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Small-Scale Broiler Farming at Rural Households With or Without Management Intervention During Winter

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Abstract: *The study was conducted to determine the productive performance and profitability of small-scale broiler farming at rural households carried out with or without management intervention during winter. Twelve thousand six hundred day old chicks were procured from a commercial hatchery and distributed into 36 farms of which18 farmers in six treatment groups (100, 200, 300, 400, 500 and 600 birds) were allowed to manage their farms in their own way while the other 18 were in six treatment groups (100, 200, 300, 400, 500 and 600 birds) trained on the basic principles of broiler farm operation, management and procedure of record keeping. Six groups, each of the three farmers (18 farmers) were provided training whereas another six groups, each of three treatment groups (18 farmers) were considered from non-trained section for comparison. Each and every trained farm owners took care of chicks providing improved management including feeds and feeding procedures, housing, disease prevention, medication, vaccination etc. as per instructions. Data were collected for productive performance, cost of farming and returns were used to determine the benefit cost ratio (BCR). Data were statistically analysed and comparisons of results were made between farms with intervention those were no intervention. Management intervention and flock size had some effects on broiler growth performance like FCR and survivability. Higher survivability and lowest FCR values found in improved management than the birds reared on traditional management. Feed efficiency improved as the flock size increased. BCR value increased with the increasing in flock size that is larger flock earns more profit than smaller counterpart. Flock size should be increased more than 300 capacities to earn profit and farmers should be trained with technical support for their income. The farmers who followed improved management in winter also earned more profit than who had not practiced improved management. It was concluded, therefore, the satisfactory productive performance is achievable and profitability be improved from small-scale broiler farming at rural households of the farmers if management intervention is made.*

Keywords: *cost and return; flock size; management intervention; small-scale*;

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I. Introduction

Small-scale broiler farming has rapidly been spread out even in the periphery of the country and this enterprise has been contributing to substantial income to the household economy especially for resource constraints farm family. Reducing extreme poverty and hungers and improving nutritional security, income generation for destitute people, commercial broiler should be included as FP (Mcleods, 2009). The outcome of recent e-conference organized by FAO also echoed the same point (Singh *et al.,* 2011). Broiler flocks of 100 birds or less are seldom found and it has become very difficult for FP keepers to ensure profit margin with a very small flock of poultry. More over, the farmers are not technically sound enough and socio-economically constraints to equip themselves with management technology appropriately. Seasonal variation in broiler management and market instability further aggravate the situation for income generation. Whether management intervention in terms of training, technical support and continuous monitoring of farmers activities could play significant role for broiler performance and their profitability are yet to be quantified and evaluated properly. In this context, sporadic works have been done limiting mostly to survey works. Therefore, it becomes necessary to determine minimum flock sizes for FP commercial broilers as FP by analyzing broiler growth performance with varying small flock sizes and their cost benefit ratios. The ultimate goal is to make production sustainable for the small farmers. Based on the facts and figures stated above, the present study was designed i) to evaluate the productive performance, costs and returns and effects of management intervention on small-scale broiler

farming during winter ii) to determine minimum flock size for family poultry (FP) production and iii) to identify the constraints of small-scale broiler farming

II. Materials and Methods

Thirty six small-scale broiler farmers who had some facilities at their home in terms of farm inputs were selected from Bhabkhali and Baera union under sadar Upazila of Mymensingh district. Among them, 18 farmers were allowed to manage their farms in their own way while the other 18 were trained on the basic principles of broiler farm operation, management and procedure of record keeping. Management intervention was made for this later group during the course of farm operation. This group of farmers also received a short training before they started farming. Most (97%) of the broiler houses of farmers were made of tin-roof with bamboo-mat ceiling and 1-1.5 feet wooden or brick wall with wire net boundary. Floor type was *kutcha* (clay made) with cemented coating. Farmers repaired their broiler houses, cleaned, washed and dried, fumigated before the commencement of trial. A floor space of 900 cm^2 was provided for each bird in each flock. Clean new papers were spread over the litter, and the house was warmed up for at least 2 hours before the arrival of day old chicks (DOCs). Farms with small flocks in operation were conducted from 25 November to 25 December 2011. During this period, the maximum temperature was 11.6^0C and minimum temperature was 28.37^0C; maximum humidity was 97.0% and minimum humidity was 71.0% and the rainfall was zero. Twelve thousand six hundred DOC were procured from a commercial hatchery and distributed into six treatment groups (100, 200, 300, 400, 500 and 600 birds). Six groups, each of the three farmers (18 farmers) were provided training whereas another six groups, each of three treatment groups (18 farmers) were considered from non-trained section for comparison. Each and every trained farm owners took care of chicks providing improved management including feeds and feeding procedures, housing, disease prevention, medication, vaccination etc. as per instructions.Strict hygienic measures and appropriate sanitation programmes were carried out by the small-scale broiler farmers of different flock sizes during the whole trial period. Frequent visits were made to farmers' households and management intervention in terms of practical training and technical advice were provided to selected farmers on all sorts of rearing and management of the broiler flocks. Efforts were made to correct faults when found on the spot during visit. Activities in relation to management practices of flocks in improved and without improved management groups are shown in Table 1Records were kept of initial body weight at one day old, weekly body weight, feed intake and mortality for each small flock. Economic performances of small flocks were estimated on both variable and total cost basis that is called tabular technique, which is easy to understand and simple in calculation. The total cost of these broiler enterprises were categorized into variable and fixed costs. Variable costs were those costs that varied with the size of the flock. Fixed costs are those costs that remain fixed whether production is zero or positive. This included interest on housing and equipment cost, depreciation of housing, depreciation of tools and equipment, land use cost and opportunity cost of family labour. Housing cost was estimated by unit cost basis (per piece of 1 sq.ft area) which is dependent on quality of housing materials. Costs of tools and equipment were determined multiplying the total number of equipment by the market price of equipment. Interest rate was calculated at the rate of 12% per annum because housing and few types of equipment are long term investment and it was charged after discussion with the Bangladesh Krishi Bank (BKB) officials. Depreciation cost of both house and equipment were assumed as 5% per year. Land use cost was estimated using 8% interest on value of land for 5 years lease. Opportunity cost of family labour accounted on the basis of labour use as part time job in another broiler farm. Gross return was estimated as the value of live weight, used litter and excreta and sale of gunny bags on the basis of market price. Gross margin and net return were estimated deducting from the gross return to variable cost and total cost, respectively. Finally, profitability as well as BCR was estimated from total gross return divided by total cost.

Table 1 Differences between with or without improved management in winter

Activity	Without improved management	With improved management
Ventilation	The farmers protected their birds from cold, but they were not aware of proper ventilation system	The farmers protected their bird from cold and they were very much aware about ventilation system of their farm. Use of fan in winter may impose cold.
Litter management	Did not take care of litter management	Take care of litter management
Water management	Did not take so much care about watering to the broilers	Fresh deep tube-well water was frequently supplied, so that remains in normal temperature.
Heat management	Few farmers used extra heat source but most of the farmers did not do so.	Extra heat sources supplied to the houses to keep birds remain comfortable. Monitoring was done by frequent visits.

All recorded and calculated parameters of biological trials were for a 2 rearing systems × 6 flock sizes were analyzed following factorial experiment in a Completely Randomized Design (CRD) for general analyses of

variance (ANOVA) using SAS 9.1.3 (2007) package program. When parameter showed significant difference, least significant difference (LSD) was calculated to make comparison among treatment groups.

III. Results and Discussion

3.1 Growth performance and flock size

Broiler flock size did not have any marked differences (P>0.05) in body weight and survivability but it had a significant (P<0.01) effect on feed consumption and FCR. Lowest feed consumption and highest feed utilization was found among the largest flock, (F_6)than other smaller counterparts. Both feed consumption and feed efficiency increased with decreases in flock size. This was probably a result of poor managerial conditions (such as random entry in the flock with unhygienic situations, irregular feed and water supply, stagnant ammoniated environment, bad odors in flock), feed wastage, careless of quality control and poor resource base in comparison to lager unit. Small farmers are those who had very small holdings or no land at all and had low access to resources, had some knowledge or even in many cases, was not in touch with modern technology to augment production as stated by several authors (Begum and Alam, 2009; Islam *et al.*, 2010; Chowdhury *et al.*, 2011) that might have reflected in the study results, as would be expected. Similar result was previously reported by Kawsar *et al.* (2011) indicating that small broiler farmers reared in small unit ranging from 100 to 300 flock sizes were low productive performer due to their insufficient technical knowledge, training and lack of technical assistance.

Table 2 Effect of flock size on growth performances

Parameter	Flock size						SED	Level of significance
	100	200	300	400	500	600		
Body weight (kg/bird)	1.563	1.517	1.482	1.470	1.508	1.495	0.029	NS
FC (kg/bird)	2.818^{a}	2.690^{ab}	2.572^{bc}	2.527^{bc}	2.503^{bc}	2.445^{c}	0.073	**
FCR	1.80^{a}	1.78^{a}	1.74^{ab}	1.72^{abc}	1.66^{bc}	1.64^{c}	0.031	**
Survivability (%)	95.17	95.59	95.76	93.76	96.38	95.66	1.058	NS

Means bearing superscripts not in common in each row differ significantly; **, P<0.01; NS, Non-significant; **FC**, Feed consumption; **FCR**, Feed conversion ratio; SED, Standard error of difference.

3.2 Growth performance and flock management

Management intervention during winter seasons had a significant effect on broiler growth performance (Table 3). Higher (P<0.01) body weight and survivability, lower (P<0.01) feed consumption and efficient feed utilization were observed when the farmers followed improved management technology. The farmers, who got training, followed advice similar to contract growers of Begum and Alam (2009). So they were able to carry out their farming job more efficiently than those of traditional farmers. Begum and Alam (2009) concluded that contract farming played a significant role in small farmer development by technical assistance having opportunity to learn technical know-how which resulted improved productivity.

Table 3 Effect of flock management on growth performances

Parameter	Flock management		SED	Level of significance
	Without improved management	With improved management		
Body weight (kg/bird)	1.472	1.539	0.017	**
Feed consumption (kg/bird)	2.684	2.501	0.041	**
FCR	1.822	1.623	0.018	***
Survivability (%)	94.06	96.71	0.611	**

Means bearing superscripts not in common in each row differ significantly; **, P<0.01; ***, P<0.001; NS, Non-significant; FCR, Feed conversion ratio; SED, Standard error of difference.

Interaction of flock size and flock management had no significant effect on broiler growth performance. But higher survivability and body weight were achieved by improved management with increasing flock sizes. Both feed consumption and FCR were decreased with an increase in flock size and also by improved management but it showed a non-significant result.

3.3 Costs of broiler production

Fixed cost differed significantly among the flock sizes. The fixed cost on broiler production was 3.88, 3.05, 2.49, 2.78, 2.22 and 1.97 % of the total cost in 100, 200, 300, 400, 500 and 600 flock sizes respectively. It indicated that as the flock size increased the fixed cost decreased. This trend was in agreement with the earlier observation of Singh et al. (1994) where the fixed cost shared 4.41 % in small farms, 3.68 in medium farms and 3.66 % in large flocks of the total cost of production, respectively. These results also coincide with the result of Rajendran et al. (2008) who concluded that fixed cost reduced with an increase in flock size. This might be due to the unit cost of broiler farming that is dependent on number of birds reared in a flock. If the number of birds

reared in a flock increased, then unit price of inputs might be decreased. The family labour cost was the major portion of the fixed cost which accounted for 1.97 to 3.37 per cent of total cost depending on flock sizes. Management intervention did not have significant effect on different item of fixed costs except land utilization cost. Differences in the value of land in different location may be the cause of those results.

Table 4 Effect of flock size on variable cost of broiler farming

Cost per bird (%)	Flock size						SED	Level of significance
	100	200	300	400	500	600		
Feed cost	67.83	67.84	67.76	68.36	69.09	69.46	0.723	NS
Chick cost	15.00^{d}	15.70^{cd}	16.39^{bc}	16.92^{b}	17.35^{ab}	17.92^{a}	0.441	***
Vaccine cost	0.86	1.28	1.17	0.77	0.82	0.95	0.157	NS
Medication cost	4.38	4.60	4.82	4.00	3.84	3.55	0.546	NS
Litter cost	1.51^{bc}	1.44^{c}	1.43^{c}	2.09^{a}	1.86^{ab}	1.64^{ab}	0.09	***
Transportation cost	1.95^{a}	1.96^{a}	1.40^{b}	1.07^{b}	1.19^{b}	1.08^{b}	0.122	***
Electric cost	1.25	1.08	1.21	0.97	0.89	0.82	0.124	NS
Other cost	0.68	0.37	0.74	0.39	0.27	0.18	0.08	***
Operational cost	2.05	2.12	2.17	2.10	2.09	2.09	0.050	NS
Variable cost	95.51d	96.39^{c}	97.07^{b}	96.66^{c}	97.38^{a}	97.58^{a}	0.097	***

Means bearing alphabet not in common in each row differ significantly; ***, P<0.001; NS, Non-significant; SED, Standard error of difference.

Feed cost accounted for 67 to 70 % which was the highest cost item in broiler production. It increased with the size of the flock but there were no significant differences among the flock sizes. Whereas in respect of management intervention, it accounted for 67.37% and in without improved management it was 69.40 % making a significant difference (P<0.01). Similar trends were noted in previous trials in summer and rainy season but feed cost shared higher in this study due to a decrease in the price of chick. If the chick cost decreases, then share of feed cost increases. Therefore, highest share have been arisen in this study. Das et al. (2008) who stated that feed cost is the prime input cost in commercial poultry production representing 65-70% of the total cost of production. Major inputs of broiler production are feed and chicks that affected the profitability (Chand et al., 2009). Interaction of flock size and flock management had no significant effect on feed cost.In variable cost, day-old chicks accounted for 15 -18 per cent of the total cost depending on flock sizes and showed highly significant differences (P<0.001) among the flock sizes (Table 4). The variable quality of chicks as indicated by so called grade 'A', 'B' and 'C' were the main causes for variation in price and even it varied batch to batch and also dealers to dealer. Management intervention had a great influence on purchase of chicks. Intervened farmers were organized and they directly purchased their DOC at hatchery rate with the help of researcher. But individual farmers were bound to buy their DOC from local dealers. Dealers did not curtail not only dealers rate but charged higher for DOC because farmers had no bargaining power and therefore had to accept it. Appendix 16 showed that individual farmers who reared broiler without intervention purchased DOCs at a rate higher than (Tk.23.35 per piece) those who followed improved management. The farmers paid their DOC cost to the local dealer with commission. Most of the farmers generally buy on credit and pay after selling their broiler. Dealers pushed low ('C') grade DOC to the village based small farmers in lieu of better quality but they charged their money similar to that of better quality. Farmers did not have anything to do since farmers were not organized. Table 5 showed that DOC price shared 17.05 % in improved management and 16.04 % in without improved management showing highly significant difference.

Table 5 Effect of flock management on variable cost of broiler farming

Cost per bird (%)	Flock management		SED	Level of significance
	Without improved management	With improved management		
Feed cost	67.37	69.40	0.418	**
Chick cost	16.04	17.05	0.188	***
Vaccine cost	0.65	1.30	0.091	***
Medication cost	5.48	2.91	0.316	***
Litter cost	1.66	1.66	0.047	NS
Transportation cost	1.83	1.05	0.070	***
Electric cost	1.12	0.95	0.072	NS
Other cost	0.57	0.30	0.049	NS
Operational cost	2.19	2.02	0.030	***
Variable cost	96.90	96.63	0.056	**

**, P<0.01; ***, P<0.001; NS, Non-significant; SED, Standard error of difference.

Vaccination and medication cost did not have significant differences among the flock sizes. Table 5 indicates that medication cost was decreased as the flock size increased but the vaccination cost did not show similar trend. The reasons were that the most of the broiler farmers randomly used medicine to protect their birds from diseases rather than going for vaccination and they borne high health care expenses. These results fully reflected where the farmers did not follow improved management; medication cost incurred 5.48 per cent whereas vaccination cost accounted for only 0.65 %. On the other hand, farmers who followed strict biosecurity and hygienic principle with the administration of vaccine in the small flock were able to rear their birds free of major disease and were able to reduce medication cost (2.91%) from total cost. Therefore, vaccination and medication costs showed significant variations in both management types. The value of Tk. 0.15 accounted for 8.29% by Golap (2001) and Uddin (1999) accounted for 7.26% which were higher than the result of the present study, Tk. 8.07 that showed 5.48%. Begum (1999) found medication cost of only 3.97% for small farms. Flock size (FS) and flock management (FM) interaction did not have significant effect on medication cost but in the vaccination cost showed significant difference due to improved management.Higher electricity cost (1.12%) was accounted when improved management was not followed. In improved management, farmers supplied additional earthen pot with burnt rice husk to provide extra heat in addition to additional bulb to protect bird from excessive cold which saved some electricity cost. Therefore, lower (0.95%) electricity cost accounted where improved management was practiced. The result of the present study was in agreement with some previous findings (Karim, 2000; Begum, 2000; Golap, 2001) that electricity cost calculated ranged from 0.99 to 1.19 per cent of total production cost in small flocks.Operating capital did not vary among the flock sizes (Table 4). It ranged from 2.05 to 2.17% which was more or less similar. But it showed significant variation between the farmers groups following different flock management (Table 5). Interest on working capital amounted to 2.19 for without improved management and 2.02 per cent for improved management. Operating capital computed as an interest on total expense (e.g. chick cost, feed cost, litter cost, medication cost, electricity cost and other cost) varied time to time, batch to batch even flock to flock. Between the flock size and flock management interaction, it showed no significant difference.Price of live broiler varied from time to time and also due to seasons of the year. During winter season (November to February) cannels, ponds, haor-baor, large marshy lands and rivers gradually became dry paving the way for fishing resulting in the availability of abundant amount of fish in the market. On the other hand, varieties of vegetables e.g. *lal-shak*, *data-shak*, cabbages, caulii flower, bean, bottle gourd etc. were in market. This resulted a fall in demand of the live broilers and therefore gross return was affected. Table 6 showed that gross return from the marketing live broilers did not differ significantly among the flock sizes, similar to summer result. But the management intervention had a significant impact between intervened group and non-intervened group. Due to lower market price of live broilers, intervened farmers marketed their broiler carefully and followed efficient feeding technique to earn more return than non-intervened farmers (Table 6). It is also evident from Table 3 and supported by previous study of Kawsar *et al*. (2017) they were stated that trained farmers were more efficient, skilled and more aware about marketing of the broilers than non-trained farmers that is supported by Mohsin *et al.*, 2008 and Akteruzaman *et al.,* 2009. Therefore intervened groups significantly earn more return than non–intervened ones. Though a little amount of return came from sac that also aggregated gross return which showed significant difference among the flock sizes and between farmers of different management groups

Table 6 Effect of flock size on profitability of broiler farming

Parameter	Flock size						SED	Level of significance
	100	200	300	400	500	600		
Fixed cost	4.49 ^{a}	3.61^{b}	2.92^{c}	3.34^{b}	2.62^{d}	2.42^{d}	0.080	***
Variable cost	95.51d	96.39^{c}	97.07^{b}	96.66^{c}	97.38 ^{a}	97.58 ^{a}	0.097	***
Total cost (Tk./Br)	150.10^{a}	142.22^{ab}	136.25^{bc}	133.05^{cd}	130.02^{cd}	126.65^{d}	2.832	***
Return (Tk./Br)	154.18	149.97	146.59	146.50	150.24	149.23	3.326	NS
Sac return (Tk./Br)	0.44^{d}	0.54^{a}	0.67 ^{b}	0.61^{bc}	1.15 ^{a}	0.56^{c}	0.027	***
Droppings return (Tk./Br)	1.72	1.67	1.74	1.73	1.16	1.77	0.041	NS
Gross return (Tk./Br)	156.33	152.18	148.99	148.84	152.55	151.56	3.321	NS
Net return (Tk/Br)	6.22 ^{d}	8.80^{cd}	12.74^{cd}	15.79^{bc}	22.46^{ab}	24.91^{a}	2.721	***
Net return (Tk./kg)	3.78 ^{d}	5.59^{cd}	8.09^{cd}	10.68^{bc}	14.77^{ab}	16.56^{a}	1.733	***
BCR	1.05 ^{d}	1.08^{cd}	1.10^{cd}	1.13^{bc}	1.18^{ab}	1.20^{a}	0.020	***

Means bearing alphabet not in common superscripts in each row differ significantly; ***, P<0.001; NS, Non-significant; Br, Broiler. BCR, Benefit cost ratio;SED, Standard error of difference.

Table 5 indicates that net profit per broiler or per kg was increased as the flock size increased and therefore differed significantly among the flock sizes. Net income from broiler farming was Tk. 3.78 for 100, 5.97 for 200, 8.09 for 300, 10.68 for 400, 14.77 for 500 and Tk.16.56 for 600 flock sizes. The smallest flock achieved little money than other larger units due to increased unit price cost with decreases in flock size. Total cost per unit decreased significantly as flock size and utilization of physical capacity increased, indicating economics of

scale (Jabber *et al.* 2007) that occurred repeatedly in the study. Significantly higher net income (Tk.17.00/kg) was earned where farmers followed good practices in respect of management backed by advice from technical personnel than those who failed to take this advantage.

Table 7 Effect of flock management on profitability of broiler farming

Parameter	Flock management		SED	Level of significance
	Without improved management	With improved management		
Fixed cost	3.11	3.37	0.056	NS
Variable cost	96.90	96.63	0.056	**
Total cost (Tk./Br)	143.65	129.13	1.635	***
Return (Tk./Br)	145.45	153.46	1.290	***
Sac return (Tk./Br)	0.83	0.50	0.016	***
Droppings return (Tk./Br)	1.54	1.72	0.024	NS
Gross return (Tk./Br)	147.82	155.66	2.353	**
Net return (Tk./Br)	4.17	26.14	1.571	***
Net return (Tk./kg)	2.81	17.00	1.001	***
Benefit cost ratio	1.03	1.21	0.011	***

**, P<0.01; ***, P<0.001; NS, Non-significant; Br, Broiler;SED, Standard error of difference.

Benefit cost ratio (BCR) was significantly highest in F_6 than that of remaining smallest flock which was due to highest maintenance cost in F_1 than those of larger counterpart. Major cost item (65-70%) involvement was in the feed that accounted for Tk.102.87 for largest flock (F_6) and Tk.88.71 for smallest unit (F_1) during winter (Table 7 and Appendix 1). Like feed cost, all components of variable cost were also higher in comparatively smaller one. So larger the flock size, lower the cost of raising of broiler under field condition. On other hand, high feed efficiency earned better return that increased BCR which was also related to the flock sizes (Tables 2 & 5). Therefore, comparatively larger flock size achieved higher economic efficiency due to better cost economy and better technical efficiency of the flock. In the present study, as the flock size increased, the benefit-cost ratio also widened.

Table 8 Effect of interaction of flock size (FS) and flock management (FM) on profitability

Interaction (FS X FM)	Economic parameter							
	Total cost (Tk./Br)	Broiler return (Tk./Br)	Sac return (Tk./Br)	Droppings return (Tk./Br)	Gross return (Tk./Br)	BCR	Net return (Tk./Br)	Net Return (Tk./kg)
F_1 X WM	159.63	150.75	0.67	1.69	153.11	0.98	-6.52	-4.38
F_1 X IM	140.58	157.60	0.22	1.75	159.55	1.14	18.97	11.94
F_2 X WM	146.83	142.10	0.73	1.67	144.50	0.99	-2.33	-1.41
F_2 X IM	137.61	157.84	0.34	1.67	159.85	1.16	19.92	12.59
F_3 X WM	140.60	139.13	0.65	1.74	141.52	1.01	0.92	0.67
F_3 X IM	131.90	154.04	0.69	1.74	156.47	1.18	24.57	15.51
F_4X WM	141.06	144.67	0.62	1.73	147.02	1.04	5.96	4.07
F_4X IM	125.03	148.34	0.59	1.73	150.66	1.21	25.62	17.28
F_5 X WM	138.57	148.24	1.72	0.59	150.55	1.09	11.98	7.95
F_5 X IM	121.61	152.25	0.58	1.72	154.54	1.27	32.94	21.58
F_6X WM	135.22	147.80	0.57	1.85	150.21	1.11	14.99	9.99
F_6X IM	118.08	150.66	0.55	1.70	152.90	1.30	34.82	23.13
SED	4.004	4.704	0.038	0.058	4.696	0.028	3.849	2.451
Level of significance	NS	NS	***	NS	NS	***	NS	NS

Means bearing dissimilar superscripts in each column differ significantly. NS, Non-significant;; ***, P<0.001; Br, Broiler: BCR, Benefit cost ratio; +, Profit; -. Loss; WM, Without improved management; IM, Improved management; F_1, Flock containing 100 birds; F_2, Flock containing 200 birds; F_3, Flock containing 300 birds; F_4, Flock containing 400 birds; F_5, Flock containing 500 birds; F_6, Flock containing 600 birds;SED, Standard error of difference.

The profitability of small- scale broiler flock significantly increased when improved management was practiced but in field level without improved management, BCR was comparatively lower. The lower BCR (1.03) in small-scale broiler farms without improved management have resulted from excessive cost of electricity, medicine, flopped of market price due to low demand of live broiler in winter, lack of scientific management and failure to obtain fair price. The average BCR in such small- scale broiler farming was 1.21 in

the improved management flocks which was lower as compared to the result reported by Nair and Ghadolyia (2000) and Begum (2004). This was quite logical since Nair and Ghadoliya (2000) and Begum (2004) worked with bigger flock sizes. Interaction effect of FS X FM on BCR showed highly significant result and Table 8 showed that BCR in small-scale broiler farming in both with or without intervention at field level widened with the size of the flocks but at field level without intervention, it was a loosing concern for such small flock (F_1 & F_2) sizes. In F_3, BCR was 1.01 and therefore was not profitable. It may have been due to lack of scientific management, high input cost, and failure to obtain fair price of live broiler. Whereas management intervention like follow-up and continuous monitoring helps to the farmers motivated to maintain hygiene and biosecurities of the flock increased broiler productivity as well as profitability. This profitability significantly improved with size of the flock.

IV. Conclusion

Management intervention and flock size had some effects on broiler growth performance like FCR and survivability. Higher survivability and lowest FCR values found in improved management than the birds reared on traditional management. Feed efficiency improved as the flock size increased. Cost and return affected both input and output cost of the broiler farming. BCR value increased with the increasing in flock size that is larger flock earns more profit than smaller counterpart. Flock size should be increased more than 300 capacities to earn profit and farmers should be trained with technical support for their income. The farmers who followed improved management in winter also earned more profit than who had not practiced improved management. It is therefore concluded that training to the small-scale broiler farmers, introduction of improved management practices, regular monitoring with adequate poultry extension services are the key elements to get satisfactory result from broiler farming. These might enhance better productive performance as well as maximize profitability. Excessive colds, low price of live broiler, lack of biosecurity of the flock, poor management due to insufficient technical knowledge of the farmers, were the main constraints of small-scale broiler farming during winter.

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Appendix

Appendix 1 Effect of flock size on variable costs of broiler farming

Flock size (FS)	Cost per bird (Tk.)									
	Chick cost	Feed cost	Vaccine cost	Medication cost	Litter cost	Transport cost	Electrical cost	Other cost	Operational cost	Variable cost
F_1 (100)	22.71	102.870^{a}	1.225	6.900	2.283^{bc}	3.050^{a}	1.910^{a}	1.035^{a}	3.128^{a}	145.112^{a}
F_2 (200)	22.58	97.827^{ab}	1.850	5.163	2.050^{c}	2.858^{a}	1.575^{ab}	0.535^{b}	3.052^{a}	139.012^{ab}
F_3 (300)	22.67	93.847^{bc}	1.592	4.347	1.967^{c}	1.953^{b}	1.675^{ab}	1.042^{a}	3.010^{a}	134.483^{bc}
F_4 (400)	22.67	91.807^{bc}	1.008	4.967	2.827^{a}	1.450^{c}	1.293^{b}	0.530^{b}	2.820^{b}	129.878^{cd}
F_5 (500)	22.58	90.513^{bc}	1.082	5.160	2.467^{b}	1.570^{bc}	1.167^{b}	0.343^{b}	2.745^{b}	127.573^{cd}
F_6 (600)	22.83	88.713^{c}	1.240	4.633	2.097^{c}	1.370^{c}	1.050^{b}	0.233^{b}	2.675^{b}	124.700^{d}
SED	0.238	2.592	0.229	0.703	0.119	0.158	0.227	0.114	0.058	2.713
Level of significance	NS	***	NS	NS	***	***	*	***	***	**

Means bearing superscripts not in common in each column differ significantly. *, P<0.05;**,P<0.01; ***, P<0.001;NS, Non significant; .**F_1**, Flock containing 100 birds; **F_2**, Flock containing 200 birds; **F_3**, Flock containing 300 birds; **F_4**, Flock containing 400 birds; **F_5**, Flock containing 500 birds; **F_6**, Flock containing 600 birds.

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