division out of the seven divisions of Bangladesh because it was provided the second highest population of chicken farms in the country. The second stage employed random selection of three (03) out of ten (10) districts of Khulna division. The third stage employed random selection of 02 upazilla from Satkhira, 03 from Khulna and 02 from Bagerhat district. Finally, three hundred different meat type chicken farms were randomly selected taking each of 40, 30 and 30 farms from Khulna, Satkhira and Bagerhat district, respectively (Table 1).

Data collection

Data were collected by three ways firstly direct observation of the farms, secondly observed the record register kept by the farmers and finally interviewed the respondents through the pretested questionnaire. Data were collected January to December 2013.

Table 1: Sample distribution of different meat type chicken farms

Type of farm	Genotype of chickens	Management	Marketing age (d)	Feed source	Sample size			Total
					Khulna	Satkhira	Bagerhat	
Broiler farm	Cobb 500	Litter/floor system	30	Nourish ready feed	40	30	30	100
Sonali farm	Cross bred	Litter/floor system	60	Aftab ready feed	40	30	30	100
Cockerel farm	Male of layer strain	Litter/floor system	90	Aftab ready feed	40	30	30	100
Total	-	-	-	-	120	90	90	300

Specifications of bio-security levels

The selected broiler, cockerel and Sonali farms were divided into three bio-security levels; poor (Score ≤60), fair (Score 61-79) and good (Score ≥80) by using measures of bio-security standard score (Source: Third meeting 12 November, 2009 of PTDDP Bio-security Standard Development Committee, Bangladesh Livestock Research Institute, Savar, Dhaka).

Data analysis

Collected data were compiled, coded, tabulated for processing and analysis in accordance with the objectives of the study. To draw a meaningful conclusion, tabular presentation of data was intensively used. The SAS 9.1.3 version was used to analyze the data (SAS, 2009). Descriptive statistics like number, percentage, mean and standard error were used in describing the selected independent and dependent variables of the study.

Table 2: The structure and marks distribution of the questions included in the questionnaire

Types of bio-security	Characters	Marks distribution	Bio-security level
Conceptual bio-security	Educational qualification Training condition Year of experiences Knowledge score about bio-security	20	Those farms got ≥ 80% marks were good, 61% to 79% marks were fair, ≤ 60% marks were poor bio-secured farms.
Structural bio-security	Location of the farm Design of the house Roofing materials Distance from high way Distance from locality Distance from other farms Protection from wild birds Boundary wall Manure pit Disposable pit Foot bath Ventilation 'No entrance' sign board	30	
Operational bio-security	Cleaning of the shed Cleaning the premises Disinfection of the shed Disinfection of the premises Cleaning and disinfection of waterers Cleaning and disinfection of feeders Feed quality Water quality	50	
Total		100	

Source: Third meeting 12 November, 2009 of PTDDP Bio-security Standard Development Committee, Bangladesh Livestock Research Institute, Savar, Dhaka.

Results and Discussion

Production performance of Cobb 500 broiler farms

Market body weight (g), total feed intake (g), feed conversion ratio (FCR) and survivability rate of Cobb 500 commercial broiler farms under different bio-security level are shown in Table 3. The Cobb 500 broiler strain gained 1367.48, 1330.90 and 1282.20g body weight at 30 days of rearing in good, fair and poor bio-secured farms, respectively. The body weight in fair bio-secured farms were found to be 1330.90g which was almost similar to the findings of Sarker *et al.* (2008) who reported 1328.3g body weight at 28 days of age. Mean differences of body weight of Cobb 500 at 30 days of age among the good, fair and poor bio-secured farms were highly significant (p<0.001).

Total feed intakes of Cobb 500 broilers at 30 days of age under good (2240.20g) and fair (2224.39g) bio-secured farms were significantly (p<0.001) higher than that of broiler farms poor bio-secured farm (2144.67g). Feed intake of Cobb 500 broilers in the present study was little higher than that of Sarker *et al.* (2008) who reported 2151.4g of feed intake at 28 days of age. This was due to the variation in rearing period. Feed conversion ratio (FCR) of Cobb 500 broilers was significantly (p<0.05) lower in good (1.64) but same in fair and poor bio-secured farms (1.67). This result was inconsistent to the findings of Chand *et al.* (2009) who reported FCR to be 1.94 but similar result was reported by Ali *et al.* (2014). Improved FCR in the present study than that of Chand *et al.* (2009) is due to the regular improvement of genetic makeup of broiler strains by the breeding company as well as good management practices. The survivability rate was found highest (95.84%) in good followed by fair (91.46%) and poor (87.74%) bio-secured farms. Survivability rate of Cobb 500 broilers differed significantly (p<0.001) among the good, fair and poor bio-secured conditions. The survivability rate in good bio-secured farms (95.84%) was similar to the findings of Ali *et al.* (2014).

Economic performance of Cobb 500 broiler farms

Economic performances of Cobb 500 broiler farms in the studied area under three different bio-secured conditions are shown in Table 4. The total cost (BDT/bird) was almost similar between good (152.43) and fair (153.84) but significantly differed from poor (149.30) bio-secured farm. The total cost of live weight gain (BDT/kg) was recorded to be 111.55, 115.81 and 116.46 for good, fair and poor bio-secured farms, respectively which indicates that cost was increased due to the lack of bio-security conditions. The higher meat production cost due to the weak bio-security measures was due to higher medication cost, labor cost and mortality. This result revealed that there was an impact of bio-security on total cost (BDT/kg) of live weight gain of broiler. The gross return and net return differed significantly (p<0.001) among good, fair and poor bio-secured farms. Benefit cost ratio (BCR) was highest in good (1.10) followed by fair (1.05) and poor (1.03) bio-secured farms. The lower BCR in fair (1.05) and poor (1.03) bio-secured farms revealed that the broiler production was highly bio-security responsive.

Table 3: Productive performances of Cobb 500 broiler farms in different bio-security levels

Performance	Level of bio-security			P value and significance level
	Good (32) Mean ± SE	Fair (30) Mean ± SE	Poor (38) Mean ± SE	
Market body weight (g)	$1367.48^{a}\pm10.89$	$1330.90^{b}\pm11.61$	$1282.20^{c}\pm7.65$	(0.0001)***
Total feed intake (g)	$2240.20^{a}\pm14.25$	$2224.39^{a}\pm15.29$	$2144.67^{b}\pm17.94$	(0.0001)***
Feed conversion ratio (FCR)	$1.64^{b}\pm0.008$	$1.67^{a}\pm0.010$	$1.67^{a}\pm0.009$	(0.02)*
Survivability (%)	$95.84^{a}\pm0.22$	$91.47^{b}\pm0.18$	$87.74^{c}\pm0.27$	(0.0001))***

Figure in the parenthesis indicates the number of observations. ^{abc} Mean values having different superscripts in a raw within three different bio-security level differed significantly. ***, p<0.001; *, p<0.05.

Table 4: Economic performances of Cobb 500 broiler farms maintained different bio-security levels

Performance	Level of bio-security			P value and significance level
	Good (32)	Fair (30)	Poor (38)	
	Mean ± SE	Mean ± SE	Mean ± SE	
Total cost (BDT/bird)	152.43^{a}±0.87	153.84^{a}±0.93	149.30^{b}±0.97	(0.0025)**
Total cost (BDT/kg)	111.55^{b}±0.46	115.8^{a}±1.11	116.46^{a}±0.49	(0.0001)***
Gross return (BDT/ bird)	169.85^{a}±1.91	164.51^{b}±2.28	155.85^{c}±0.93	(0.0001)***
Net return (BDT/bird)	17.42^{a}±1.26	15.79^{b}±0.18	6.55^{c}±0.71	(0.0001)***
Net return (BDT/kg)	11.13^{a}±0.85	6.18^{b}±1.68	3.53^{b}±0.54	(0.0001)***
Benefit cost ratio (BCR)	1.10^{a}±0.007	1.05^{b}±0.014	1.03^{b}±0.004	(0.0001)***

Figures within the parenthesis indicate the number of observations. ^{abc}Mean values having different superscripts in a raw within three different bio-security levels differed significantly. ***: p<0.001; **: p<0.01.

Table 5: Productive performances of cockerel farms maintained different bio-security levels

Performance	Level of bio-security			P value and significance level
	Good (37)	Fair (34)	Poor (29)	
	Mean ± SE	Mean ± SE	Mean ± SE	
Marketed body weight (g)	959.87^{a}±5.055	945.52^{b}±2.98	931.22^{c}±2.83	(0.0001)***
Total feed intake (g)	2173.81^{a}±2.39	2145.05^{b}±3.93	2130.03^{b}±12.47	(0.02)*
Feed conversion ratio (FCR)	2.26±0.013	2.26±0.010	2.29±0.016	(0.42)NS
Survivability (%)	97.32^{a}±0.21	93.38^{b}±0.20	91.20^{c}±0.20	(0.0001)***

Figures within the parenthesis indicate the number of observations.^{abc}Mean values having different superscripts in a raw within three different bio-security levels differed significantly.***: p<0.001; *:p<0.05; NS: Non significant.

Table 6: Economic performances of cockerel farms maintained different bio-security levels

Performance	Level of bio-security			P value and significance level
	Good (37)	Fair (34)	Poor (29)	
	Mean ± SE	Mean ± SE	Means ± SE	
Total cost (BDT/bird)	142.12±0.24	141.49±0.314	141.06±0.59	(0.14)NS
Total cost (BDT/kg)	148.21^{b}±0.78	149.69^{ab}±0.55	151.52^{a}±0.77	(0.007)**
Gross return (BDT/bird)	165.39^{a}±1.03	161.80^{b}±0.84	159.46^{b}±1.14	(0.0003)***
Net return (BDT/bird)	23.26^{a}±0.01	20.32^{ab}±0.90	18.40^{b}±1.30	(0.0065)**
Net return (BDT/kg)	20.98^{a}±0.98	18.31^{ab}±0.94	16.49^{b}±1.37	(0.016)*
Benefit cost ratio (BCR)	1.14^{a}±0.007	1.12^{ab}±0.007	1.10^{b}±0.009	(0.012)*

Figures within the parenthesis indicate the number of observations.^{abc}Mean values having different superscripts in a raw within three different bio-security levels differed significantly. ***:p<0.001; **:p<0.01; *:p<0.05; NS: Non significant.

Productive performance of cockerel farms

Productive performances of cockerel farms maintained different bio-security levels are shown in Table 5. Data of the table revealed that average market body weight of cockerel reported to be 959.87, 945.52 and 931.22g, respectively for good, fair and poor bio-secured farms during 60 days of rearing period. Market body weight of cockerel differed significantly ($p<0.001$) among the farms maintained different bio-security levels which indicates that live weight gain of cockerel responded to farm bio-security levels.

Economic performance of cockerel farms

The economic performances of cockerels reared in different bio-secured farms are shown in Table 6. Total costs of production were calculated according to both per bird and per kg live weight gain of cockerels. The total production cost (BDT/bird) was found to be 142.12, 141.49 and 141.06 in good, fair and poor bio-secured farms, respectively. It was observed that the total cost per bird did not differ significantly ($p>0.05$) but total cost per kg cockerel production was significantly differed ($p<0.01$) among three different bio-secured cockerel farms. Gross return (BDT/ bird) was significantly different ($p<0.001$) among good, fair and poor bio-secured farms. Net returns (BDT) both for per bird and per kg body weight gain were also differed significantly between good and poor bio-secured farms being highest in good and lowest in poor bio-secured conditions. The benefit cost ratio (BCR) was found to be 1.14, 1.12 and 1.10 which followed a lower trend from good to poor bio-secured farms. This lower trend of BCR from good to poor was due to the impact of bio-security practices.

Productive performance of Sonali farms

Productive performances of Sonali crossbred farms maintained different bio-security levels are shown in the Table 7. Market body weight (g/bird) was recorded to be 1248.37, 1221.48 and 1187.88 during 90 days of rearing period for good, fair and poor bio-secured farms, respectively where the mean difference was significant ($p<0.001$). Total feed intake of Sonali crossbred chicken at 90 days of rearing was varied significantly between good, fair and poor bio-secured farms being highest in good (4269.99g) and lowest in poor (4089.48) bio-secured conditions. Feed conversion ratio (FCR) of Saonai birds were reported to be 3.42, 3.43 and 3.44 for good, fair and poor bio-secured farms, respectively where variation was not significant ($p>0.05$). Sarker *et al.* (2008) found FCR value of 3.47 at the targeted weight of 1250g in crossbred Sonali bird which was consistent with the present findings.

Survivability rate was varied significantly ($p<0.001$) among the Sonali farms maintained different bio-security levels being highest in good (96.95%) followed by fair (95.09) and poor (94%) bio-secured farms. According to the FAO working paper (FAO, 2014) average mortality rate of Sonali was recorded to be 5.4% (survivability 94.6%) which was almost similar to the survivability rate of present study under poor bio-secured condition. In a study, Sarker *et al.* (2008) reported that survivability of crossbred Sonali was 91.7% at the targeted weight of 1250g which was lower than the present findings.

Table 7: Productive performances of Sonali crossbred farms maintained different bio-security levels

Performance	Level of bio-security			P value and significance level
	Good (39) Mean ± SE	Fair (43) Mean ± SE	Poor (18) Mean ± SE	
Market body weight (g)	$1248.37^a \pm 3.18$	$1221.48^b \pm 3.22$	$1187.88^c \pm 5.29$	(0.0001)***
Total feed intake (g)	$4269.99^a \pm 7.72$	$4199.20^b \pm 9.60$	$4089.48^c \pm 12.02$	(0.0001)***
Feed conversion ratio (FCR)	3.42±0.0081	3.43±0.0083	3.44±0.018	(0.26)NS
Survivability (%)	$96.95^a \pm 0.21$	$95.09^b \pm 0.23$	$94.00^c \pm 0.24$	(0.0001)***

Figures within the parenthesis indicate the number of observations.[abc]Mean values having different superscripts in a raw within three different bio-security levels differed significantly. ***: $p<0.001$; NS: Not significant.

Table 8: Economic performances of Sonali crossbred farms maintained different bio-security levels

Performance	Level of bio-security			P value and significance level
	Good (39) Mean ± SE	Fair (43) Mean ± SE	Poor (18) Mean ± SE	
Total cost (BDT/bird)	239.06±6.42	236.78±7.35	233.55±9.41	(0.13)NS
Total cost (BDT/kg)	191.54^{c}±5.52	193.88^{b}±4.43	196.67^{a}±6.92	(0.02)*
Gross return (BDT/bird)	276.64^{a}±0.70	270.72^{b}±0.70	263.33^{c}±1.16	(0.001)**
Net return (BDT/bird)	37.57^{a}±0.73	33.94^{b}±0.60	29.78^{c}±1.19	(0.0001)***
Net return (BDT/kg)	28.45^{a}±0.52	26.11^{b}±0.43	23.32^{c}±0.92	(0.0001)***
Benefit cost ratio (BCR)	1.15^{a}±0.003	1.13^{b}±0.002	1.12^{c}±0.0051	(0.0001)***

Figures within the parenthesis indicate the number of observations.^{abc} Mean values having different superscripts in a raw within three different bio-security levels differed significantly. ***: p<0.001; **:p<0.01; *:p<0.05; NS: Not significant.

Economic performance of Sonali farms

Economic performances of Sonali crossbred farms in different bio-security levels are shown in Table 8. Total cost and net return was calculated both for per bird and per kg live bird. Total cost (BDT/bird) was found to be 239.06, 236.78 and 233.55 in good, fair and poor bio-secured farms, respectively which did not differ significantly (p>0.05). In this study the total production cost per kg live Sonali crossbred was highest in poor (BDT 196.67) followed by fair (BDT 193.88) and good (BDT 191.54) bio-secured farms. This was due to higher medication and labour cost was needed due to lack of proper bio-security in poor and fair bio-secured farms.

Gross return of Sonali (BDT/bird) was found to be 276.64, 270.72 and 263.33 in good, fair and poor bio-secured farms, respectively where the mean difference was significant (p<0.01). This finding was inconsistent with the working paper report of FAO (FAO, 2014) where an average gross return was reported to be BDT 164.1. Net return (BDT/bird) from Sonali crossbred chicken differed significantly (p<0.001) among the farms maintained different bio-security levels being highest in good (37.57) and lowest in poor (29.78) bio-secured conditions. Net return per kg live bird showed similar trends being highest in good (28.45) and lowest in poor (23.32) bio-secured conditions. Benefit cost ratio (BCR) was found to be 1.15, 1.13 and 1.12 in good, fair and poor bio-secured farms, respectively and the mean difference was highly significant (p<0.001). FAO (2014) reported higher BCR from Sonali crossbred chicken (1.49) than that of the present findings.

Conclusion

The productive performances in terms of market body weight, total feed intake, efficiency of utilization of feed and survivability of three meat type chickens like Cobb 500 broiler, cockerel and Sonali crossbred farms followed similar trends being highest in good followed by fair and poor bio-secured conditions. Economic performances of three meat type chicken farms also responded similarly to the measurement of bio-security levels in the farms. The lowest survivability was observed in Cobb500 than those of cockerel and Sonali chickens in poor bio-secured conditions which revealed that the broiler farms were highly bio-security sensitive. The highest survivability of Sonali chicken in fair and poor bio-security conditions revealed that Sonali crossbred was more adaptive than Cobb500 broiler and cockerel. Net returns as well as benefit cost ratio (BCR) of Sonali crossbred farms were higher as compared to cockerel and Cobb 500 broiler farms which indicate that the Sonali was the highly benefited chicken farms than Cobb 500 and cockerel. It can be concluded that all three meat type chickens are very much sensitive to the bio-security measurement of the farm and the Sonali crossbred farming is more beneficial from economic point of view.

Conflict of interest

There is no conflict of interest neither on the results nor any part of this study.

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