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ASSESSING ECONOMIC EFFICIENCY: CREDIT CONSTRAINTS AMONG LAYER FARMERS IN TOGO'S MARITIME REGION, WEST AFRICA

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ABSTRACT
In Togo's Maritime Region, credit constraints pose a significant barrier to economic efficiency for layer farmers. This study use stochastic profit frontier approach, moves beyond simple comparisons to illuminate the underlying mechanisms behind this disparity. A random sample of 155 farmers participated in a structured data collection conducted in July 2023 using direct elicitation methods. Our findings reveal how producers without credit constraints (PSCCs) leverage capital-intensive inputs like feed, while those facing constraints (PACCs) struggle with limited access to veterinary services and costly manual labor. While capital acts as a profit booster for both groups, its impact is amplified for PSCCs, highlighting the crucial role of financial stability in optimal input allocation and profit maximization. Employing the Cobb-Douglas production function within a stochastic profit frontier framework, the study identifies an efficiency gap of 9%, with PACCs and PSCCs exhibiting average profitability of 55% and 64%, respectively. Additionally, influential factors such as income, credit availability, and loan amounts are identified for both groups. The stark profit disparity underscores the substantial revenue loss tied to credit limitations, particularly for PACCs facing a significantly higher frequency of minimum profitability. By quantifying the impact of credit constraints and pinpointing areas of inefficiency, this study paves the way for targeted interventions like microcredit schemes and improved veterinary access. This research empowers policymakers to foster a more productive, sustainable, and equitable poultry farming landscape, particularly for credit-constrained smallholder farmers in Togo's Maritime Region and beyond.

KEY WORDS
Economic efficiency, credit constraints, layer farmers.

The West African region thrives as a hub for poultry production, boasting over 400 million poultry. Within this landscape, Togo, a developing nation, heavily relies on its agricultural sector, with approximately 80% of its population engaged in family farming within rural areas (Kohnert, 2018). Amidst this agricultural backdrop, modern layer farming has emerged as a linchpin in Togo's egg consumption patterns due to its rapid production cycles, investment simplicity, and inclusivity across diverse social strata.

A diverse range of avian species, including chickens, guinea fowl, ducks, pigeons, and turkeys, contributes to this dynamic landscape (Dao, 2010). Notably, chickens' stand out, occupying a staggering 82.81% of poultry farms according to the National Census of Agriculture, with the Maritime region alone housing 82% of commercial poultry farms (Dao, 2010). This stronghold on table egg production secures Togo's position as the third-largest poultry producer among the WAEMU countries, trailing only Burkina Faso and Senegal (Banla et al., 2018).

Furthermore, beyond its agricultural context, poultry farming in Togo represents more than a mere economic activity; it serves as a lifeline for rural households, addressing immediate needs such as health, education, and sustenance, while fortifying protein intake. Despite its evident significance, a critical impediment looms large, limited access to financial services for small family farms. Shockingly, 98% of Togo's poultry farmers lament the absence of suitable financing structures as a primary hindrance. This glaring credit gap stifles productivity and restrains rural economic development, casting shadows on investment and consumption decisions (Ciaian et al., 2012; Eswaran, 1996; Tang and He, 2021).

Amidst these challenges, a fundamental need arises to bolster production levels, improve competitiveness, and foster the growth of small to medium-sized agricultural enterprises. The Food and Agriculture Organization (FAO) identifies enhancing farmers' access to input and product markets, particularly financial services, as pivotal to overcoming these constraints. While prior studies have underscored the adverse impact of credit limitations on agricultural households' production choices (Quisumbing and McNiven, 2020), few have quantitatively assessed these constraints' specific effects on the economic efficiency of poultry farms.

Existing research has broadly addressed credit constraints among global farmers, exposing their repercussions on productivity and income levels (Blancard et al., 2006; Niyongabo, 2008; Shah et al., 2007). However, these studies primarily focused on broader agricultural contexts, failing to explore the nuanced efficiency dynamics within the poultry farming sector.

Several studies, including those conducted by Crinot et al. (2019), Pougoué et al. (2019a), Pougoué et al. (2019b), and Effiong and Umoh (2010), focused exclusively on analyzing technical efficiency in egg-producing farms. This concentration arose from the challenges associated with factor pricing, as highlighted in the works of Sodjinou and Aboh (2009).

Understanding the constraints faced by smallholder farmers in accessing credit is crucial for devising upliftment strategies (Sharma and Zeller, 1997; Zeller et al., 1997). Economic efficiency in layer farming is multifaceted, relying on technical mastery and factor pricing, yet this doesn't always ensure overall economic efficiency (Farrell, 1957; Nichols, 2014). Notably, the correlation between credit access and efficiency within Togo's poultry farming remains unexplored, despite its established global impact (Abate et al., 2019; Coelli and Battese, 1996).

Theoretical frameworks underpinning farm performance emphasize the integration of knowledge, skills, and attitudes (Fellows et al., 1996; Le Boterf, 2010; Le Clainche and Carlier, 2008; Wittorski, 1998). In this context, such competencies play a pivotal role in farm management. This study aims to uncover the intricate connections between credit constraints, economic efficiency, and competency levels among Togo's egg-producing poultry farmers. By integrating theoretical frameworks, empirical analysis, and practical insights, it seeks to fill critical gaps and offer actionable recommendations for enhancing the sector's sustainability and growth.

MATERIALS AND METHODS OF RESEARCH

The Maritime region of Togo was selected for this study due to its favorable conditions for layer farming and the notable size of its farms. In this region, rural producers and entrepreneurs face challenges arising from inadequate infrastructure, significantly impacting their access to formal and semi-formal loans. Data for the study were collected from egg producers in the Vo, Lacs, and Golfe prefectures of the Maritime region, situated approximately 60 km to 90 km from the capital, Lomé.

The selection of survey areas was informed by the outcomes of the Agricultural Sector Support Program, aiming to identify the most productive regions for layer farms. This criterion led to selecting three target prefectures (Golfe, Lacs, and Vo). All cantons within these three prefectures were identified, and, following a random draw, nine townships were chosen—

three per prefecture. Subsequently, all table egg producers within the selected nine townships were identified. The individuals included in the sample at each township were then randomly drawn.

For data collection regarding the credit constraint rationing position of laying hen farmers in the study area, the direct elicitation technique proposed by (Barham et al., 1996; Boucher et al., 2009; Fletschner et al., 2010) was employed. The survey was conducted from July 1 to July 31, 2023.

Table 1 – Distribution of respondents by prefecture

Prefectures	Townships	Producers/prefecture
Golf	Amoutified baguida Be	51
Lacs	Aklakou Anfoin Glidji	52
Vo	Togoville Vo Koutimé Vogan	52
Total	09	155

In sum, 3 prefectures, 9 Townships and 155-layer farmers are concerned by this study at the rate of 32 per prefecture. The observation unit is the layer farmer represented by the farm manager.

The Cobb-Douglas functional form incorporated the stochastic frontier profit function equation. The choice of this functional form stems from its advantages in terms of ease of interpretation and estimation, effectively addressing the issue of multi-collinearity. Considering a layer farmer who integrates factors of production, including the capital, poultry feed, veterinary products, labour, day-old chicks, and flock size for table egg production, the stochastic profit frontier is represented by the following equation:

$$\ln \Pi \text{ i Ly} = \beta\ 0\ + \beta\ 1 \ln (\text{CALI}) + \beta\ 2 \ln (\text{DVETO}) + \beta\ 3 \ln (\text{DPOUX}) + \beta\ 4 \ln (\text{QMOS}) + \beta\ 5 \ln (\text{EFFECT}) + \beta\ 6 \ln (\text{CAP}) + \text{V i} - \text{U i (Dao, 2010)} \quad (1)$$

Where:

Π_i Ly: the farmer's profit in FCFA is defined as the total revenue minus the operating expenses; CALI: total food cost (1-18 weeks) in FCFA/hen; DVETO: total expenditure on veterinary products in FCFA/laying cycle; DPOUX: expenditure for the purchase of day-old chicks in FCFA/hen; QMOS: total expenditure of salaried labor for the production of a laying cycle in FCFA; EFFECT: the total number of birds housed; CAP: Capital contributions measured in FCFA; V_i: takes into account random variations in production, which are assumed to be independently and identically distributed N (0 ,σ_v^2); U_i: are variable non-negative random errors, associated with the technical inefficiency of production, which are assumed to be independently and identically distributed and truncations to zero of the normal distribution N(μ,) σ_u^2.

The Maximum Likelihood (ML) estimation technique was used to estimate Stochastic Frontier Analysis. The basic idea of the maximum likelihood principle is to choose the parameter estimates (β, σ2 and ε) to maximize the probability of obtaining the data:

$$\text{lnL} = {}^{n}/_{2}\ln[\tfrac{\pi}{2}] - \text{nl}/2\ln\ \sigma^2 + \sum_{i=1} ln[1 - F(\varepsilon_i \sqrt{{}^{\gamma}/_{\sigma}}\sqrt{1-\gamma})] - 1/\sigma^2 \sum_{i=1} \varepsilon_i^2 \quad (2)$$

$$\sigma^2\ \varepsilon = \sigma_v^2 + \sigma_u^2 \text{and } \gamma = \sigma_u^2/\sigma_v^2 \text{ (Dao, 2010)} \quad (3)$$

Where: σ_v^2 and σ_u^2 are the variances of the equation for *v* and *u,* respectively.

The maximum likelihood estimation of the MV for the specified production function parameters was conducted using Stata 13.0 software. The variance parameters (λ) interpreted values in the stochastic frontier production model were obtained.

To explore the relationship between levels of economic inefficiency and socio-economic and demographic variables, a regression analysis was performed on the returns based on the status of credit constraints. This analysis aimed to identify potential factors contributing to inefficiency.

The model was estimated alongside the stochastic frontier profit model using a single-step maximum likelihood estimation procedure. The sfcross command, pre-programmed in Stata software, was employed to determine the factors influencing observed profitability.

$$\mu i = \delta 0 + \delta 1 Z1i + \delta 2 Z2i + \delta 3 Z3i + \delta 4 Z4i + \delta 5 Z5i + \delta 6 Z6i + \delta 7 Z7i + \delta 8 Z8i + \delta 9 Z9i + \delta 10 Z10i + \omega i \text{ (Djagba et al., 2019)} \quad (4)$$

Where: μi denotes economic inefficiency; δ 0 – δ 10 are the estimated parameters; ωi is the normally distributed random error term.

Variables Z1 to Z10 are designated as inefficiency variables in the model. Specifically, Z1 represents the age of the layer farmer, Z2 signifies the sex of the layer farmer, Z3 corresponds to the educational level of the layer farmer, Z4 denotes the size of the household, and Z5 pertains to the level of income or wealth. Z6 captures the market values of all physical assets of the layer farmer, including machinery such as the hatchery, the animal feed mill, and other equipment. Z7 reflects the involvement in secondary activities, while Z8 signifies access to information on micro-finance institutions. Z9 represents the membership of the layer farmer in a cooperative, and finally, Z10 corresponds to the amount of credit requested.

Table 2 – Description of the variables of the economic inefficiency model

Variables	Codes	Terms	Expected Sign	Type Of Variable	Authors
Demographic Factors					
layer farmer age	Z1	1= Young [15 to 30] 2= Adult [30 to 60] 3= Old 60 and over	+	Qualitative	(Effiong and Umoh, 2010)
layer farmer sex	Z2	1= Male 0= Female	+	Qualitative	
layer farmer education level	Z3	0= None 1= Primary 2= Secondary 3= Superior	+	Qualitative	
household size	Z4	-	+	Quantitative	
Socio-Economic Factors					
Income level or Wealth	Z5	1= Less rich 2= Richer	+	Qualitative	(Akram et al., 2013)
Secondary activity	Z6	0= No 1= Yes	+	Qualitative	
Institutional Factors					
Information on MFIs	Z7	0= No 1= Yes	+	Qualitative	(Akram et al., 2013)
Availability of credit	Z8	0= No 1= Yes	+	Qualitative	
Membership of a cooperative	Z9	0= No 1= Yes	+	Qualitative	
Credit amount	Z10	-	+	Quantitative	

RESULTS AND DISCUSSION

The Table 3 presents information on egg production elements among sampled respondents categorized by their credit constraint status. The constrained farms, consisting of 63 cases, are compared with the unconstrained group, which comprises 32 cases.

A statistically significant difference ($P<0.05$) was observed between Average Annual Chicken Contribution (PACC) and Profit from Standard Chicken Contribution (PSCC) concerning profit earned, feed costs during the rearing phase (1 to 18) weeks, expenses for veterinary products, purchase costs of chicks, manager's skill, number of livestock, and capital.

The comprehensive annual profit average is approximately 3750 FCFA (±214) per hen. However, PACCs exhibit a significantly lower average annual profit of 2782 FCFA (±169) compared to their PSCC counterparts, who achieve a higher average of 5619 FCFA (±360).

Furthermore, the average feed cost per hen during the rearing phase is 1670 FCFA (±115) for PACCs and 1830 FCFA (±138) for PSCCs. Veterinary product expenditures are also divergent, with PACCs spending an average of 187 FCFA (±5.04) and PSCCs spending 256 FCFA (±7.18).

Expenditures associated with chick purchases and livestock numbers demonstrate a notable increase for Profit from Standard Chicken Contributions (PSCCs) compared to Average Annual Chicken Contributions (PACCs). The skill score, serving as an indicator of human capital and evaluated as very good based on Fellows et al.'s (2005) business skill level scale, is higher for PSCCs (64.09% ±3.12) compared to PACCs (46.12% ±1.93). Additionally, a significant difference is observed between the two groups concerning capital.

Table 3 – Descriptive statistics of dependent and independent variables for the stochastic frontier analysis model

Variables and unit of measurement	PACC [1] (n1=63)	PSCC [2] (n2=32)	Sets (n=95)	*p-value*
	Avg.	Avg.	Avg.	
Annual profit generated per hen	2782(169)	5619 (360)	3750 (214)	0.000 ***
Feed costs in FCFA (1–18-week rearing)	1670(115)	1830 (138)	1722(123)	0.000 ***
Expenditure for veto products in FCFA	187.06(5.04)	256.3 (7.18)	210.38 (5.31)	0.000 ***
Expense for the purchase of the chick in FCFA	973.01(7.48)	1040.93 (11.25)	995.89 (7.03)	0.000 ***
Skill score (%)	46.12(1.93)	64.09 (3.12)	52.17 (1.86)	0.000 ***
Number of livestock	511(32.05)	2534 (308)	1193 (144)	0.000 ***
Capital invested at start-up	5000000(20000)	9000000(60000)	6500000(25000)	0.000 ***

**** Significance threshold of 1% test of the difference in mean of the two groups; () Standard deviation in brackets; PACC 1: Producer with credit constraints; PSCC2: Producer without credit constraints. Source: Survey, 2021.*

The estimates are made according to the typology of holdings which are mainly represented by the status of credit constraint. The maximum likelihood estimates of the parameters of the stochastic profit function specified in equation (6) are obtained using Stata 13.0 software. The sfcross command, pre-programmed in this software, made it possible to maximize the log likelihood function of the profit function. To estimate this model, the following variables were tested: profit (in FCFA), total feed cost (FCFA), chick purchase expenditure (FCFA), expenditure related to veterinary services (FCFA) wage rate, capital and number of livestock.

Table 4 – Maximum likelihood estimation of the profit frontier

Variables	Credit stress status		Sets (n=95)
	PACC [1] (n1=63)	PSCC [2] (n2=32)	
Stochastic production frontier			
Constant	33.11 *** (8,824)	17.33 (2.7E-04)	12.5 -
lnCALI	1.04 *** (0.742)	4.22 *** (1.98E-05)	1.75 *** (0.006)
lnDVETO	-0.32 ** (0.205)	0.76 ** (1.6E-05)	0.45 *** (0.001)
lnDPOUX	1.82 (0.714)	2.31 (3.5E-05)	1.90 ** (0.008)
QMOS	0.08 ** (0.124)	0.18 (2.37E-06)	0.054 *** (6E-04)
LnEFFECT	0.20 *** (0.086)	0.42 *** (2.87E-06)	0.33 *** (6E-04)
LnCAP	0.29 ** (0.14)	2.26 *** (0.76)	0.75 ** (0.64)
Efficiency parameters			
Sigma-squared ($\sigma^{2)}$)	10.06 *** (16,298)	2.25E-01 *** (0.059)	0.36 *** (0.0061)
Gamma (ɣ)	0.28 (0.038)	0.56 (7.87E-07)	0.819 (1.23E-04)
LT-test	13.92 ***	5.01 **	15.86 ***
Log-likelihood	-31.59	0.64	-45.138

****, ** and * (respective level of significance at 1%, 5% and 10%) 1: Producer with credit constraint, 2: Producer without credit constraint Source: Survey, 2021.*

The estimates of the maximum likelihood test (LT-test) and the sigma-square are statistically significant at the 1% level, indicating a good fit and correctness of the specified distribution assumption of the composite error term. The estimated gamma is 81.9%, suggesting that approximately 81.9% of the variation in the profit levels of layer farms, encompassing all producer categories, is attributed to economic inefficiency, while only 18.1% is ascribed to random factors.

Table 4 presents variable estimates for two distinct groups of producers: those operating under credit constraints (PACC) and those without such constraints (PSCC). The study's results emphasize significant coefficient differences for the feed cost variable.

Analysis reveals that all coefficients associated with feed costs exhibit positive and statistically significant values at the 1% threshold for both groups individually and collectively. This statistical significance underscores a strong correlation between the cost of feed and the profit levels of both producer groups. However, the positive coefficient also signifies that the impact of feed costs on farm profits varies between the two groups. PACCs demonstrate lower production elasticity in response to this capital-intensive input compared to PSCCs, suggesting that PACCs utilize lower capital-intensive inputs due to financial constraints.

Producers under constraints attribute their limited use of these inputs to the unavailability of credit, highlighting a critical link between credit accessibility and adopting capital-intensive inputs in the production process. Moreover, higher marginal effects observed for capital-limited inputs among PSCCs suggest that these producers can allocate inputs more proportionally, leading to a higher profit margin than their PACC counterparts. This discovery underscores the economic ramifications of credit constraints on input choices and subsequent profit levels, as supported by the findings of the study conducted by Pougoué et al. (2019a). Their research provided evidence that feed alone constitutes 78.72% of the production cost. Additionally, Chavas et al. highlighted that the most profitable use of animal feed involves ad libitum feeding (Chavas and Aliber, 1993).

The coefficients associated with the expenditure variable related to veterinary products exhibit a positive and statistically significant for the Profit from Standard Chicken Contributions (PSCCs), a negative and statistically for the Average Annual Chicken Contributions (PACCs) ($P<0.05$), and 1% for the combined dataset. This signifies that profit increases with rising spending on veterinary products for PSCCs and decreases for PACCs. The financial constraints on PACCs limit their ability to apply vaccine treatments, significantly impacting their profitability timely. Supporting evidence from Mehmood et al. (2017) indicates that drug cost constitutes a small proportion of operating costs, around 2.79%, with the success and profitability of the business closely tied to the amount of these drugs used, as highlighted by Ekpenyong's findings where drug cost constituted 5.34% of the total variable cost in the layer industry (Ekpenyong, 2002).

The coefficient of the labor cost variable is negative, with a significant influence at the 5% level for the PACCs but not significant for the PSCCs. This implies that the labor force reduces the profit level of PACCs, potentially due to their lack of sufficient machinery, making the use of labor more expensive for them.

The coefficient of the farm size variable is positive, with values of 0.20 and 0.42 for PACC and PSCC, respectively, and is statistically significant at 1%. This aligns with findings by Bhasin and Akpalu (2002), who suggested that farmers operating on a large scale tend to be more efficient in resource utilization compared to those on a smaller scale. Additionally, Effiong et al. also noted that an increase in herd size is associated with a further reduction in costs, as capacity is expected to increase rapidly, consistent with the observations in this study (Effiong and Umoh, 2010).

The current study unveils a positive and statistically significant difference in the coefficient of the capital variable, with significance observed at the 5% threshold for the Average Annual Chicken Contributions (PACC) group and the 1% threshold for the Profit from Standard Chicken Contributions (PSCC) group. This indicates that an increase in capital leads to a simultaneous increase in profit for both groups.

The impact is more pronounced for PSCCs, suggesting that the positive relationship between capital and profit is stronger for producers without credit constraints in this context.

This heightened effect can be explained by the notion that farmers with a stable economic standing find it easier to procure production inputs, enabling them to achieve optimal production levels and maximize profits.

Table 5 displays the frequency distributions of profit levels for both PACC and PSCC groups. It is evident that profit varies widely among the sampled producers in the two groups. The average profit is 55% (±0.163) for the PACC group and 64% (±0.220) for the PSCC group. The two groups, primarily distinguished by their credit constraint status, exhibit a difference of 9% in the level of profit made. The minimum profit for both groups is 25%, with the maximum profit reaching 85% for PACC and 95% for PSCC.

Considering the minimum overall profit threshold of 25%, the profit frequency distribution highlights that the majority (11.11%) of producers operating under credit constraints (PACCs) have achieved this level. In contrast, only 6% of producers without such constraints (PSCCs) have reached similar profit levels. This discrepancy suggests a more substantial loss of potential revenue for PACCs than PSCCs.

Table 5 – Distribution of producers according to their level of profit

Profit level (%)	PACC [1] (n_1=63)		PSCC [2] (n_2=32)		Together (n=95)	
	Clear	Freq.	Clear	Freq.	Clear	Freq.
[25-35[	7	11.11	2	6.25	9	9.47
[35-45[	4	6.35	4	12.50	8	8.42
[45-55[	11	17.46	3	9.38	17	17.89
[55-65[	15	23.81	3	9.38	18	18.94
[65-75[	13	20.63	6	18.75	19	20
[75-85[	11	17.46	6	18.75	17	17.89
[85-95[	2	3.17	2	6.25	4	4.21
[95-100[	0	-	6	18.75	6	6.31
Total	63	100	32	100	95	100
Mean	0.55 (0.163)		0.64 (0.220)		0.55 (0.216)	
Minimum	0.25		0.25		0.25	
Maximum	0.85		0.95		0.95	

() Are the standard deviations, 1: Producer with credit constraints, 2: Producer without credit constraints.
Source: (Survey, 2023).

Parametric estimates illustrating the relationship between economic inefficiency and demographic, socio-economic, and institutional factors of egg producers are delineated in Table 6. The high values of the coefficient of determination (R2) underscore the robust explanatory power of the covariates and affirm the model's strong adequacy to the data. It is important to note that profit levels were employed in estimating the regression model.

Table 6 – Parameter estimates of the inefficiency effect model

Variables	Credit stress status		Together (n=95)
	PACC [1] (n1=63)	PSCC [2] (n2=32)	
Constant	0.11 (8.824) ***	0.33 (0.27) ***	12.5
Age	0.04 (0.742) ***	0.22 (0.452) **	0.15 (0.006) ***
Sex	0.32 (0.205)	0.18 (0.551)	0.025 (0.001)
Secondary activity	0.27 (0.086) *	0.82 (0.368) **	0.69 (0.427) **
wealth level	-3.19 (0.351)	-0.23 (0.784) ***	-2.27 (0.054) **
Access to MFI information	0.65 (0.781)	-0.65 (0.547)	0.135 (0.241)
Level of education	0.16 (0.98) ***	-0.78 (0.497) ***	0.24 (0.004) **
household size	-0.07 (0.21) **	-0.78 (0.784) **	0.52 (0.263) **
Availability of credit	0.057(0.87)	-0.36(0.94)	-0.02 (0.06) *
Apart. at the cooperative	0.63 (0.248)	-0.78 (0.43)	0.72 (0.493)
Credit amount	-0.12 (2.142) **	-0.8 (2.447) **	-0.6 (1.475) **
R^2	0.67	0.52	0.72

****; **; * (Are the levels of significance 1%, 5% 10%). 1: Producer with credit constraints; 2: Producer without credit constraints.*
Source: Survey data, 2021.

Contrary to predictions, age (represented by years of experience) positively and significantly affects economic inefficiency ($P < 0.05$) in both PACCs and PSCCs. This suggests younger farmers are more efficient, likely due to their increased energy levels and technical proficiency. This association highlights a positive correlation between age,

efficiency, and technical competence in poultry farming. These findings corroborate those of (Ali et al., 2019; Mehmood et al., 2017), who observed similar trends.

Producer wealth level exhibits a negative and statistically significant effect on economic inefficiency for PACCs ($P < 0.01$), but not for PSCCs. This suggests that as wealth increases, credit constraints for PACCs diminish, leading to greater efficiency. PSCCs with higher wealth likely diversify their operations and access additional resources, enhancing financial stability and reducing credit market constraints. Our results align with those of (Ali et al., 2019; Mehmood et al., 2017; Tipi et al., 2009), who found sufficient capital positively impacts economic efficiency.

As anticipated, education level has contrasting effects on economic inefficiency. For PSCCs, it has a negative and significant effect ($P < 0.05$), implying higher education improves profitability. This could be due to improved information processing and utilization. However, for PACCs, education has an unexpected positive effect. This could be linked to inadequate education limiting the optimal use of complex technologies, suggesting education plays a key role in acquiring credit and managing complex systems. This result underscores the role of education in improving management skills and acquiring credit, as confirmed by studies such as Akram et al. (2013) and Ali et al. (2019).

Household size negatively and significantly affects economic inefficiency in both groups ($P < 0.05$), with the strongest effect for PACCs. This indicates larger households provide a readily available labor force, improving efficiency through optimal input allocation. Similar to Effiong and Umoh (2010), our findings suggest reliance on family labor increases household size in rural economies, corroborating the results of Rahman and Umar (2009) on the impact of family size on crop production.

Regarding credit availability, delineated as a binary variable, has a negative and significant effect on economic inefficiency ($P < 0.01$). This aligns with Ayaz and Hussain (2011) and Mehmood et al. (2017), suggesting financial institutions inadequately support rural communities. This highlights the need for revised financial strategies to address rural challenges and promote socio-economic advancement.

Loan amount has a negative and significant effect on economic inefficiency ($P < 0.05$), particularly for PSCCs. This suggests wealthier producers with larger loans invest in assets, improved breeds, and capital-intensive inputs, leading to greater efficiency. This aligns with Hassan and Ahmad (2005) and Mehmood et al. (2017), who found increased loan amounts improve input access and efficiency.

In conclusion, our study provides valuable insights into the factors influencing economic inefficiency in poultry farming. The findings emphasize the importance of age, wealth, education, household size, credit availability, and loan amount for PACCs and PSCCs. These insights can inform policy interventions and strategies to improve efficiency and support sustainable poultry production, particularly in rural communities.

CONCLUSION

The economic efficiency of layer farmers with credit constraints (PACC) and without constraints (PSCC) was estimated using the parametric stochastic frontier technique. The results showed that, on average, the two groups of producers presented a difference in economic efficiency of 9%. The average levels of profitability for PACCs and PSCCs are 55% and 64%, respectively. It was found that the economic efficiency of both groups is influenced by income level, amount of credit availability and amount of loan. In addition, the economic efficiency of producers with constraints was influenced by household size and amount of credit. In contrast, that of producers without credit constraints was influenced by income level, education, and amount of credit. Establishing a policy that could improve layer farmers' access to financial services, which could encourage poultry farmers to stay in this sector, is recommended.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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