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FACTORS AFFECTING THE PROFITABILITY OF POULTRY EGG PRODUCTION IN SOUTHERN TOGO: A QUANTILE REGRESSION APPROACH

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Abstract. Poultry farming plays a crucial role in food security and income generation in West Africa, where urbanization continues to increase the demand for animal protein. In Togo, egg production has become an important source of revenue, yet farm profitability varies widely. This study analyzes the factors influencing the agricultural income of poultry egg producers in southern Togo. Data were collected from 269 farmers in the Maritime and Plateaux regions using structured questionnaires completed between January and February 2025. Descriptive statistics and quantile regression were employed for data analysis. Only 36.8% of producers had received training in animal husbandry; most were between 40 and 50 years old, 94.1% were men, and 88.5% were married. Profitability analysis showed that egg production is lucrative, with feed expenses representing the largest cost component. Regression results revealed that egg prices were the most consistent indicator of income, with stable effects across quantiles. Breed, housing depreciation, flock size, and feed pricing all positively influenced income, whereas loan availability and labor costs had negative effects. Most sociodemographic variables were not statistically significant. Overall, the findings highlight the central roles of feed management and egg prices in determining profitability and suggest that interventions should focus on cost reduction, technical training, and infrastructure support to enhance production performance.

Keywords: poultry production, quantile regression, Togo

INTRODUCTION

Togo has experienced robust economic growth over the past decade, with an average annual rate of 5.7% between 2011 and 2019. After slowing to 1.8% in 2020 due to the COVID-19 pandemic, growth recovered to 5.3% in 2021 and 5.4% in 2022. Agriculture remains a key pillar of the economy, accounting for one quarter

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of national gross domestic product (GDP) and roughly 39% of total employment (World Bank, 2022).

Despite its importance, the agricultural sector continues to face low and stagnant labor productivity, and structural transformation has progressed slowly. These challenges reduce Togo's ability to fully leverage its comparative advantage, integrate into regional and global value chains, and respond to external demand for agricultural products (World Bank, 2022). The National Development Plan (PND 2018–2022) highlights both the sector's potential for growth and job creation and its persistent constraints, including limited access to finance, inadequate investment, insufficient technical skills, poor water management, difficulties accessing land, and weak infrastructure.

Within the poultry subsector, table-egg production plays a significant role in rural livelihoods. However, the economic performance of laying-hen farms varies widely due to differences in farm size, production practices, and resource-use efficiency. In 2021, animal production recorded strong results, with 30.6 million poultry and an estimated 10,317,842 tons of eggs produced nationally (Togo Officiel, 2022). National egg production remained high in 2022 at around 11,350 tons (Togo Officiel, 2022). Given this context, assessing the profitability of laying-hen farms is essential for improving resource management and supporting sector growth.

This study, therefore, examines the factors that influence the agricultural income of poultry egg producers in southern Togo, focusing on the Maritime and Plateaux regions.

LITERATURE REVIEW

Several studies have examined the economic aspects of poultry egg farming in Togo, but most have focused on resource-use efficiency rather than determinants of income variation among producers in the Maritime and Plateaux regions. For example, Tchaye and Yovo (2023) and Adabe and Abbey (2024) used stochastic profit frontier models to assess the efficiency of poultry farms and laying-hen producers. Their results show that gender, poultry-related training, access to credit, participation in agricultural projects, distance to supply points, and access to extension services are key factors influencing profit efficiency.

Other research in the region has addressed different dimensions of poultry production. Chawke et al. (2021) examined the socioeconomic status of poultry farmers, their investments, production costs, profits, and the challenges they face. In Turkey, Dogan et al. (2018) investigated the technical and economic efficiency of poultry egg farms in Konya Province and found an average efficiency score of 98.6%. They reported that chick and hen mortality rates, as well as the feed conversion ratio, negatively affected efficiency. In Nigeria, Kanu and Nwaru (2020) analyzed resource-use efficiency and production elasticity among smallholder broiler producers using four functional forms – linear, double logarithmic (Cobb-Douglas), semi-logarithmic, and exponential. Similarly, Tijjani et al. (2012) used multiple linear regression with ordinary least squares to study input–output relationships in egg production in Borno state. Their findings indicate that revenue is positively and significantly associated with hired labor costs, flock size, feed expenditures, equipment depreciation, and other operating costs.

Additionally, a Nigerian study that applied quantile regression to assess the key determinants of poultry egg profitability found that farmer age, farm size, egg price per crate, cost of medicines, and farm location had positive and significant effects on agricultural income across quantiles (Johnson et al., 2020).

DATA AND METHODS

Study area

The study was conducted in Southern Togo. Located between the Republic of Ghana to the west and the Republic of Benin to the east, Togo is a narrow strip of land ranging from 50 to 150 km in width. The country covers 56,600 km² and stretches approximately 600 km from Burkina Faso in the north to the Atlantic Ocean in the south, lying between latitudes 6°–11° N and longitudes 0°–1°4 E. Togo has two main climatic zones: a humid tropical climate and a subequatorial climate. The southern part of the country is characterized by a subequatorial climate with two rainy seasons and two dry seasons.

Maritime Region. The Maritime Region occupies 6,100 km² in southern Togo, located between 6°–6° 50' N and 0° 40'–1° 50' E (DE 2014). Although relatively small – representing 11.30% of the national territory – it is home to 3,534,991 people, or 42% of Togo's total population (INSEED, 2022). The region attracts people from northern and central Togo as well as neighboring countries due to its favorable climate and fertile soils, which support farming and mining activities. It has

strong economic potential across the primary (agricultural, cattle farming, fishing), secondary (mining, manufacturing), and tertiary (transport, services, commerce, banking) sectors. The climate is characterized by alternating rainy and dry seasons.

The coastal zone of Togo was selected for this study because of its favorable conditions for raising laying hens and the presence of many large poultry farms.

Plateaux region. The Plateaux Region shares borders with Benin to the east, Ghana to the west, the Central Region to the north, and the Maritime Region to the south. It is the largest region in Togo, located between 6° 9' and 8° 5' N (DE 2014). Covering 16,800 km² – more than 2.7 times the size of the Maritime Region – it has a population of 1,635,946 (INSEED, 2022). The climate is well-suited for livestock raising, with adequate rainfall to sustain grasslands and sufficient water resources for animals. The region is also known for its abundant natural resources. According to the Ministry of Livestock, more than 12.15 million chickens were produced in the region in 2023 (Togo Officiel, 2024).

Data sources

Data were collected between January and March 2025. A pre-tested, structured questionnaire was used to interview 269 farmers who were members of farmer groups working with the Togo Institute for Technical Advice and Support (ICAT-TOGO). Secondary data were obtained from online sources and relevant institutions. The primary data included age, gender, marital status, educational level, production system, access to credit, and household characteristics. Farmers were also asked about total revenue, egg production, and the costs, prices, and quantities of key inputs such as labor, medications, day-old chicks, and feed.

Choice of variables

The variables selected to capture the production and socioeconomic characteristics of the farmers, along with their expected signs, are described in Table 1.

Output. Output was measured as the sum of cash receipts from egg sales, the value of eggs consumed by the household, and the value of eggs given out as gifts.

Table 1. Description and measurement of variables used in the Quantile regression model

Variables	Variable	Expected sign	Description
1	2	3	4
Dependent variable			
Production outcome	Y_i		Quantity of eggs produced (continuous)
Independent variable			
Socio-demographic			
Sex	X_1	+/–	Gender of the poultry farmer (1 = male, 2 = female).
Age	X_2	+/–	Age of the farmer in years
Marital status	X_3	+/–	1 if farmers are married, 0 otherwise
Education level	X_4	+	Highest level of formal education attained, 0 – none, 1 – breeding training, 2 – primary, 3 – secondary, 4 – university
Experience (years)	X_5	+	Number of years the farmer has been involved in poultry farming (continuous)
Main occupation	X_6	+	1 – whether poultry farming is the farmer's primary occupation, 0 – otherwise
Household size	X_7	+	Total number of individuals living in the farmer's household (continuous)
Institutional/organizational factors			
Farmers associations	X_8	+	1 – if farmers have a Membership status in a producer organization, 0 – otherwise
Extension services	X_9	+	1 – if farmers have Access to extension services, 0 – otherwise

Table 1 – cont.

1	2	3	4
Access to credit	X_{10}	+/–	1 – if farmers access financial support for poultry farming activities, 0 – otherwise
Production/management practices			
Type of breed	X_{11}	+	The main poultry breed raised: 0 – don't know, 1 – Isa Brown, 2 – Lerghon
Day-old chick	X_{12}	+	Number or cost of day-old chicks purchased for production (continuous)
Feed	X_{13}	+	Quantity of feed used in poultry production (kg) (continuous)
Production costs		+	
Energy	X_{14}	+	Quantity of electricity in kWh (continuous)
Veterinary cost	X_{15}	+	Expenses for animal health care (continuous)
Labor cost	X_{16}	+	Wages hired labor used on the farm (continuous)
Transport cost	X_{17}	+	Expenses related to transporting and outputs (continuous)
Equipment	X_{18}	+	Cost of purchasing and maintaining poultry equipment (continuous)
Depreciation	X_{19}	+	Value reduction of buildings (continuous)
Other charges	X_{20}	+	Miscellaneous costs not included in the above categories (continuous)

Source: own elaboration based on survey data, 2025.

Socioeconomic characteristics. These variables include the farmer's age (years), gender (1 – male; 2 – female), farming experience (years), education level (0 – none; 1 – breeding training; 2 – primary; 3 – secondary; 4 – university), main occupation (continuous), and household size (continuous). These variables were included to assess their influence on production performance.

Input. Inputs were grouped into four categories: feed intake (kg), flock size (number of birds), Operating expenses (FCFA), and other costs (e.g., depreciation).

Application to poultry production. In this study, the output variable was the number of eggs produced per bird during the production period. Input variables included feed (kg/bird), number of laying hens, labor costs (CFA/bird), medicine and veterinary costs (CFA/bird), energy consumption (CFA/bird), transport costs (CFA/bird), other charges (CFA/bird), and equipment costs (CFA/bird). Details of all variables are presented in Table 1.

DATA ANALYSIS

Net income estimation

The profitability of chicken-egg production in the study area was assessed by analyzing production costs and returns. Gross margin analysis is commonly used to evaluate business efficiency by comparing enterprises or alternative production strategies (Olorunwa, 2018). Budget analysis involves examining and interpreting the components of production costs and revenues, as shown below:

Net Income (Ni) of the i^{th} producer is defined as the difference between Total Revenue (TR_i) and Total Cost (TC_i). This equation represents the farmer's profit after all production costs have been deducted from income generated through sales (Equation 1):

$$NI_i = TR_i - TC_i \quad (1)$$

Equation 2 expresses Total Revenue (TR_i) as the product of the price of eggs and other outputs (P_i) and the quantity sold (Q_i):

$$TR_i = \text{Price } (P_i) * \text{Quantity sold } (Q_i) \quad (2)$$

Equation 3 defines Total Cost (TC_i) as the sum of Total Variable Costs (TVC_i) and Total Fixed Costs (TFC_i):

$$TC_i = TVC_i + TFC_i \quad (3)$$

Where:

NI_i – Net Income accrued to i^{th} farmer from egg sales (CFA)

TR_i – Total Revenue realized from egg production (CFA)
TC_i – Total Cost incurred by i^{th} farmer (CFA)
TVC_i – Total Variable Cost (CFA)
TFC_i – Total Fixed Cost (CFA)
P_i – Price per unit of output (CFA)
Q_i – Total quantity of eggs sold/produced by the i^{th} farmer.

Quantile regression model

Quantile regression has several advantages over the Ordinary Least Squares method (OLS), including its ability to handle outliers and provide robust estimates when the distribution of the dependent variable is skewed. It was used in the study to assess the impact of sociodemographic variables and poultry-specific characteristics on the farm income of poultry egg producers. Quantile regression is also suitable for addressing data heterogeneity because it examines the conditional distribution of the response variable beyond the mean. As noted by Cade et al. (1999), focusing solely on mean effects can understate, overstate, or entirely miss important distributional changes.

The ordinary least squares model is given in Equation (4):

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_n X_{ni} + \varepsilon_i \quad (4)$$

Where ε_i are independently and identically distributed with mean zero and constant variance. Let $F(y) = P(Y \leq y)$ denote the cumulative distribution function of a random variable Y.

According to Koenker and Bassett Jr. (1982), the τth quantile of Y is defined as:

$$Q_y(\tau) = \{inf(y) = F(y) \geq \tau\}$$

Where $\tau \in [0, 1]$.

$Q_y(\tau)$ represents the inverse of the distribution function of the response variable. Therefore, the quantile function in Equation (5) can be written as:

$$Y_i = \beta_0(\tau) + \beta_1(\tau)X_1 + \beta_2(\tau)X_2 + \ldots + \beta_n X_n + \varepsilon_i \quad (5)$$

The conditional quantile function is given by Equation (6):

$$Q_{(\frac{\tau}{\varepsilon})} = \beta_0(\tau) + \beta_1(\tau)X_1 + \beta_2(\tau)X_2 + \ldots + \beta_n(\tau)X_n + u_i \quad (6)$$

$\varphi_t = Q_{(\tau)}\varepsilon_t$ is identically distributed with mean zero and variance one. This can be written more compactly as Equation (7):

$$Q_{yi}(\tfrac{\tau}{\varepsilon}) = X_i^T i\beta_i(\tau) \quad (7)$$

Where:

$$X = (1, X_0 \ldots \ldots \ldots \ldots X_i)^T \quad (8)$$

The conditional cumulative probability of (Y_i) is given by Equation (9):

$$Pr(Y_i \leq q(X_i))/X_i = x = \tau \quad (9)$$

The minimization problem to be solved is:

$$E(|Y_i - q(X_i)\tau|X_i = x) \;\; min\; E(|Y_i - f(x_i)|\tau|X_i = x) \quad (10)$$
$$f \in \mathrm{L(u)}$$

The τth quantile regression estimator β_i, which minimizes the objective function over β_τ, is defined in Equation (11):

$$Q_{(\beta\tau)} = \sum_{y_i > X_i\beta_\tau}^{n}(\tau)|Y_i - X_i^T| + \sum_{y_i < X_i\beta_\tau}(1-\tau)|Y_i - X_i^T\beta_\tau \quad (11)$$

Here, $\tau|e_i|$ and $(1 - \tau)|e_i|$ represent the asymmetric penalties for under-prediction and over-prediction, respectively, where $0 < \tau < 1$. The quantile regression coefficients can be estimated using linear programming.

The explicit functional form is presented in Equation (12):

$$Q_T(Y / X = x) = X^T(\tau)\; 0 < \tau < 1 \quad (12)$$

Where:

Y – average annual income earned by the ith farmer from egg production
X_1 – X_n – socio-demographic characteristics of farmers and poultry-specific attributes
B_τ – marginal change in the τ^{th} quantile resulting from a marginal change in X.

The dependent and independent variables used in this study are presented in Table 1.

RESULTS

Flock size

Table 2 presents the distribution of poultry egg farmers by flock size. The mean flock size was 745 birds. Nearly half of the respondents (47.96%) had flocks of 500–1000 birds, with an average flock size in this group of approximately 746 birds. Flocks of 1001–2000 birds accounted for 28.62% of respondents, while larger flocks were less common: 12.64% of farmers had flocks of 2001 to 3000 birds, and 10.78% managed more than 3000 birds.

This distribution indicates that most poultry egg farmers in the surveyed area are small-scale operations.

Table 2. Distribution of respondents by flock size

Flock size	Frequency	Percentage (%)	Mean	Median	Std. deviation
500–1000	129	47.96			
1001–2000	77	28.62			
2001–3000	34	12.64			
>3000	29	10.78			
Total	269	100	1654.09	1500.00	1182.214

Source: own elaboration based on survey data, 2025.

Socioeconomic characteristics of poultry egg farmers

As shown in Table 3, only 4.8% of respondents were younger than 30, while 47.6% were aged 40–50. The majority of respondents were male (94.1%), with females representing 5.9%. Most respondents were married (88.5%), and 11.5% were single. Table 5 shows that households had an average of four members, ranging from zero to nine. Among respondents who were full-time farmers, 65.8% relied on farming as their main source of income. Regarding educational attainment, 36.8% had received training in livestock husbandry, 3.3% had no formal education, 12.6% had completed elementary school, 32.3% had completed secondary school, and 14.9% had completed further education.

Experience in chicken farming varied widely: 29% had less than five years of experience, 36.8% had five to ten years, 16% had ten to fifteen years, 8.2% had fifteen to twenty years, and 10% had more than twenty years (Table 4). In terms of production, 66.2% of farms raised Isa Brown chickens, while 17.8% raised Leghorn. Of those with access to finance, 84% relied on personal resources, and only 16% used credit services. Additionally, only 39.4% of respondents had access to extension services, whereas 60.6% did not (Table 4).

Profitability of poultry egg production

Table 6 presents the main expenses associated with chicken egg production. Animal feed was the largest cost component, accounting for 74.65% of total variable costs (TVC). Paid labor cost 2,960,665.428 CFA francs (5,294 USD), representing 12% of TVC. Medication and veterinary care accounted for 2.37%, while day-old chicks represented 7.33% of TVC. Transportation contributed 2.02% to the variable cost structure.

Table 3. Distribution of poultry farmers according to socioeconomic characteristics

Variables	Frequency	Percentage (%)
Gender		
Male	253	94.1
Female	16	5.9
Total	269	100
Age (years)		
Less than 30	13	4.8
30–40	44	16.4
40–50	128	47.6
50–60	70	26.0
Greater than 60	14	5.2
Total	269	100
Marital status		
Single	31	11.5
Married	238	88.5
Total	269	100
Education level		
No Education	9	3.3
Breeding training	99	36.8
Primary	34	12.6
Secondary	87	32.3
University	40	14.9
Total	269	100

Source: own elaboration based on survey data, 2025.

Table 4. Distribution of poultry farmers according to socio-economic characteristics

Variables	Frequency	Percentage
Farming experience (years)		
Less than 5	78	29.0
5–10	99	36.8
10–15	43	16.0
15–20	22	8.2
Greater 20	27	10.0
Total	269	100
Main occupation		
Part-time poultry farmer	92	34.2
Full-time poultry farmer	177	65.8
Total	269	100
Farmers associations		
No	158	58.7
Yes	111	41.3
Total	269	100
Type of Breed		
Don't know	6	2.2
Isah Brown	178	66.2
Lerghon	48	17.8
Isah Brown&Lerghon	37	13.8
Total	269	100
Vulgarization		
No	163	60.6
Yes	106	39.4
Total	269	100
Access to credit		
No	226	84.0
Yes	43	16.0
Total	269	100

Source: own elaboration based on survey data, 2025.

Table 5. Household size

Variables	House size
Mean	4,30
St. deviation	2,122
Minimum	0
Maximum	9

Source: own elaboration based on survey data, 2025.

Egg sales were the primary source of revenue, accounting for 86.51% of total revenue (TR), with an average value of 25,327,202.01 CFA francs (45,598 USD). Culled laying hens generated an average of 3,841,542.565 CFA (6,876 USD), or 13.12% of TR. Overall, poultry egg production in the study area was profitable, with an average net income of 4,682,305.115 CFA francs (2,374 USD). Farmers earned 0.19 CFA francs for every CFA franc invested, corresponding to a return on investment (ROI) of 19%. The net income ratio of 0.159 indicates that 15.9% of total revenue remained as net profit after covering all costs.

Factors influencing the income of egg producers in the study area

Table 7 presents the results of the quantile regression used to identify the factors affecting the agricultural income of egg farmers. Three quantile models – at the 25th, 50th, and 75th quantiles – were computed. The model's performance was evaluated based on economic theory and econometric criteria, including the F statistic, the significance of variable coefficients, and pseudo-R^2 values. The F statistic was highly significant at the 1% level, indicating that the explanatory variables collectively had a statistically significant effect on agricultural revenue.

Each model demonstrated a reasonable fit, with pseudo-R^2 values of 0.71, 0.72, and 0.70 at the 25th, 50th, and 75th quantiles, respectively. This indicates that the independent variables explained 71–72% of the variation in agricultural revenue across different points in the income distribution.

Egg prices emerged as the most influential factor across all quantiles, with strong and consistent coefficients (0.870 at $\tau = 0.25$, 0.861 at $\tau = 0.50$, and 0.867 at $\tau = 0.75$), highlighting how farmers' earnings increase substantially with higher egg prices. Revenue from slaughtered chickens also had a significant impact, particularly at the lowest quantile (coef = 0.125 at $\tau = 0.25$). Waste recovery had a small but positive effect.

Table 6. Profitability of layer hen production to farmers in South Togo

Description of items	Mean cost in (CFA/year)	Total in CFA	Percentage (%) contribution to total cost
Revenues composition			
Egg sales	25327202.01		86.51
Culled layers	3841542.565		13.12
Waste/manure	108794.2379		0.37
Total Revenue (TR)		29277538.82	100
Variable cost item			
Cost of birds	1803866.71		7.33
Feed cost	18359987.47		74.65
Labor cost	2960665.428		12.04
Cost of medication/vet services	581710.3643		2.37
Cost of energy	23174.16357		0.094
Other charge	104630.3797		0.43
Transport	496632.7138		2.02
Total Variable Cost (TVC)		24330667.23	88.72
Fixed cost			
Depreciation on equipment	93658.28996		0.38
Poultry house	170908.1803		0.69
Total Fixed Cost (TFC)		264566.4703	1.08
Total Cost (TC = TVC+TFC)		24595233.7	100
Gross Margin (GM = TR – TVC)		4946871.586	
Net Income (NI = TR – TC)		4682305.115	
Returns on investment (ROI = NI/TC)		0.190	
Net profit Ratio = NI/TR		0.159	

CFA (African Financial Community franc) is the Togo currency (USD 1 = CFA 550 in 2025).
Source: own elaboration based on survey data, 2025.

Among input variables, animal feed cost was the most significant, with coefficients of 0.466 ($t = 11.68$) at $\tau = 0.25$, 0.436 ($t = 9.88$) at $\tau = 0.5$, and 0.494 ($t = 10.84$) at $\tau = 0.75$, indicating a strong relationship between feed costs and farmers' financial performance.

Herd size coefficients were close to zero but highly significant across all quantiles ($t > 4.7$), suggesting that larger herds are associated with higher revenues.

Some factors were significant only at specific quantiles. At $\tau = 0.75$, breed type became important (coef = 0.046), indicating that high-performing breeds benefit the most profitable producers. Depreciation of poultry houses was significant at $\tau = 0.50$ (coef = 0.046), suggesting that infrastructure quality matters for farmers at the median income level.

A few cost-related and financial factors had negative effects at higher quantiles. Credit availability was significantly negative at $\tau = 0.50$ (coef = –0.084), and labor costs were significantly negative at $\tau = 0.75$ (coef = –0.046), indicating potential inefficiencies associated with these factors.

Table 7. Parameter estimates of the Quantile regression and OLS

Quantile variable	τ = 0.25 Coeff	t-ratio	τ = 0.5 Coeff	t-ratio	τ = 0.75 Coeff	t-ratio
Constant	**8.905**	.9896	**7.336*** **	6.697	**6.937*** **	6.134
Gender	.024	.351	**.145***	1.940	.076	.979
Age	.003	.174	**.033***	1.747	.004	.193
Marital status	.005	.096	.040	.701	**.111***	1.865
Education	.016	1.221	**.025***	1.657	–.001	–.093
Experience	.013	.956	.014	.945	.006	.400
Occupation	–.008	–.236	**.060***	1.603	–.001	–.013
Household size	.004	.525	–.002	–.218	–.002	–.199
Association	.025	.731	.004	.099	–.026	–.672
Breed	.009	.433	**.024***	1.049	**.046****	1.920
Vulgarisation	–.016	–.480	–.008	–.204	–.051	–1.34
Credit acces	–.071	–1.555	**–0.84****	–1.672	–.032	–.617
Feed	**.466*****	11.676	**.436*****	9.876	**.494*****	10.84
Transport	–.004	–1.005	–.004	–.904	–.006	–1.29
Labor	.013	.644	–.008	–.375	**–.046****	–1.99
Energy	–.005	–716	.008	.902	**.020**	2.303
Drugs	–.033	–1.375	–.036	–1.366	–.018	–.653
Equipment	–.013	–.676	–.028	–1.353	–.028	–1.29
Depreciation poultry house	.008	.432	**.046****	2.155	**.036***	1.651
Other charges	.003	.911	–.003	–.777	–.002	–.462
Flock size	**.000*****	5.192	**.000*****	5.061	**.000*****	4.710
Price of egg	.870	1230.1	.867	560.01	.867	281.7
Price of water	.000***	7.402	.000	5.604	.001	5.206
Price of a hen	.125***	254.06	.121	112.95	.101	46.99
Pseudo R2	**.715**		**.718**		**.705**	
F-statistics	**0.000**		**0.000**		**0.000**	
No. of obs.	**269**		**269**		**269**	

***, **, * significant at 1%, 5% and 10% respectively.
Source: own elaboration based on survey data, 2025.

DISCUSSION

Socioeconomic characteristics of poultry egg farmers

Tables 3, 4, and 5 show that most layer farmers are middle-aged, consistent with findings from Nigeria (Adeyonu, 2016; Osinowo and Tolorunju, 2019). Farmers in this age group are generally economically active and receptive to adopting agricultural innovations to increase production. The highly uneven gender distribution – dominated by men – reflects a regional pattern in southern Togo, where men participate more actively

in commercial poultry production (Tchaye and Yovo, 2023). The predominance of married respondents suggests stable family structures that may help ensure adequate labor availability. Large households (Table 5) often contribute family labor, reducing dependence on hired workers and lowering production costs, a relationship also noted by Johnson et al. (2021).

Regarding education, a significant proportion of farmers had at least a secondary schooling or training in animal husbandry. Education and training are essential for understanding modern management practices, and previous studies have shown that farmer education enhances productivity (Luvhengo et al., 2018). Farmers' experience levels varied, although many had five to ten years of practice. Experience tends to improve technical efficiency and managerial skills, though its effects may depend on age and educational attainment (Ojo, 2003).

The strong preference for the Isa Brown breed (66.2%) over the Leghorn breed (17.8%) indicates a regional shift toward high-productivity breeds to meet increasing consumer demand in West Africa (Ihou et al., 2025). However, challenges remain. Only 16% of respondents had access to credit services, highlighting financial constraints that hinder investment and growth. Similarly, only 39.4% of farmers had access to extension services, suggesting limited technical support for many farmers. As emphasized by Soviadan et al. (2024), access to finance and extension services play a critical role in improving productivity and promoting technology adoption.

Overall, the socioeconomic characteristics of farmers influence their production capacity, willingness to adopt new technologies, and ability to manage production risks. Expanding access to credit and extension services is likely to improve sectoral performance, productivity, and long-term sustainability.

Profitability of egg production for poultry farmers

Feed costs (74.65%) remain the most significant obstacle to profitability, as they directly affect production efficiency (Table 6). This aligns with studies showing that feed typically accounts for more than 60% of total poultry costs (Arif and Shafi, 2021). Labor constitutes the second-largest component (12%). Medium-sized farmers often rely on hired labor due to their larger flock sizes and more commercial orientation, which increases labor costs. Although labor costs are often lower than feed costs, they still play a substantial role in determining overall profitability (Adaszyńska-Skwirzyńska et al., 2025).

Expenditure on pharmaceuticals and veterinary care (2.37%) indicates that farmers prioritize flock health to reduce mortality and maintain productivity. Preventive and curative health management practices are essential for sustaining long-term profitability. Similarly, the cost of day-old chicks (7.33%) highlights their importance in the cost structure. This finding aligns with Chawke et al. (2021), who reported that chick purchasing accounted for approximately 12% of variable costs in broiler production in India, though this proportion varies by region depending on farming practices, input prices, and production systems.

The majority of revenue (86.51%) was generated from egg sales, confirming that egg production is the primary purpose of keeping laying hens. Revenue from culled birds, while less substantial (13.12%), still provides an important supplementary income stream that supports cash flow. Positive profitability indicators (ROI = 0.19; net income ratio = 0.159) and the positive net income recorded demonstrate that poultry egg production is financially viable in the study area. These findings are consistent with previous research showing that poultry farming remains profitable despite increasing input costs, as observed in broiler industries in Poland (Adaszyńska-Skwirzyńska et al., 2025) and Nigeria (Ebukiba et al., 2023).

Although profitability is evident, the ratios also indicate room for improvement. Enhancing efficiency – particularly through reducing feed costs, improving flock management, increasing access to high-quality inputs, and strengthening credit or extension services – could further raise ROI and overall profitability. Therefore, while the results highlight the economic potential of poultry egg production, they also point to the need for improved production practices and supportive policies to ensure long-term sustainability.

Factors influencing the agricultural income of egg producers

Table 7 shows that egg prices are the most significant factor influencing agricultural income across all quantiles. This finding aligns with Chen (2019) and Mubarok et al. (2024), who noted that egg prices – shaped by market dynamics, feed costs, and seasonal fluctuations – directly determine the profitability of poultry enterprises.

The relatively uniform coefficients across quantiles indicate that both low-income and high-income producers benefit from favorable egg prices.

Waste recovery and income from culled birds provide additional revenue, though smaller in magnitude. For low-income farmers, however, these supplementary income sources play an important role in maintaining financial stability.

On the input side, feed prices emerged as the most influential factor, underscoring the central role of feed costs in the poultry sector. Although the positive coefficients may appear counterintuitive, they suggest that farmers facing higher feed prices are those typically operating larger, more commercial, or more productive farms – allowing them to remain profitable despite cost increases. This structural relationship reflects global trends in industrial poultry systems, where feed cost efficiency is a key determinant of competitiveness.

Herd size was also significant, supporting the idea that larger flock sizes are associated with higher income. This aligns with findings of Khan et al. (2022) and Arulnathan et al. (2024), who argue that greater production capacity enhances productivity and profitability in commercial poultry systems. Breed type becomes significant only at higher quantiles, indicating that high-income producers benefit more from superior genetics, such as improved laying rates and feed conversion. Likewise, the significance of housing depreciation at the median quantile suggests that infrastructure quality matters particularly for mid-level producers seeking to advance into the top income category. These results are consistent with Aldieri et al. (2021), who emphasize that improved technologies and infrastructure enhance technical efficiency.

Conversely, the negative and significant labor cost coefficients at higher quantiles indicate diminishing returns to hired labor. As farms expand, increased wage expenditures or inefficient labor management may reduce profitability. Similarly, the negative effect of credit availability suggests challenges related to loan use or repayment. According to Karlan et al. (2014), the issue often stems not from a lack of credit itself but from uninsured risks, poor loan targeting, or burdensome repayment conditions that impede rather than enhance farm profitability.

Overall, the results show that although market conditions and scale expansion contribute positively to income, inefficiencies in labor use and credit management can constrain profitability among the most advanced producers. Enhancing farmers' financial literacy, improving labor management, and increasing access to risk-mitigation tools – such as insurance or subsidized credit – could therefore significantly strengthen economic outcomes.

CONCLUSION AND RECOMMENDATIONS

This study examined the factors influencing the profitability of chicken egg producers in southern Togo. The results indicate that laying hen production is financially viable in the study area, as demonstrated by the positive net income calculated from field survey data. Feed costs, flock size, and the number of chicks were identified as the most important determinants of profitability, exerting positive and significant effects across all quantiles. In contrast, labor costs and credit access showed significant negative effects on poultry income at all quantile levels, suggesting inefficiencies in labor use and challenges in credit utilization. The analysis also showed that most poultry farms are headed by men, which may reflect the perception that male-headed households have greater access to resources and a higher tolerance for production risks. Additionally, the majority of respondents had some form of agricultural training, and their farming experience typically ranged from 5 to 10 years, indicating a relatively experienced and skilled producer base. Based on these findings, several policy recommendations emerge. The government should develop targeted strategies to strengthen the competitiveness of the poultry sector. Policymakers should implement measures that increase farmers' earnings and reduce input costs; expand nationwide access to credit, given that financing remains one of the major constraints for poultry egg producers; and strengthen extension services to ensure farmers receive timely and relevant information on poultry egg production.

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REFERENCES

Adabe, E.K., Abbey, A.G. (2024). Assessing economic efficiency: credit constraints among layer farmers in Togo's maritime region, West Africa. RJOAS: Russ. J. Agric. Soc.-Econ. Sci., 6(150). Retrieved from: https://rjoas.com/issue-2024-06/article_11.pdf

Adaszyńska-Skwirzyńska, M., Konieczka, P., Bucław, M., Majewska, D., Pietruszka, A., Zych, S., Szczerbińska, D. (2025). Analysis of the production and economic indicators of broiler chicken rearing in 2020–2023: A case study of a Polish farm. Agriculture, 15(2). https://doi.org/10.3390/agriculture15020139

Adeyonu, A.G. (2016). Determinants of poultry farmers' willingness to participate in national agricultural insurance scheme in Oyo State, Nigeria. Appl. Tropic. Agric., 21(3), 55–62. https://eprints.lmu.edu.ng/id/eprint/651

Aldieri, L., Brahmi, M., Chen, X., Vinci, C.P. (2021). Knowledge spillovers and technical efficiency for cleaner production: An economic analysis from agriculture innovation. J. Clean. Prod., 320, 128830. https://doi.org/10.1016/j.jclepro.2021.128830

Arif, M.M., Shafi, M.M. (2021). Variations in profitability of different size of commercial broiler poultry farms in central region of Khyber Pakhtunkhwa. Sarhad J. Agric., 37(3), 858–867. https://doi.org/10.17582/journal.sja/2021/37.3.858.867

Arulnathan, V., Turner, I., Bamber, N., Ferdous, J., Grassauer, F., Doyon, M., Pelletier, N. (2024). A systematic review of potential productivity, egg quality, and animal welfare implications of extended lay cycles in commercial laying hens in Canada. Poult. Sci., 103(4), 103475. https://doi.org/10.1016/j.psj.2024.103475

Cade, B.S., Terrell, J.W., Schroeder, R.L. (1999). Estimating effects of limiting factors with regression quantiles. Ecology, 80(1), 311–323. https://doi.org/10.2307/176999

Chawke, A.P., Kahate, P.A., Sul, D.M., Nage, S.P., Shelke, R.R. (2021). Economic Cost and Profit Assessment of Poultry Farming in Bhandara District. Int. J. Curr. Microbiol. Appl. Sci., 10(01), 1396–1404. https://doi.org/10.20546/ijcmas.2021.1001.166

Chen, S. (2019). Research and forecast of egg price fluctuation in China.AgEcon Search, 11(09), 12–16. https://doi.org/10.22004/ag.econ.300051

DE (2014). Cinquième rapport national sur la diversité biologique du Togo 2009–2014 [Fifth national report on biological diversity of Togo]. Unfpa, GEF, CBC, UNDB, US, Lomé, Togo. Retrieved Sept 15th 2025 from: https://tg.chm-cbd.net/fr/documents/cinquieme-rapport-national-sur-la-diversite-biologique-du-togo-2009-2014

Dogan, N., Kaygisiz, F., Altinel, A. (2018). Technical and economic efficiency of laying hen farms in Konya, Turkey. Brazil. J. Poult. Sci., 20(02), 263–272. https://doi.org/10.1590/1806-9061-2017-0649

Ebukiba, E., Nurudeen, O., Sennuga, O., Omole, A., Bamidele, J., Osho-Lagunju, B., Alabuja, F., Iheonu, M. (2023). Profitability and resource-use efficiency of poultry egg production in Kuje Area Council, Int. J. Res. Innov. Soc. Sci., 11, 172–179. https://doi.org/10.47772/ijriss.2023.7685

Ihou, A.F.Y., Georges, A.A., Alayi, A., Mansingh, P.J. (2025). Assessing performance and economic efficiency of table eggs production in southern Togo. J. World Poult. Res., 15(3), 321–331. https://dx.doi.org/10.36380/jwpr.2025.31

Johnson, S.B., Mafimisebi, T.E., Oguntade, A.E., Mafimisebi, O.E. (2020). Factors affecting the profitability of poultry egg production in Southwest Nigeria. an application of quantile regression. Rev. Agric. Appl. Econ. (RAAE), 23(1), 65–72. https://doi.org/10.15414/raae.2020.23.01.65-72

Johnson, S.B., Awoseyila, F., Adetarami, O., Owolabi, O.T. (2021). Analysis of factors influencing the choice of production systems in poultry egg farming. Tropic. Agric., 98(1). Retrieved from: https://journals.sta.uwi.edu/ojs/index.php/ta/article/view/7936

Kanu, I.M., Nwaru, J.C. (2020). Analysis of resource use efficiency and elasticity of production among smallholder broiler producers in Ikwuano Local Government Area of Abia State, Nigeria. Int. J. Agric. Env. Food Sci., 4(4), 432–438. https://doi.org/10.31015/jaefs.2020.4.6

Karlan, D., Osei, R., Osei-Akoto, I., Udry, C. (2014). Agricultural Decisions after Relaxing Credit and Risk Constraints. Quart. J. Econ., 129(2), 597–652. https://doi.org/10.1093/qje/qju002

Khan, N.A., Ali, M., Ahmad, N., Abid, M.A., Kusch-Brandt, S. (2022). Technical efficiency analysis of layer and broiler poultry farmers in Pakistan. Agriculture, 12(10), 1742. https://doi.org/10.3390/agriculture12101742

Koenker, R., Bassett Jr, G. (1982). Robust tests for heteroscedasticity based on regression quantiles. Econometr. J. Econometr. Soc., 43–61. https://doi.org/10.2307/1912528

Luvhengo, U., Senyolo, M., Lekunze, J. (2018). Productivity and value chain analysis in small-scale poultry farming: Stochastic frontier application. Asia Life Sci., 27(2), 329–341. Retrieved Sept 16 2025 from: https://research.wur.nl/en/publications/productivity-and-value-chain-analysis-in-small-scale-poultry-farm/

Mubarok, A.F., Setiadi, A., Komalawati, Wulandari, S., Yusuf, E. S. (2024). Volatilitas harga daging dan telur ayam ras di Indonesia. Anal. Kebijak. Pertan., 22(2), 151–167. https://doi.org/10.21082/akp.v22i2.151-167

Ojo, S.O. (2003). Productivity and Technical Efficiency of Poultry Egg Production in Nigeria. Int. J. Poult. Sci., 2(6), 459–464, 2003. https://doi.org/10.3923/ijps.2003.459.464

Olorunwa, O.J. (2018). Economic analysis of broiler production in Lagos State poultry estate, Nigeria. J. Invest. Manag., 7(1), 35–44. https://doi.org/10.11648/j.jim.20180701.15

Osinowo, O., Tolorunju, E.T. (2019). Technical efficiency of poultry egg production in Ogun State, Nigeria. J. Agribus. Rural Dev., 51(1). https://doi.org/10.17306/j.jard.2019.01137

INSEED (Institut National de la Statistique et des Etudes Economiques et Démographiques) (2022). Résultats définitifs du RGPH-5. Institut National de la Statistique et des Etudes Economiques et Demographiques du Togo. Retrieved Sept 15 2025 from: https://inseed.tg/resultats-definitifs-du-rgph-5-novembre-2022/

Soviadan, M.K., Ahmed, O., Kubik, Z., Enete, A.A., Okoye, C.U., Glauben, T. (2024). Evaluating the impact of improved technology adoption in traditional poultry farming on potential outcomes of farmers: evidence from rural Togo. Cogent Food Agric., 10(1). https://doi.org/10.1080/23311932.2024.2341091

Tchaye, F.K., Yovo, K. (2023). Poultry farm efficiency in Togo: what impact on competitiveness? Afr. Sci. J., 3(20), 106–139. https://doi.org/10.5281/zenodo.8393015

Tijjani, A., Ndukwe, I.G., Ayo, R.G. (2012). Isolation and characterization of lup-20(29)-ene-3, 28-diol (Betulin) from the stem-bark of *Adenium obesum* (Apocynaceae). Trop. J. Pharm. Res., 11(2), 259–262. https://doi.org/10.4314/tjpr.v11i2.12

Togo Officiel (2024). Production animale: les Plateaux, principale région pourvoyeuse du Togo. Portail Officiel De La République Togolaise. [Official Portal of the Togolese Republic]. Retrieved Sept 15th 2025 from: https://www.republiquetogolaise.com/agro/2703-9076-production-animale-les-plateaux-principale-region-pourvoyeuse-du-togo

Togo Officiel (2022). Élevage : la production animale en nette progression. Portail Officiel De La République Togolaise. [Official Portal of the Togolese Republic]. Retrieved Sept 15th 2025 from: https://www.republiquetogolaise.com/agro/1409-7258-elevage-la-production-animale-en-nette-progression

World Bank (2022). Togo – Country economic memorandum: Toward sustainable and included growth. World Bank. Retrieved Sept 15th 2025 from: https://documents1.worldbank.org/curated/en/099715006162211825/pdf/P174741091bbc700a089000336ea46bdd3f.pdf