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Research Note

PERFORMANCE OF COMMERCIAL POULTRY FARMS: A PROFITABILITY AND EFFICIENCY ANALYSIS

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ABSTRACT

The present study determines the profitability and technical, allocative and economic efficiency of commercial poultry farms. It is based on the data collected from 30 poultry farms of Gazipur district for the year 1995-96. Descriptive statistical measures as well as stochastic production frontier method were used for the analysis of data. The results of the study indicated that poultry farming was a profitable business and the large farms were the most profitable compared to the others. The estimated technical efficiency of the poultry farms was 0.92 and overall allocative efficiency was 0.69. The estimated economic efficiency of poultry farms was 0.62 indicating that there exists the potential to increase profit of the poultry farms with the available resources by increasing their efficiency. Major problems faced by the poultry farms (as reported by the farmers) were inadequate availability of feed and chicks, inadequate supply of vaccines, and high price of feed.

1. INTRODUCTION

Poultry farming, in Bangladesh, was largely a backyard venture. The villagers have been keeping indigenous chicken for centuries under semi-natural conditions mainly for their domestic consumption with very little commercial motives. Poultry farming, on commercial and scientific line, is a recent endeavor and it has a great potential for providing additional income to our farming community and educated unemployed persons of the rural areas through creating self employment opportunities (Alam et al., 1998;Yasmin et al., 1989; Ahmed and Hamid, 1992).

The number of commercial poultry farms is gradually increasing in both rural and urban areas of Bangladesh. But there are a limited number of studies on production and economic aspects of poultry (Islam, 1995; Ali, 1993; Miah, 1990). Particularly, we have little information about the performance of poultry farms in terms of economic efficiency. Efficiency is a very important factor of productivity growth especially in developing agriculture where resources are meager. Efficiency, as defined by the pioneering work of Farrell (1957), is the ability to produce a given level of output at lowest cost. Efficiency can be estimated by separately estimating technical and allocative efficiency from a production

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frontier using farm survey data or by combining farmer with experimental data. Technical efficiency is defined as the ratio of farmer's actual output to the technically maximum possible output, at the given level of resources. Allocative efficiency is expressed as the ratio of the technically maximum possible output at the farmer's level of resources to the output obtainable at the optimum level of resources. Economic efficiency is simply the product of technical and allocative efficiencies.

The general objective of the study is to know the performance of the commercial poultry farms. The specific objectives of the study are as follows:

i. to determine the profitability of commercial poultry farms,

ii. to estimate technical, allocative and economic efficiency of commercial poultry farms, and

iii. to identify the problems of the poultry farms.

The next section of the paper describes the research methodology used in this study. The third section deals with the results and discussion. Summary, conclusions and recommendations are presented in the last section.

2. DATA AND RESEARCH METHODOLOGY

Data

The present study covers one-year period from 1 July 1995 to 30 June 1996. Primary data were collected from 30 commercial poultry (layer) farms of Gazipur Sadar thana by interviewing the farm owners through interview schedules. Purposive sampling technique was followed for the study. Out of 30 sample layer farms, 14 were small, 10 were medium and 6 were large layer farms. Farm size was arbitrarily classified on the basis of number of poultry birds as per opening stock on 1st July 1995. Farms having 1000 to 3000 birds were considered as small farms, 3001 to 5000 as medium farms while those having 5001 and above birds as large farms. No poultry farms having less than 1000 poultry birds were included in the study.

Analytical Technique

Descriptive statistics was used to determine the profitability of the commercial poultry farms. On the other hand, tabular, statistical as well as econometric methods were used for the economic efficiency analysis.

Profitability analysis

The following profit (Π) equation was used to determine the profitability of commercial poultry farms:

$$\prod = PeEs + PeEc + PeEg + TVBP - \sum_{i=1}^{n} PxiXi \pm Ic - TFC$$

Where, Π = Profit per poultry farm per year (Tk.),

P_e = Per unit price (Tk.) of egg,

E_s = Total number of eggs sold in a year,

E_c = Total number of eggs consumed in a year by the farm family,

E_g = Total number of eggs gifted in a year,

TVBP = Total value of by-product,

P_{xi} = Per unit price of ith (variable) input,

X_i = Number/quantity of ith input (i = 1, 2, 3, …, n), and

I_c = Value of change in inventory,

TFC = Total fixed cost.

Efficiency Analysis

Stochastic production frontier was used to determine the technical efficiency of the poultry farms. In a stochastic frontier production model output is assumed to be bounded from above by a stochastic production. Aigner et al. (1977), and Meeuseen and van den Broeck (1977) used stochastic frontier. Forsund, Lovell and Schmidt (1980) made comprehensive review on different types of frontier approach and related literature (Schmidt (1986), Bauer (1990) and Greene (1993)). The essential idea behind the stochastic frontier model is that the error term is composed of two parts, a systematic and a one sided component. A Cobb-Douglas production function was used to calculate the required coefficients for analyzing technical, allocative and economic efficiency. The stochastic production frontier in Cobb-Douglas specification can be written as:

$$Y = f(X)e^{\varepsilon} \quad \text{Where, } \varepsilon = v - u$$

$$\log Y = \log f(X) + v - u$$

Here, $\log Y = \log f(X) + v$ is distributed one sided, u and v are independent of each other and X is exogenous, v is symmetrical two-sided error term such that $v \sim N(0, \sigma^2 v)$ which captures the effects of random shocks outside the farmer's control, observation and measurement error and other stochastic noise. Thus v allows the frontier to vary across farm or over time for the same farm and therefore the frontier is stochastic. The error u is the one sided component such that $u \sim N(0, \sigma^2 u)$ which captures deviations from the frontier due to inefficiency.

The empirically estimated Cobb-Douglas production function was specified as:

$$\log(Y) = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4$$

Where,

Y = Return from poultry product and by-product (Tk./Farm/Year)

a = Constant or intercept,

X_1 = Cost of feed (Tk./Farm/Year),

X_2 = Cost of labor (TK./Farm/Year),

X_3 = Cost of medicine (TK./Farm/Year),

X_4 = Cost of electricity (TK./Farm/Year)

b_1, b_2, b_3, b_4 are the coefficients of the respective variables.

In order to estimate an efficient frontier, farm level data on input and output quantities are required. However, it is often the case that input and output quantity data are unavailable. Data are often available, however, on farm output revenues and input expenditures. Therefore, in this study a common approach is used—Revenues and expenditures data used as proxies for output and input quantities.

To determine technical, allocate and economic efficiency, stochastic production frontier method was used under Limdep 6.0 programme. The coefficient of the parameters were calculated in both Ordinary Least Square (OLS) and Maximum Likelihood Estimation (MLE) methods. From the stochastic frontier production function coefficients, farm specific technical efficiency (TE_j) was estimated as follows:

$TE_j = AGR_j/MGR_j$

Where,

AGR_j = jth farmer's actual gross revenues and

MGR_j = jth farmer's maximum possible gross revenues.

MGR_j was measured by substituting the jth farmer's level of resources into the estimated stochastic frontier production function (Ali and Chaudhary, 1990).

Farm specific allocative efficiency (AEij) in use of variable input (I) was calculated as below:

$AE_{ij} = MGR_j/OGR_{ij}$

Where,

OGR_{ij} was gross revenues at the optimum level of the ith input with all other inputs remaining at the level at which the jth farmer used them. Farm-specific optimum input level was calculated by using MVP/MFC=1 principle.

The allocative efficiency (AE_j) of all inputs on the jth farm was estimated as:

$AE_j = MGR_j/OGR_j$

Where,

OGR_j was the jth farmer's gross revenue at the optimum level of all variable inputs.

Farm specific economic efficiency (EE_j) was estimated using the following equation:

$EE_j = TE_j.AE_j$

Where,

EE_j = Economic efficiency of the jth farmer,

TE_j = Technical efficiency of the jth farmer,

AE_j = Allocative efficiency of the jth farmer.

3. RESULTS AND DISCUSSION

Basic Characteristics of the Sample Farms

Basic characteristics of the sample farms are reported in Table 1. Out of 30 sample farms 47 percent were small (having 1000 to 3000 birds), 33 percent were medium (having 3001 to 5000 birds) and 20 percent were large (having 5001 and above birds) farms. Sample farms were operated under single and joint ownership. Seventy one percent of small farms, 80 percent of the medium farms, and 83 percent of the large farms were under single ownership. All the poultry farm owners were well educated. About 47 percent of all poultry farm owners had above primary to higher secondary level education. About 33 percent had graduation and 20 percent farmers had master's degree level education.

Occupational distribution of the poultry farm owners showed that 10 percent of poultry farm owners were engaged in only poultry farming. Thirty percent were raising poultry with other business and 47 percent farms raised poultry farming with agriculture. Thirteen percent of all farm owners had poultry raising with service.

Owners of the commercial poultry farm were relatively young men. The age composition of owners of the sample poultry farms indicated that none of the owners had the age below 26 years. The highest number of owners (47 %) were in the age group of 26-36 years, 37 percent farms fell in the age group of 37-47 years, and only 16 percent farms were in the age group of 48 and above years. Most of the sample poultry farm owners started poultry business in the year 1994 and 1995.

Average size of the small farms was initially 1802 number of poultry and 1536 sq. feet space, while the present number of poultry are 2238 and space 3384 sq. feet. For medium farms, initial number of poultry were 3922 and space 5374 sq. feet. For large farms, initial number of poultry were 4183 and space 6031 sq. feet. In case of all farms, initial number were 2901 and space 5114 sq. feet.

Three types of poultry houses —cage system, slate (*macha)* system and floor system—are found among the sample farms. Predominant poultry raising system in small farms is cage system (50 percent) followed by floor (43%) and *macha* system (7%). For medium farms, poultry raising through cage, *macha* and floor system was 80, 10 and 10 percent, respectively.

On the other hands, these figures for large farms were 50, 33 and 17 percent, respectively. About 60 percent of all farms used cage system, 13 percent *macha* system and 27 percent floor system.

Table 1. Basic characteristics of the sample farms.

Description	Small (having 1000 to 3000 birds	Medium (having 3001 to 5000 birds)	Large (having 5001 and above birds)	All
Sample size	14	10	6	30
Ownership Pattern				
Single owner (%)	71	80	83	77
Joint owner (%)	29	20	17	23
Percent of farmers with Educational status				
Above primary to higher secondary	58	30	50	47
Graduation	21	50	33	33
Masters	21	20	17	20
Percent of farmers having occupation				
Only poultry	14	10	-	10
Poultry + Business	22	40	33	30
Poultry + Agriculture	50	40	50	47
Poultry + Service	14	10	17	13
Percent of farmers in the age-group				
26-36 years	43	50	50	47
37-47 years	36	40	33	37
48 and above	21	10	17	16
Average size of the farms				
Number of birds (initial)	1802	3670	4183	2901
Number of birds (Present)	2238	3922	7285	3809
Space in sq. feet (initial)	1536	3245	6031	3005
Space in Sq. feet (present)	3384	5374	8717	5114
Percent of farmers having Housing Patterns				
Cage	50	80	50	60
Slate (Macha)	7	10	33	13
Floor	43	10	17	27

Use of Feed Stuff Per Poultry Per Year

The sample farms used different feed items, such as broken maize/wheat, rice polish/bran, oil cake, salt etc. (Table 2). On average, the sample farms used 19 kg of broken maize/wheat, 8 kg of rice bran/ polish, 3.5 kg of oil cake, 0.14 kg of salt, 0.07 kg of premix, 3.6 kg of protein concentrate/fish meal, 2.6 kg of oyster shell and 2.2 kg of soybean. Small farms provided more feed to the poultry compared to the medium and large farms. The reasons might be a less number of poultry on their farms and inefficiency of input use i.e., overuse of feeds due to

their inadequate technical knowledge on poultry rearing. The small farms should increase the number of poultry to an economic size of their farms.

Table 2. Quantity of individual feed stuff per bird per year.

Feed ingredients	Quantity of feed per bird by farm size (Kg.)			
	Small	Medium	Large	All
Broken Maize/Wheat	21.30	18.46	18.95	19.34
Rice Bran/Polish	8.68	7.66	7.77	7.95
Oil cake	3.99	3.63	3.00	3.47
Salt	0.22	0.17	0.07	0.14
Premix	0.10	0.08	0.05	0.07
Protien concentrate/Fish meal	3.69	3.70	3.56	3.64
Oyster shell	3.45	2.24	2.39	2.59
Soybean	2.75	1.67	2.43	2.18

Labor Use Pattern of the Sample Farms

The sample farms of the study area used both family and hired labor (Table 3). Labor use pattern analysis showed that only 13 percent of the total labor use came from family sources while 87 percent was hired. About half of a man-day was required for caring of a poultry during the whole range of production.

Table 3. Labor use pattern of sample farms.

Farm size category	Labor use (man-day) per farm			Labor use (man-day) per bird
	Family	Hired	Total	
Small	235	834	1069	.55
	(22)	(78)	(100)	
Medium	256	1716	1972	.48
	(13)	(87)	(100)	
Large	183	3224	3407	.47
	(5)	(95)	(100)	
All	231	1606	1837	.49
	(13)	(87)	(100)	

Note: Figures in the parentheses are the percentages of the total.

Costs of and Return from Poultry Farming

In this study, cost items consisted of feed, labor, vaccine and medicine, electricity, water, transportation, equipment and machinery, housing, land use cost, interest on operating capital and miscellaneous. Total costs per farm per year were classified into cash and non-cash costs.

Cash costs were those costs, which the owners of the poultry farms had to pay out of their pocket to acquire the inputs. On the other hand, non-cash costs were estimated for family labor, housing, equipment and machinery, interest on operating capital etc. On the return side, gross returns, net returns above cash costs and full costs and net returns per Taka invested were determined and analyzed in this study.

Costs of raising poultry

Costs of raising poultry per bird were negatively related with the farm size. Larger the farm size, lower the cost of raising per bird. The total costs per poultry per year were calculated as Tk. 555 for small farms, Tk. 503 for medium farms, Tk. 487 for large farms and Tk. 509 for all layer farms (Table 4). The cash costs per poultry per year for small, medium, large and all layer farms were Tk.461, Tk.422, Tk.422, and Tk431, respectively. Cash cost accounted for about 84 percent and non-cash cost was only about 16 percent of the total costs of all farms.

Table 4. Annual costs per bird according to farm size

Items	Costs per bird by farm size (Tk.)			
	Small	Medium	Large	All
A. Cash costs = (a+b+c+d+e+f+g)	461.11 (83.15	421.68 (83.90)	421.69 (86.53)	431.17 (84.69)
a. Feed cost	425.14	387.16	384.89	395.41
b. Hired labour	18.32	18.31	18.91	18.54
c. Vaccine and medicine	4.98	5.11	5.62	5.28
d. Electricity	3.84	3.72	3.44	3.64
e. Transportation	5.28	3.88	3.63	4.12
f. Repairing	0.50	1.61	3.07	1.91
House	0.17	1.08	2.24	1.31
Equipment & machinery	0.33	0.53	0.83	0.60
g. Miscellaneous	3.06	1.90	2.13	2.27
B. Non-cash cost = (h+i+j+k+1)	93.42 (16.85)	80.90 (16.10)	65.64 (13.47)	77.96 (15.31)
h. Family labor	7.34	6.15	2.34	4.95
i. Housing	42.52	36.22	26.63	34.03
j. Equipment & Machinery	18.31	16.05	14.36	15.92
k. Land use cost	2.20	1.38	1.21	1.51
l. Int. on operating capital	23.06	21.08	21.08	21.56
Total costs = (A + B)	554.54 (100)	502.58 (100)	487.33 (100)	509.13 (100)

Figures within parentheses indicate percentage of total costs.

Returns from poultry farming

Gross returns consisted of the money value of total output plus inventory change. Inventory change was defined as the difference between the total value of farm's poultry at the beginning of the year plus birds bought and the total value of farm's poultry at the end of the year plus birds sold, gifted and consumed. Thus, inventory change = (Closing stock + Sold + Gift + Consumed) – (Beginning stock + Purchase). The net returns were calculated at both cash and full cost basis. The net returns above full costs were calculated by subtracting the gross costs from gross returns; the net returns above cash costs were calculated by subtracting all cash expenses from the gross returns. Table 5 shows that the annual gross returns per poultry stood at Tk. 752, Tk. 717, Tk. 739 and Tk. 734 for small, medium, large and all poultry farms, respectively. The average gross returns from eggs per poultry per year were Tk. 722, Tk.681, Tk. 694 and Tk. 696, respectively. The inventory change per poultry was estimated at Tk. 29.01, Tk. 35.35, Tk. 43.87, and Tk. 37.13 for small, medium, large and all poultry farms. A lower rate of family consumption, a lower death rate due to better management, and a greater number of purchases of poultry were the main reasons for higher inventory change for larger farms. The details of inventory change of poultry farms are provided in Appendix table 1.

The net returns above cash and full costs per poultry were Tk. 291, Tk. 197 for small farms, Tk. 296 and Tk. 215 for medium farms, Tk. 317 and Tk. 251 for large farms, and Tk. 303 and Tk. 225 for all farms, respectively (Table 5). Thus, the net returns above cash costs and full costs per taka invested were estimated at Tk. 0.63 and Tk. 0.36 for small, Tk. 0.70 and Tk. 0.42 for medium farms, Tk. 0.75 and Tk. 0.51 for large farms and Tk. 0.70 and Tk. 0.44 for all layer poultry farms. Results indicated that large poultry farms are the most profitable compared to the others.

Table 5. Annual gross and net returns per bird according to farm size.

Items	Small	Medium	Large	All
	Gross returns per bird (Tk.)			
Gross returns = (A+B+C)	751.69	717.22	738.75	733.85
A. Egg	721.60	681.19	693.89	695.82
a. Sell	721.09	680.73	693.52	695.38
b. Consume	0.46	0.42	0.31	0.39
c. Gift	0.05	0.04	0.06	0.05
B. By product (poultry excreta)	1.08	0.68	0.99	0.90
C. Inventory change	29.01	35.35	43.87	37.13
	Net return per bird (Tk.)			
Net return over cash cost (Tk.)	290.58	295.54	317.06	302.69
Net return over full cost (Tk.)	197.16	214.64	251.43	224.73
Net return per Taka. invested(cash cost)	0.63	0.70	0.75	0.70
Net return per Taka. invested (full cost)	0.36	0.42	0.51	0.44

Technical, Allocative and Economic Efficiency of the Poultry Farms

Estimates of production function by Ordinary Least Square (OLS) and Maximum Likelihood Estimates (MLE) are shown in Table 6. In the case of all inputs, feed is the only one input whose effect is statistically significant at 1 percent level of significance in both MLE and OLS method. The coefficients of labour and medicine are positive but insignificant at 1 percent level, although they are significant at 15 percent level. The coefficient of electricity is negative and insignificant.

Table 6. Estimates of production function by OLS and MLE (frontier)

Parameters	OLS	MLE
Constant	0.1642	0.2156
	(0.2672)	(0.3744)
Feed	0.9914*	1.0000*
	(0.0873)	(0.1041)
Labour	00.0727 NS	0.0462 NS
	(0.1575)	(0.1639)
Medicine	0.1594 NS	0.1432 NS
	(0.1206)	(0.1478)
Electricity	-0.2156 NS	-0.1846 NS
	(0.1824)	(0.2687)
μ/σ_u		0.5532
		(13.04)
σ_u/σ_v		1.2912
		(0.9969)
$\sqrt{(\sigma^2_v + \sigma^2_u)}$		0.0677
		(0.0830)

Note: * indicates significant at 1 percent level. NS indicates not significant. Figures in the parentheses are standard error of the estimates.

The results of the technical, allocative and economic efficiencies are shown in Table 7. The average technical efficiency of the poultry farms is 0.92, which indicates that the poultry farms are 8% technically inefficient. This means that there exists an 8% potential for increasing poultry farmers' income at the existing level of their resources. Overall allocative efficiency of the poultry farms is 0.69 which means that there is a probability to increase farmers' gross revenues by increasing resources properly. The individual allocative efficiency of feed, labour, medicine and electricity were 0.55, 0.99, 0.65 and 1.92. In the case of feed and medicine the farmers of the study area are allocatively inefficient by 45% and 35% respectively, which means that there is a potential to increase the farmers' gross revenues by increasing feed and medicine. In the case of labour, the poultry farms were 0.99 percent efficient which was close to unity, that means the poultry farms were efficient in labor use. The allocative inefficiency was the highest in the case of electricity. The poultry farm owner's used more electricity; as a result the contribution of the electricity was negative. So, the farm owner

should decrease electricity use to increase their gross income. The economic efficiency of the commercial poultry farms was 0.62, which means that there exists a potential for increasing the gross revenues of the farm owners by 38% by using the available resources properly.

In the present study, the number of poultry farms by farm size were just a few which were not adequate to perform efficiency analysis according to farm size. That is why, the efficiencies were calculated jointly, rather than by farm category.

Table 7. Technical, allocative and economic efficiency of poultry farms.

Type of efficiency	Average efficiency level	Range of efficiency	Standard deviation
A. Technical	0.92	0.68-1.00	0.0784
B. Allocative			
Overall	0.69	0.54-0.94	0.0810
Feed	0.55	0.45-0.83	0.0725
Labour	0.99	0.95-1.00	0.0143
Medicine	0.65	0.58-0.71	0.0343
Electricity	1.92	1.72-2.22	0.1112
C. Economic	0.62	0.54-0.66	0.0243

Problems of poultry farming as perceived by farmers

Finally, the study identified some problems relating to poultry farming, which are reported in Table 8. The major problems of the layer farms, as perceived by the farmers, are: inadequate availability of feeds, high price of feeds, inadequate availability of chicks, outbreak of poultry diseases, social insecurity and political unrest, inadequate supply of electricity, inadequate supply of vaccines and medicines, inadequate institutional credit and unavailability of skilled manpower, fluctuation of egg prices and lack of special transportation facilities required for eggs and poultry.

Table 8. Distribution of farmers according to problems faced in poultry raising in the study area.

Nature of problems	Percent of farmers by farm category			
	Small	Medium	Large	All
Inadequate availability of feed	100	100	100	100
High price of feed	100	100	100	100
Inadequate availability of chicks	100	100	100	100
Diseases	71	80	100	80
Social security and political unrest	71	80	83	77
Inadequate supply of electricity	78	70	67	73
Lack of veterinary service facilities and inadequate supply of essential medicine	64	70	83	70
Lack of credit facilities	50	80	100	70
Lack of skill manpower	64	70	67	67
Transport/communication facilities	86	50	50	67
Irregular fluctuation of egg price	42	60	83	57

Source: Field survey, 1996.

Appendix table 1: Inventory change of poultry farms

Items	Number & value	Farm size categories			
		Small	Medium	Large	All
Opening stock	Birds (no)	1928	4097	7250	3716
	Value (Tk.)	250329	378200	968792	436645
Purchase	Birds (no)	1113	1010	4917	1839
	Value (Tk.)	31973	70480	126917	63798
Sale	Birds (no)	393	785	3900	1224
	Value (Tk.)	39350	75750	392250	122063
Gift	Birds (no)	2	0	20	5
	Value (Tk.)	193	0	2017	493
Family consumption	Birds (no)	75	56	95	73
	Value (Tk.)	7525	5575	9267	7223
Death	Birds (no)	300	344	771	409
	Value (Tk.)	22003	27990	61083	31815
Closing stock	Birds (no)	2274	3922	7285	3825
	Value (Tk.)	290523	512200	1010217	508354
Change in inventory	Value (Tk.)	55931	144845	318042	137991

4. CONCLUSIONS

Poultry can play a vital role for the development of Bangladesh. Poultry farming are a profitable business. Net profit per bird is directly related to the farm size. Large farms were more profit earners and small farms were less profit earners compared to others. Production of poultry farms were positively related with the variable inputs of feed, labor and medicine and negatively related with electricity. Poultry farms are technically efficient but inefficient in terms of allocative and economic efficiency. Therefore, there is scope to increase net profit of the farms by changing available inputs use. Farm owners are suffering from some problems like inadequate availability of feed and chicks, inadequate supply of vaccines, high price of feed, and political unrest. Government should come forward to solve such problems otherwise the growth of poultry farms may be hampered.

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