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Original Research

Economic Comparison for the Effect of Breeds and Housing Systems on Broiler Farms Production and Profit

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Abstract

Broiler production is a promising sector to achieve food security and economic development in Egypt. It has a big share in animal protein supply which can relieve the problem of animal protein shortage. This study focused on estimating broiler farms profitability after the major financial changes that took place in Egypt, by studying how different housing systems and broiler breeds can affect farm production and profitability. Farm records and research questionnaires were used to collect data from broiler farms in two governorates (Al Sharkia and Ismailia). Different broiler breeds and housing systems were compared. Results showed that despite the high cost of production, broiler production is still a profitable business appealing for further private or governmental investments. The veterinary management, housing system and breed have a positive effect on the productivity. The highest production was obtained for Cobb breed and closed systems, whereas Ross breed achieved the highest net profit. Despite the challenges faced by producers, it was concluded that broiler farms in the study area are acting in the second stage of production where resources are probably used for the existing conditions.

KEYWORDS
Broilers, Farm profit, Housing systems, Veterinary management

INTRODUCTION

Broiler industry is one of the main agricultural industries in Egypt that represented about 18 billion LE, with an estimate of 140 million birds with an average meat production of 1,035,193 tons (FAO, 2014). It creates employment opportunities for both rural and semi-urban inhabitants. Moreover, it is an accessible protein source for the growing population as well as an income generator for millions.

Semi-intensive systems (with flocks between 2000-3000 birds) are common in rural Egypt and act as a transitional stage between traditional and commercial production. Such farms received limited institutional support services including veterinary services which can lead to diseases (El-Menawey *et al.*, 2019), which are further enhanced by climate changes (Adesiji *et al.*, 2013). According to Mbuza *et al.* (2017), diseases challenged 32.4% of farms. Small flocks were reported to have higher mortality than medium and large ones which might be due to poor management practices (FAO, 2017).

Production costs also impact farm profit. Energy costs increased for heating in winter and for ventilation in summer (Adesiji *et al.*, 2013). On the returns side, broiler companies are investing more to improve the genetic make-up of broiler breeds. Several breeds with better performance were developed (Martins *et al.*, 2012). Also, housing system was found to affect production targets (Preisinger, 2005). Therefore, the total returns are influenced by inputs costs and production (Zahir-ud-Din *et al.*, 2001).

Therefore, this research aimed to evaluate the profit of broiler farms in Egypt by investigating the effect of these two important parameters (breed and housing system) on production, costs and returns.

MATERIALS AND METHODS

Data collection and study area

Data of 167 broiler farms from two Governorates: El Sharqia (114) and Ismailia (53) were collected during 2019-2022. Data were obtained through farm records when available and research questionnaires (Bassyouni *et al.*, 2021). Data included production, costs and returns parameters.

Production parameters included breed (Hubbard, Cobb, Ross), amount (kg) and price (LE) of feed consumed/cycle, mortality percentage, total body weight (BW) (kg), and housing system (opened or closed). Cost parameters were divided into variable costs (day old chicks (DOCs), total veterinary management (TVM) (drugs, vaccines, disinfectants and veterinary supervision), labor (variable), feed, electricity and other costs (Sankhayan, 1983) and fixed costs (rent, fixed labour and depreciation) (Attallah, 2000).

Statistical analysis and statistical model

Data were collected, arranged with all the un-logic data had been rejected. Data were then summarized, and homogeneity test was performed. Data were analysed by using SPSS (2001)

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and MSTAT (1984).

Analysis of variance was done to fulfil the following equation:

$V_{ijk} = \mu + S_i + Lj + e_{ijk}$

(V_{ijk} = An observed value, μ = overall mean, S_i = Effect due to the breed, L_j= Effect due to housing systems, e_{ijk}= error). Efficiency measures of cost and return parameters per 100 birds were calculated (Omar, 2003).

Production and economic analysis

The following measures were calculated including average production (kg)= Number of live birds x Average body weight at the marketing age); Mortality percentage= (total number of birds died/total number of birds stocked)*100, total costs (TC) (LE) (New, 1991)= fixed costs + variable costs. Total variable costs (LE) (Atallah, 1997) = cost of feed + day old chicks (DOCs) + litter + medicaments + Miscellaneous costs (labor, fuel, water and electricity). Total fixed costs (LE) (Omar, 2003) = rent or depreciation + fixed labour costs. Depreciation rates were calculated (Lotfollahian and Hosseini, 2007; Muhammad, 2002 and Rahimi and Behmanesh, 2012) on five years for feeders, drinkers, ventilation system and on 25 years for the buildings, and on 15 years for heaters, compressor, tanks, vehicles and refrigerator as in the following equation:

$$Depreciation\, rate = \frac{Value\, of\;\; Asset}{Age\;\; of\;\; Asset\,(year)}$$

(Muhammad, 2002)

Total returns were calculated by adding returns from bird sales (= kilograms produced x price/kg (LE)) to returns from litter sales. Net income (Rosegrant *et al.*, 2008) = total returns – total costs.

The correlation matrix was then estimated between the studied variables to exclude the variable that have a high correlation between each other from the production and costs function and to avoid the multicollinearity between the studied variables (Atallah, 1997).

Production (Atallah, 1997) and costs functions (Sankhyan, 1983), both linear and logarithmic, were performed to assess the effect of changes in production and costs parameters on total bird production and returns by using forward, backward, enter and mixer methods by using (SPSS, 2001). Choosing the best function was according to the acceptance of the function economically, statistically (significance of F test, t-test as well as value of adjusted coefficient of determination R2) and reality of its results to the birds' production conditions (Atallah, 1997).

RESULTS AND DISCUSSION

Effect of broiler breeds on mortality percentage

The results showed significant variations (P<0.01) among broiler breeds (Table 1) on mortality percentage. Mortality percentage was 5.30%, 4.80% and 4.31% for Hubbard, Ross and Cobb, respectively. This is in contrary to Rokonuzzaman *et al.* (2015) who found no significant difference between Cobb 500, Hubbard Classic and Arbor Acres breed.

Effect of broiler breeds on values of drugs, vaccines, disinfectants, veterinary supervision and TVM

The value of TVM parameters were found to be highest for Ross breed where the values were 297.06 LE, 150.69 LE, 38.44 LE and 405.88 LE for drugs, vaccines, disinfectants and veterinary supervision, respectively (Table 1). Accordingly, the highest TVM value was recorded for Ross breed (892.07 LE)

Effect of broiler breeds on total weight (TW) (Kg), total return (TR), total costs (TC) and net profit (NP) (LE)

Significant differences in TW (Kg), TR, TC and NP (LE) among raised breeds were found (P<0.01) according to (Table 2). The highest production weight was found in farms raising Cobb (204.29 Kg). This is contradicted to obtaining the highest returns for farms raising Hubbard (6361.34 LE). Total production costs were highest for Hubbard (4959.12 LE). The highest NP was found for Ross breeds (1507.93 LE)

According to FAO (2017) Cobb achieved higher body weight and weight gain than Ross also Amao *et al.* (2015) reported Cobb performing was better and profitable due to cobb had the highest mean value (1423.00g) in body weight.

Effect of housing systems on mortality percentage

Data in Table 3 cleared that no significant differences (P > 0.01) among mortality percentage in different housing systems.

Table 1. Effect of broiler breeds on mortality % and values (LE) of TVM.

Breeds	N	Mortality %	Drugs	Vaccines	Disinfectants	Veterinary supervision	TVM
Cobb	58	4.31±0.24^{C}	261.47±9.70^{C}	129.81±5.74^{B}	34.06±1.44^{C}	393.10±10.96^{B}	818.43±19.00^{C}
Hubbard	58	5.30±0.35^{A}	271.45±10.90^{B}	131.09±5.69^{B}	36.47±1.39^{B}	389.66±10.63^{C}	828.66±20.05^{B}
Ross	51	4.80±0.28^{B}	297.06±12.56^{A}	150.69±7.02^{A}	38.44±1.75^{A}	405.88±10.26^{A}	892.07±22.10^{A}
Total	167	4.80±0.17	275.80±6.42	136.63±3.59	36.23±0.88	395.81±6.15	844.47±11.92

LE: Egyptian pound; TVM: total veterinary management

Data are presented as Mean ±S.E., Means in the same column with different letters are significantly different at (P < 0.01)

Table 2. Effect of broilers breed on TW (kg), TR, TC and NP (LE).

Breeds	N	TW	TR	TC	NP
Cobb	58	204.29±1.85^{A}	6246.42±166.95^{B}	4750.25±81.51^{C}	1496.17±103.91^{B}
Hubbard	58	202.07±1.50^{B}	6361.34±158.53^{A}	4959.12±87.78^{A}	1402.22±94.05^{C}
Ross	51	203.10±1.82^{AB}	6300.17±163.65^{C}	4792.24±96.79^{B}	1507.93±88.32^{A}
Total	167	203.16±0.99	6302.75±93.80	4835.61±51.22	1467.13±55.44

TW: total weight; TR: total return; TC: total cost; NP: net profit; LE: Egyptian pound

Data are presented as Mean ±S.E., Means in the same column with different letters are significantly different at (P < 0.01)

Management systems have the major effect on mortality percentage and not the housing system (FAO, 2017).

Effect of housing systems on values of drugs, vaccines, disinfectants, veterinary supervision and TVM

Housing system was found to impact the value of veterinary management items significantly (P<0.01) as in (Table 3). Values of drugs (362.50LE), vaccines (172.92) and disinfectants (46.34 LE) were found to be higher for closed systems. On the other hand, the veterinary supervision was found to be higher (396.77 LE) in opened systems. This might be attributed to high prevalence of disease conditions in opened systems than closed systems. Accordingly, the value of TVM was higher in closed systems (965.09 LE) compared to opened systems (835.13 LE).

Vaccination programs and health measures vary in regarded to several local factors such as type of production, production costs and potential economic losses (Marangon and Busani, 2007).

Total weight (Kg), total return (TR), total costs (TC) and net profit (NP) (LE)

Table 3 shows that the total production (kg) was found to be significantly higher (P < 0.01) in closed systems (225.23 kg) compared to open ones (201.45 kg.

Although, production costs was higher for closed systems (5080.46 LE/, farmers were able to achieve higher returns (7051.38 LE) and consequently higher NP (1970.92 LE).

Suitable housing system could result in increasing production performance and quality of production (Abd El-Hack *et al*., 2016).

Table 3. Effect of housing system on mortality %, values of TVM (LE), TW (Kg), TR, TC and NP (LE).

	Housing system	N	Mean± SE	t-value	Probability
Mortality %	Opened	155	4.85±0.19	1.03	NS
	Closed	12	4.16±0.29		
Drugs	Opened	155	269.09±6.21	3.91	***
	Closed	12	362.50±30.85		
Vaccines	Opened	155	133.82±3.65	2.87	**
	Closed	12	172.92±12.86		
Disinfectants	Opened	155	35.45±0.87	3.28	***
	Closed	12	46.34±3.99		
Supervision	Opened	155	396.77±6.44	3.56	**
	Closed	12	383.33±20.72		
TVM	Opened	155	835.13±11.75	2.87	**
	Closed	12	965.09±58.67		
Total weight	Opened	155	201.45±0.93	7.04	***
	Closed	12	225.23±1.87		
TR	Opened	155	6244.79±94.50	2.24	*
	Closed	12	7051.38±421.95		
TC	Opened	155	4816.66±53.60	3.25	**
	Closed	12	5080.46±159.84		
NP	Opened	155	1428.13±55.02	2.59	**
	Closed	12	1970.92±270.63		

TVM: total veterinary management, TW: total weight, TR: total return, TC: total cost, NP: net profit, LE: Egyptian pound
NS: Non significant at (P>0.05); *: Significant at (P < 0.05); **: Significant at (P<0.01)

Table 4. Correlations between mortality percentage, drug, vaccine, disinfectant, veterinary supervision, TVM, TW, TR, TC, NP (LE).

	Mortality %	Drugs	Vaccines	Disinfectant	Supervision	TVM	TW	TR	TC	NP
Mortality %	1									
Drugs	-0.09	1								
Vaccines	-0.05	.88**	1							
Disinfectant	.18*	.23**	.30**	1						
Supervision	-0.09	0.01	0.05	0.03	1					
TVM	-0.09	.83**	.83**	.30**	.54**	1				
TW	-.41**	.36**	.26**	0.04	0.02	.29**	1			
TR	-.24**	.69**	.56**	0.11	-0.05	.55**	.66**	1		
TC	-.15*	.79**	.67**	0.04	0.02	.64**	.46**	.86**	1	
NP	-.27**	.44**	.33**	0.14	-0.02	.34**	.69**	.88**	.54**	1

TVM: total veterinary management; TW: total weight; TR: total return; TC: total cost; NP: net profit; LE: Egyptian pound.
NS: Non significant at (P>0.05); *: Significant at (P < 0.05); **: Significant at (P<0.01)

Table 5. Logarithmic production and cost functions.

Production	= 2.11+ 0.12 Log drug + 0.05 Log vaccine – 0.70 Log disinfectant + 0.7 Log supervision t (49.77)** + (3.78)** + (3.29)** - (3.24)** + (4.05)** R^2 = 0.39 F = 9.05
	= 2.01 + 0.10 TVM t (26.87)** + (3.98)** R^2 = 0.08 F = 15.71
	= 2.34 – 0.02 Log mortality number t (174.25)** (4.29)** R^2 = 0.09 F = 18.34
Cost	= 3.69 + 0.35 Log mortality number t (201.65)** (1.02)* R^2 = 0.08 F = 5.04

*: Significant at P < 0.05; **: Significant at P < 0.01

Effect of housing systems on correlations between drug, vaccine, disinfectant, TVM, TR, TC, Net profit

The correlation was made to measure the level of correlation between variables affecting broiler production (mortality percentage, drug, vaccine, disinfectant, TVM, TC, TR, Net profit (LE) (Table 4).

The correlations were significant at (P<0.01) except mortality % was only significant at (P<0.05). There is high positive correlation between drugs, vaccines, disinfectant, TVM, total weight, TC, TR, Net Profit (LE). This shows the relative relationship of each of these variables. This can assist broiler farmers in the farm budget planning and expunge any variable that does not have any bearing to the level of income generation potential of an enterprise.

The regression showed both the logarithmic production function and cost function (Table 5). Production function was highly significant (P<0.01) that 39% of the changes in production was attributed to drugs, vaccines, disinfectants and veterinary supervision.

The total elasticity of production was (+0.17), therefore if all resources in the equation were increased by 10%, broiler production will increase by 1.7%. Therefore, broiler farms act in the 2nd stage of production.

About 8% from the changes in production was attributed to changes in values of TVM (LE). The average elasticity of TVM was (+0.10) which means that changing in the values of TVM by 10% will increase broiler production by 1%. Moreover, 9% of changes in production were attributed to change in mortality. Changes in the mortality number by 10% will reduce production by 0.2% and will increase cost by 3.5%.

These results disagreed with those of Omar (2003), as he concluded that the broiler production farms act in the 1st stage of production. This can be attributed to the development that occurred in broiler farms and the more experience gained by managers.

CONCLUSION

Broiler farming in the study area is profitable despite the high cost of production. The government or the private sector can still invest in broiler farms and achieve profit. Cobb was found to achieve higher body weight compared to Hubbard and Ross. This is important for broilers processors, where large body weight is needed for further processing than small ones.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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