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Effect of Coping Strategies of Rising Feed Costs on Poultry Farmers' Technical Efficiency in South-west Nigeria

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ABSTRACT

Background: The rising feed cost is a major challenge in Nigeria's poultry industry. It impacts production costs and threatens the industry's sustainability as well as poultry farmers welfare. Implementing effective coping strategies is crucial for poultry farmers to maintain profitability by optimizing resource allocation. This study therefore examined the effect of coping strategies of rising feed costs on poultry farmers technical efficiency in South-West, Nigeria.

Methods: The study employed a quantitative research approach using a survey research design. Multistage sampling procedures were used to select three states (Lagos, Ogun and Oyo) from the South-West zone in Nigeria. In the second stage, 575 poultry farmers from all Poultry Association of Nigeria zones were selected using simple random sampling technique. Data on production activities of poultry farms were collected from the farmers using structured questionnaire. Data collected were analyzed with the use of descriptive and inferential statistics.

Result: The results of the study showed that the adopted strategies used by the farmers were use of finished feed (UFF), mixed farming (MF), downsizing of flock size (DFS), no change of strategies (NCS), verge of exiting the venture (VEV). Of the poultry farmers, 48.00% adopted MF to cope with the rising feed cost while 24.70%, 16.10%, 6.20%, 5.20% adopted UFF, DFS, VEV and NCS, respectively. The study, therefore concluded that mixed farming as a coping strategy enhances the poultry farmers' efficiency, it is therefore recommended that the poultry farmers should engage in mixed farming as a coping strategy to rising feed costs.

Key words: Feed costs, Mixed farming, Poultry farmers, Profitability, Stochastic frontier.

INTRODUCTION

Food and agricultural organization (FAO) opined that livestock plays a crucial role in the global economy and improving food security, as it supports the livelihoods of a significant portion of the world's population and contributes to protein supply (FAO, 2022). With at least 1.3 billion people worldwide relying on livestock for their livelihoods, it is an essential aspect of agriculture in industrialized and developing countries (FAO, 2022). The demand for livestock products, especially poultry products (egg and chicken), is increasing due to the African population (World Health Organization, 2010). According to Obi (2003), the consumption of eggs and other poultry products will increase by 200% between 2010 and 2020 for some subSaharan African countries. This trend is obvious in Nigeria as one of the countries in Africa. Poultry egg has served as one of the cheapest protein source in Nigeria today making it one of the food ingredients to fight protein malnutrition in the Nigeria economy. According to USDA (2014), the demand for egg is expected to increase by more than 100%, this demand can only be met if the supply can be increased. Poultry production also helps to generate income, creates employment opportunities for the populace, improve human nutrition and provide quality food, organic fertilizer (manure) and a renewable asset among majority of the rural household (Bello *et al.,* 2022). They are highly valuable globally because of their immense contribution, to food security, protein supply and peoples' livelihood. The Nigerian poultry industry contributes approximately 25% to agricultural GDP, (Makasi *et al.,* 2020).

According to MI (2022), poultry sector is dealing with the effects of feed and feed grain shortage, since the COVID-19 pandemic lock-down. In different countries worldwide, the pandemic has led to closure of most poultry feed companies, closure of farms, loss of employment and others.

Rising feed cost is a major challenge faced by the poultry industry, as it significantly impacts production costs and can threaten the industry's sustainability. As Sani (2015) pointed out, feed accounts for 60-75% of the total cost of production in the poultry industry and the increasing prices of key ingredients like maize and soybean meal only

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exacerbate the issue. Rising feed costs can significantly impact the profitability of poultry farming, forcing farmers to consider reallocating their resources outside the poultry industry. The reallocation of resources can be a threat to the sustainability of the overall poultry industry. To address this problem of rising feed cost, it is essential to identify and promote coping strategies to help poultry farmers maintain their operations' profitability, efficiency and sustainability.

MATERIALS AND METHODS

The study area

The study employed a quantitative research approach using a survey research design.

This study focused on South west Nigeria, a region that is part of the six geopolitical zones in the country. South west Nigeria includes the states of Ekiti, Ondo, Osun, Ogun, Oyo and Lagos. According to the National Population Commission's 2012 report, the region has a population of 38,257,260 people.

Method of data collection

The study population for this research comprises layer's poultry farmers from the Poultry Association of Nigeria (PAN) of three selected Nigerian states of Ogun, Oyo and Lagos. Table 1 shows the zonal structure of the Poultry Association of Nigeria in the three selected states.

Sample size and sampling technique

The farmers population was obtained from the registered layer's poultry farmers in the various PAN zones in the selected states.

The number of registered poultry farmers in each state is as follows:

1. Ogun state: 430 registered poultry farmers.
2. Oyo state: 363 registered poultry farmers.
3. Lagos state: 321 registered poultry farmers.

The total number of registered poultry farmers across the three states is 1,114 (430 + 363 + 321).

The Yamane (1967) formula was used to determine the sample size.

The formula is given as:

$$n = \frac{N}{1+N(e)^2}$$

The study utilized a multistage sampling procedure to select the poultry farmers. The sampling process was carried out in three stages.

Table 1: PAN zonal structure of the 3 states.

State	Zones
Lagos	Agege, Alimosho, Badagry, Epe, Etiosa, Ikorodu and Ojo
Ogun	Egba, Ijebu, Mowe, Remo, Otta and Yewa
Oyo	Ibadan II, Oyo, Ogbomoso, Ibadan I and Oke-Ogun

Purposive selection of states

The first stage involved the purposive selection of three states (Lagos, Ogun and Oyo) out of six regional states. This selection was based on the high concentration of poultry farmers in these states, making them suitable for the study.

Purposive selection of poultry association zones

In the second stage, all poultry association zones in each of the selected states were purposively chosen. This ensured that the study covered a wide range of poultry farming practices and associations within the selected states.

Random selection of poultry farmers

The final stage involved randomly selecting 575 poultry farmers from the eighteen poultry association zones across the three states.

Random sampling provide a representative sample of regional poultry farmers. Table 2 shows the sampling procedure for the selection of the poultry farmers.

However, after interviewing the 575 selected poultry farmers, only 515 responses were considered useful for the analysis.

Method of data analysis

Descriptive and inferential statistics were employed for this study.

Descriptive statistics

a. Frequency

Used to show the number of occurrences of each category or value in the dataset.

b. Mean

The average value of the dataset, representing a central tendency.

Inferential statistics

Stochastic frontier production function analysis (SFPFA) was used to capture the degree of technical efficiency in the production process. It was used to identify inefficiencies and areas for improvement in the production system.

Estimation of poultry farmers production efficiency

A stochastic frontier production function model is a method in econometrics that is used to estimate the level of inefficiency in the production process. This approach is often used when trying to assess the performance of farms, factories or other production processes.

The model includes two error terms: One captures random shocks (weather events, accidents, *etc.*) and the other captures inefficiency. The first error term is usually assumed to be normally distributed and independent of the input levels, while the second error term is typically assumed to be non-negative and can be dependent on input levels, representing the inefficiency in the production process.

The stochastic frontier model can be represented as:

$$\ln Y_i = f(X_i;\beta) * \exp(V_i - U_i) \quad \ldots. (1)$$

Where,

Y_i = Output of the ith firm.

X_i = Vector of inputs of the ith firm.

f() = Production function.

β = Vector of parameters to be estimated.

V_i = Random variable which is assumed to be identically and independently distributed as N(0, σ^2_v) and independent of the U_i.

U_i = Non-negative random variable which accounts for technical inefficiency in production and is assumed to be identically and independently distributed.

The empirical model of the stochastic production frontier is specified as.

$$\ln Yi = \beta 0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + V_i - U_i \quad \ldots.(2)$$

Y = Output of the farmers (crates of egg).

x_1 = Number of birds.

x_2 = Quantity of feed (in kg).

x_3 = Hire Labour input use in production in man-day.

x_4= Quantity of water (in litres).

In's = Parameters to be estimated.

Ln's = Natural logarithms.

Vi = The symmetric component that captures random error associated with random factor under the control of poultry farmers.

Ui = The asymmetric error component represents the deviation from the frontier production (the technical inefficiency). The inefficiency model:

$$Ui = \alpha 0 + \alpha 1\ Z1i + \alpha 2\ Z2i + \alpha 3\ Z3i + \alpha 4\ Z4i + \alpha 5 Z5i + \alpha 6 Z6i \quad \ldots.(3)$$

Where,

Ui = Technical efficiency of the poultry farmers.

Z1 = Age of farmers (years).

Z2 = Marital status.

Z3 = Level of education (years).

Z4= Household size.

Z5 = Farming experience (years).

Z6 = Extension contacts (Yes=1, No=0) .

αi's = Parameters to be estimated.

RESULTS AND DISCUSSION

Table 3 Presents the Various Strategies Poultry Farmers Adopted in Response to the High Price of Feed.

It is important to note that different farmers opted for different coping strategies based on their unique circumstances and resources available to them. The strategies observed in the study are as follows:

No change of strategy (5.2%)

A small proportion of the poultry farmers (5.2%) did not adopt any strategy in response to the high price of feed.

Table 2: Sampling procedure for the selection of the poultry farmers.

State	PAN zones	Population of layer's poultry farmers	No. of sampled layer's poultry farmers	No. of questionnaire distributed	No. of questionnaire retrieved and completely filled
Lagos	Agege	40	24	24	18
	Alimossho	38	21	21	22
	Badagry	32	20	20	16
	Epe	54	26	26	21
	Etiosa	35	20	20	20
	Ikorodu	64	37	37	33
	Ojo	58	30	30	25
	Sub total	321	178	178	153
Ogun	Egba	84	42	42	35
	Ijebu	70	35	35	32
	Mowe	62	28	28	21
	Remo	80	42	42	41
	Otta	70	32	32	32
	Yewa	64	28	28	30
	Sub total	430	207	207	191
Oyo	Ibadan I	75	41	41	39
	Ibadan II	70	36	36	30
	Ogbomosho	64	31	31	27
	Oke-ogun	69	36	36	35
	Oyo	85	46	46	40
	Sub total	363	190	190	171
Total		1,114	575	575	515

This could be due to various reasons, such as lack of awareness, resources or alternative options.

Use of finished feed (24.7%)

Approximately a quarter of the poultry farmers (24.7%) switched to using finished feed to cope with the high price of feed. Finished feed is a complete and balanced feed product that can potentially help farmers reduce feed costs and improve efficiency.

Mixed farming system

A large (47.8%) percentage of poultry farmers adopted a mixed farming system, integrating crop production or other livestock into their operations. This approach can help farmers diversify their income sources, reduce feed costs by utilizing farm-produced feed ingredients and enhance overall farm resilience.

Downsizing flock size

Downsizing (16.1%) was another strategy adopted by poultry farmers to reduce their flock size, which may help lower feed costs and make it more manageable for them to maintain their operations amidst high feed prices.

Verge of exiting the poultry business

Some farmers (6.2%) chose verge of exiting the poultry business altogether to cope with the high feed price. This decision can be difficult, but in some cases, it may be the most *via*ble option for farmers facing significant financial stress due to high feed costs, thereby allocating resources met for poultry venture to other ventures.

Results of maximum likelihood estimate of poultry farmers' stochastic frontier production functions

The results from Table 4 indicates that three variables were significant in the model at 5% probability level ($p<0.05$). These variables are number of birds, quantity of feed and quantity of water with a coefficient of 0.2078, 0.3538 and 0.6875 respectively. The coefficients are positive and inelastic. The positive coefficients indicate that increasing the value of each of these variables is associated with an increase in the output of poultry

Table 3: Poultry farmers strategies for coping with high price of feed.

	Frequency Yes/No	Total	Per cent Yes/No	Total
No change of strategy	27.0/488	515	5.2/94.8	100.0
Use of finished feed	127.0/388	515	24.7/75.3	100.0
Engagement in mixed farming	246.0/269	515	47.8/52.2	100.0
Downsizing of flock size	83.0/432	515	16.1/83.9	100.0
Verge of exiting the poultry business	32.0/483	515	6.2/93.8	100.0

Field Survey 2022.

Table 4: Results of maximum likelihood estimate of the stochastic frontier production functions of poultry farmers.

Variables	Coefficient	Std. error	t-value
No. of birds	0.2078	0.1159	1.7929
Qty. of feed	0.3538	0.1132	3.1254
Hired labour	-0.1503	0.1631	-0.9215
Qty. of water	0.6875	0.2585	2.6596
Constant	0.3118	0.1084	2.8763
Inefficiency			
Constant	0.8128	0.3488	2.3303
Age	0.7004	0.3488	2.0309
Marital status	0.4293	0.6639	0.6389
Level of education	- 0.3875	0.1599	-2.4238
Household size	-0.5601	0.6344	-0.8829
Farming experience	-0.6092	0.3318	-1.8360
Extension agent visit	0.1158	0.5391	0.2148
Mean efficiency = 0.84732219E+00□² = 0.49178894E+02(□) = 0.37280455E+03			
Log-likelihood function= -0.80007035E+03			

Field Survey 2022.

Table 5: Respondents production efficiency and strategy adoption.

		Strategies adopted					
		No change of strategy	Use of finished feed	Engagement in mixed farming	Downsizing of flock	Verge of exiting poultry business	Total
TECH.	.1-.20	2(0.38)	1(0.19)	0(0.00)	5(0.97)	8(1.55)	16
EFF	.21-.30	2(0.38)	1(0.19)	1(0.19)	3(0.58)	5(0.97)	12
	.31-.40	2(0.38)	2(0.38)	1(0.19)	3(0.58)	2(0.38)	10
	.41-.50	5(0.97)	4(0.78)	1(0.19)	1(0.19)	0(0.00)	11
	.51-60	7(1.36)	3(0.58)	1(0.19)	8(1.55)	2(0.38)	21
	.61-.70	2(0.38)	3(0.58)	3(0.58)	3(0.58)	0(0.00)	11
	.71-.80	2(0.38)	3(0.58)	2(0.38)	0(0.00)	0(0.00)	7
	.81-.90	4(0.78)	1(0.19)	5(0.97)	0(0.00)	0(0.00)	10
	.91-1.00	81(15.73)	94(18.25)	162(31.56)	48(9.32)	32(6.21)	417
Total		107 (20.78)	112(21.73)	176(34.25)	71(13.77)	47(9.50)	515(100)

Field Survey 2022.

farmers in the study area. The inelastic nature of the coefficients suggests that the relationship between thevariables and output is relatively constant across different levels of the variables.

The coefficient of 0.2078 for number of birds indicates that a one-unit increase in the number of birds will lead to a 20.78% increase in output, holding all other factors constant. This finding is in line with the findings of Akudugu *et al.* (2023) who found farm size to have a positive and significant relationship with probability of adopting e-extension services Similarly, a one-unit increase in the quantity of feed (with a coefficient of 0.3538) is associated with a 35.38% increase in output and a one-unit increase in the quantity of water (with a coefficient of 0.6875) is associated with a 68.75% increase in output.

For the inefficiency parameters which shows the farm specific characteristics, only the age was significant (P<10%) with positive coefficient while educational level and farm experience were significant (P<5%) with negative coefficients.

The results revealed that only age was found to be significant at a 10% probability level, with a positive coefficient indicating that older poultry farmers may not adopt improved technologies that could enhance efficiency and may therefore be less efficient in their production. This is an important consideration for policy makers and extension agents, as they may need to target older farmers with specific outreach programs to encourage the adoption of new technologies. This result is contrary to the findings of Wordofa *et al.* (2021), who observed that the farm households who used improved agricultural technologies were relatively older than those who did not use the technologies.

Education and farm experience were also found to be significant at a 5% probability level, with negative coefficients indicating that higher levels of education and more experience in poultry farming were associated with higher levels of technical efficiency. This suggests that farmers with more education and experience may be more likely to adopt new technologies and management practices and may have a greater understanding of the production process. This result contradict the findings of Issahaku *et al.* (2018), who found that additional years of education reduced the likelihood of farmers complying with extension services.

Distribution of farmers by production efficiency and strategy adoption

Table 5 shows the interaction between the production efficiency of the poultry farmers strategies adopted.

Table 5 shows that 15.73% of the poultry farmers who do not change their strategies were technically efficient, about 18.25% of the poultry farmers who used finisher feed were technically efficient, while 33% those that engaged in mixed farming were found to be technically efficient, 9.32% of the poultry farmers adopted downsizing of flock size as their coping strategy, while only 6.2% of the poultry farmers at the verge of exiting the poultry business were found to be technically efficient. These farmers are on the verge of exiting because of their low efficiency imposed by high price of feed.

CONCLUSION

The results of the maximum likelihood estimate show that the number of birds, quantity of feed used and quantity of water were the variables that could make the poultry farmers more efficient.

The inefficiency parameters shows the farm-specific characteristics where age was found to be one factor reducing the poultry farmers' efficiency. Educational level and farming experience were found to be positive contributors to the efficiency of the poultry farmers.

Poultry farmers that engaged in mixed farming were more technically efficient than those that adopted other coping strategies.

The study therefore recommends that:

1. The finding of this study suggests that the government and the private sector should aid the poultry farmers by subsidizing the prices of the raw materials used in feed

production since most of the feed costs are absorbed by the poultry farmers.
2. Increasing the poultry farmers educational level and well-being will help the farmers decide how to respond to the high feed cost.
3. The poultry farmers should engage in mixed farming, enabling them to be more technically efficient in their production.

Conflict of interest

All authors declare that they have no conflict of interest.

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