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Productive and Economic Efficiency of Some Layer Farms in Egypt

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Abstract

Egg production is an important factor that helps to meet the nutritional needs of the growing populations in developing countries. Commercial egg production is a source of high quality protein and income compared to other livestock production activities. The study used a multiple regression profit model to estimate the effect of breeds and housing system on profitability. Data were collected from 100 randomly selected layer farms in (Al Sharkia and Ismailia) during the period from 2019 to 2022, through research questionnaires. Results showed that hen reared in closed system had higher egg production, higher total return than those reared in the opened system. Lohman breed are more tolerable to the Egyptian conditions in the study area as shown by lower mortality % and lower values of total veterinary management (TVM). Layer farms in the study area were operating in the second stage of production. Therefore, layer farms are considered a good investment for both private and government sectors.

KEYWORDS
Layers, Egg, Housing systems, Lohman, Veterinary management

INTRODUCTION

Layers sector is one of the main pillars of poultry production in Egypt. It acts as the main source of income for numerous families both in the countryside and in the cities (MALR, 2008). The value of egg production rose from 707 million LE to 2.1 billion LE (El Nagar and Ibrahim, 2007). Although the global annual egg production has reached more than 83 million ton of eggs (FAO, 2019), egg production is expected to witness continuous growth as the global demand is projected to increase by 39% from 2005 to 2030 (MacLeod *et al*., 2013).

Several layer farms were producing up to 500 eggs/hen throughout the production cycle; this has reduced the need for replacement flocks and has improved farm economics and sustainability (Abo Ghanima *et al*., 2020). Eggs and spent hens are the main source of income for layer farms (Begum *et al*., 2010).

Breed is an important factor affecting farm production. Indigenous breeds have desirable characteristics under local production conditions as disease resistance, greater robustness against stressors, superior adaptability and higher survival than commercial hybrid strains (Usman *et al*., 2014). Lohman Brown hens had significantly higher egg production and weight compared with Bovan Brown (Ershad, 2005).

Housing system can also impact layers' performance. If layers were heat stressed, at any age, this will lead to increased water intake and decreased egg production. Moreover, excessive heat loss will lead to severe stress, shock and high mortality (Abbas *et al*., 2012). Generally, mortality rate and production length had negative effect on economic efficiency of farms while egg yield had positive effect (Dogan *et al*, 2018).

Therefore, this research aimed to evaluate the profit of Layers 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 100 layers farms from two Governorates: Al Sharkia (75) and Ismailia (25) were collected during 2019-2022. Data were obtained through farm records when available and research questionnaires (Bassyouni *et al*., 2021). Data of the breed reared (Lohman, Hy-line), total egg production/cycle, mortality percentage, and housing system (opened or closed) were collected. 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 labor and depreciation) (Atallah, 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 analyzed by using SPSS (2001) and MSTAT (1984).

Analysis of variance was done to fulfil the following equation:

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

(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 for 100 birds/cycle were calculated (Omar, 2003).

Production and economic analysis

The following measures were calculated including average egg production (count)= Number of live birds X Average numbers of egg yield); and total live body weight for the spent hens (kg); mortality percentage= (total number of birds died/total

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number of birds stocked)*100, total costs (TC, LE)= fixed costs + variable costs (New, 1991). Total variable costs (LE)= cost of feed + day old chicks (DOCs) + litter + medicaments + miscellaneous costs (labor, fuel, water and electricity) (Atallah, 1997). Total fixed costs (LE)= rent or depreciation + fixed labor costs (Omar, 2003). Depreciation rates were calculated (Muhammad, 2002; Lotfollahian and Hosseini, 2007; 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= Value of Asset/Age of Asset (Year) as reported by Muhammad (2002)

Total returns were calculated by adding returns from bird sales= kilograms produced X price/kg (LE) to returns from spent hens and litter sales. Net profit= total returns – total costs (Omar, 2003).

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 (Atalah, 1997).

Production (Atallah,1997) and costs functions (Sankhayan, 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 breed on mortality percentage

The results showed that mortality percentage differed significantly (P<0.01) among breeds (Table 1). Mortality percentage was 11.67% and 7.80% for Hy-Line and Lohman, respectively. This might be attributed to disease occurrence and birds' resistance to diseases. This agreed with (Ershad, 2005) who found variations between breeds (Bovan than Lohman) in mortality percentage.

Effect of breed on values of drugs, vaccines, disinfectants, veterinary supervision and TVM (LE)

The values of TVM parameters were found to be highest for Hy-Line breed where the values were 672.29 LE, 504.22 LE, 336.14 LE and 168.07 LE for drugs, vaccines, disinfectants and veterinary supervision, respectively (Table 1), that result might be due to farmers are investing more on hygienic measures for Hy-Line or based on their susceptibility to diseases. Also might be due to their high cost during the rearing season. According to Ewa *et al*. (2015), investors should carefully select layer breeds because this will impact the future of their investments.

Effect of breed on egg production (trays), total return (TR), total costs (TC) and net profit (NP) (LE)

Significant differences in egg production, TR, TC and NP (LE) among raised breeds were found (P<0.01) according to (Table 2). The highest production, returns and costs were found in farms raising Hy-line (980.71 trays), (48330.21 LE) and (32993.33 LE); respectively. The highest net profit was observed in farms raising Lohman (19768.18 LE). The results might be attributed to the good genetic potential of Hy-Line breed and hence high production. Higher variable costs parameters might be the reason for increasing total production costs. Egg production and profit are variable among breeds (Abd-El Hamed and Hamdy, 2022) and the results obtained disagreed with them in that total return was highest for Lohman breed, but this might be attributed to market conditions during the rearing season, though agreed for the final conclusion that Lohman breed is the most profitable to be reared.

Effect of housing systems on mortality percentage

Table 3 cleared significant differences (P< 0.01) among mortality percentage in different housing systems. Mortality percentage was higher for closed systems (13.75%). This result might be due to stocking size or due to diseases. Different housing systems impact the wellbeing of birds (Abo Ghanima *et al*., 2020).

Effect of housing system on values of drugs, vaccines, disinfectants, veterinary supervision and TVM (LE)

Housing system was found to impact the value of veterinary management items significantly (P<0.01) (Table 3). Values of drugs (692.38 LE), vaccines (519.28 LE) and disinfectants (346.19 LE) and supervision (173.09 LE) were found to be higher for closed systems and accordingly, the value of TVM was higher in closed systems (1730.94 LE) compared to opened systems (1135.71 LE). This result might be due to the high stocking rate in closed system which necessitates more strict hygienic measures where TVM parameters are of high cost specially drugs and vaccination programs. Vaccination programs and other health measures vary according to several factors such as type of production, production costs and potential economic losses (Marangon and Busani, 2007).

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

Breeds	N	Mortality %	Drugs	Vaccines	Disinfectants	Veterinary supervision	TVM
Lohman	68	7.80±0.42^{B}	428.67±38.02^{B}	321.50±28.51^{B}	214.33±19.01^{B}	107.17±9.50^{B}	1071.67±95.04^{B}
Hy-line	32	11.67±0.93^{A}	672.29±9.32^{A}	504.22±6.99^{A}	336.14±4.66^{A}	168.07±2.33^{A}	1680.72±23.30^{A}

Means within the same column with different superscript letters are significantly different at P < 0.01.

Table 2. Effect of layer breed on total egg production (tray), TR, TC and NP (LE).

Breeds	N	Total eggs/ Carton	TR	TC	NP
Lohman	68	896.99±23.63^{B}	46710.72±1303.36^{B}	26942.54±706.33^{B}	19768.18±993.29
Hy-line	32	980.71±12.12^{A}	48330.21±757.71^{A}	32993.33±915.50^{A}	15336.89±1269.20

Effect of housing system on total egg production (tray), total return (TR), total cost (TC) and net profit (NP) (LE)

Data in Table 3 showed that the total egg production was found to be significantly higher (P<0.01) in closed systems (961.04) compared to open ones (917.94), this result might be due to using improved management practices to gain high egg production, also higher stocking densities reared. Proper housing system could result in increasing production performance and quality production (Abd El-Hack *et al*., 2016). Also, Abo Ghanima *et al*. (2020) showed that egg production in the caged system was higher than that in the floor system. With higher production costs in closed systems (34399.50 LE) farmers were capable to achieve higher returns (47409.66 LE) but lower NP (13010.15 LE). The variation in total returns between systems is much smaller than the variation in total costs. The high investments in the closed systems lead to increased production. Total returns might be lower than expected because of market conditions and selling price, which negatively impact the net profit.

Correlations between drug, vaccine, disinfectant, TVM, egg production (tray), TR, TC, NP (LE)

Correlation measured the level of correlation between variables affecting layers production (mortality percentage, drug, vaccine, disinfectant, TVM, TR, TC, Net profit (LE) (Table 4). The correlations were significant at P<0.01 except mortality percentage that was only significant at (P<0.05). There is high positive correlation between drugs, vaccines, disinfectant, TVM, total egg production, TR, TC, NP (LE). This showed the relative relationship

Table 3. Effect of housing system on mortality %, values of TVM(LE), T. Egg (No), TR, TC and NP (LE).

	Housing system	N	Mean±SE	t-value	Probability
Mortality %	Opened	75	7.40±0.40	7.36	**
	Closed	25	13.75±0.56		
Drugs	Opened	75	454.29±34.26	5.35	**
	Closed	25	692.38±5.80		
Vaccines	Opened	75	340.71±25.69	5.36	**
	Closed	25	519.28±4.35		
Disinfectants	Opened	75	227.14±17.13	3.54	*
	Closed	25	346.19±2.90		
Supervision	Opened	75	113.57±8.56	3.36	**
	Closed	25	173.09±1.45		
TVM	Opened	75	1135.71±85.64	4.54	*
	Closed	25	1730.94±14.50		
Total eggs/ Carton	Opened	75	917.94±22.14	5.36	**
	Closed	25	961.04±11.21		
TR	Opened	75	47362.91±1176.79	5.36	**
	Closed	25	47409.66±656.58		
TC	Opened	75	27164.12±618.17	3.58	*
	Closed	25	34399.50±932.66		
NP	Opened	75	20198.79±925.89	3.39	**
	Closed	25	13010.15±889.56		

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, total eggs/cartoon, TC, TR, NP(LE).

	Mortality%	Drugs	Vaccines	Disinfectant	Supervision	TVM	Total Eggs	TR	TC	NP
Mortality %	1									
Drugs	0.06	1								
Vaccines	0.06	1.0**	1							
Disinfectant	0.07	1.0**	1.0**	1						
Supervision	0.07	1.0**	1.0**	1.0**	1					
TVM	0.07	1.0**	1.0**	1.0**	1.0**	1				
Total eggs	-0.26	.71**	.71**	.71**	.71**	.70**	1			
TR	-.30**	.60**	.60**	.59**	.60**	.59**	.85**	1		
TC	.36**	.81**	.81**	.80**	.80**	.80**	.51**	.41**	1	
NP	-.60**	-0.08	-0.08	-0.08	-0.08	-.08*	. 41**	.64**	-.42**	1

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	= 3.15 + 1.17 Log Drug + 0.51 Log Vaccine – 0.80 Log Disinfectant + 1.70 Log Supervision t t- (30.55)** (4.78)** (2.30)** (2.55)** (3.06)** R^2 = 0.55 F = 11.06
	1.22 + 2.11 Log TVM t- (25.88)** (4.95)** R^2 = 0.45 F = 17.81
	= 3.26 – 1.40 Log Mortality number t (35.47)** (6.27)** R^2 = 0.22 F = 22.25
Cost	= 4.50 + 2.40 Log Mortality number t (50.14)** (3.04)* R^2 = 0.20 F = 7.60

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

of each of these variables.

Regression showed both the logarithmic production function and cost function (Table 5). Production function was highly significant (P<0.01) that 55% of the changes in egg production was attributed to drugs, vaccines, disinfectants and veterinary supervision. The total elasticity of production was (+2.58), therefore if all resources in the equation were increased by 10%, egg production will increase by 25%. Therefore, layers farms act in the 2nd stage of production.

About 45% from the changes in production was attributed to changes in values of TVM (LE). The average elasticity of TVM was (+2.11) which means that changing in the values of TVM by 10% will increase egg production by 21%. Moreover, 22% of changes in production were attributed to changes in mortality. Changes in the mortality number by 10% will reduce production by 14% and will increase cost by 24%.

CONCLUSION

Although the recent challenges that has faced egg production in Egypt, Layer farms are still capable to achieve profit and operate in the second stage of production. Lohman breed is more profitable compared to Hy-Line even if the production was lower. Closed production systems are more costly compared to opened systems, but this extra cost is not compensated for by the profit, as opened systems had achieved higher net profit in the study area. Moreover, it is concluded that if farmers invest more in the veterinary management, egg production is projected to increase by 21%.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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