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Research Article

LUCID INVESTIGATION OF COST EFFICIENCY OF SMALL-SCALE POULTRY BROILER FARMS IN NIGER STATE OF NIGERIA

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ABSTRACT
The study lucidly investigated cost efficiency of small-scale poultry broiler production in Niger State of Nigeria, using cross-sectional data elicited *via* questionnaires coupled with interview schedule from 97 broiler agriprenuers' selected *viz.* multi-stage sampling technique; and, data were analyzed using descriptive statistics, cost concepts and income measures, Gini coefficient-Lorenz curve, stochastic frontier cost function and poultry broiler constraint index. Findings discovered a productive, literate working population, having reasonable household size recommended by FAO to be fair in terms of living standard for a typical farming setting in Africa. Also, it was observed that government and non-governmental programmes efforts in driving the over-saturated labour market in the state back to agriculture is yielding desirable result as evidenced from Gini coefficient estimate which showed that the enterprise was dominated by mostly small and medium income stream earners; and, also the enterprise was found to be viable in the study area based on the profit stream recorded. Furthermore, relative presence of economies scale was observed among the agriprenuers', implying that an average technical unit in the study area produce at a minimum cost considering the size of the operational holding. The result was further corroborated by the mean cost efficiency score which indicated that an average farm in the study area is 19% above the cost frontier, indicating relative efficiency in allocation of scarce resources. However, results indicated presence of cost inefficiency effects based on estimated gamma coefficient which is significant and the generalized likelihood ratio chi-square estimate which is greater than the calculated chi-square. Albeit, study recommends cost cut by 19% on the average and institutional and non-institutional intervention to ensure prudent cost efficiency, thus, ensuring viability and sustenance of this sector in the state.

Keywords: *Cost, Efficiency, Stochastic Frontier, Broiler, Niger State, Nigeria*

INTRODUCTION
Niger state has great potential for better economic growth both in the short and long run than current experiences. In spite of continuous and laudable interventions by public and private sectors to sustain and ensure viability and vibrancy of poultry sector, this livestock sub-sector is currently under serious threat as evidenced by continual closure of small to large firms and collapse of Niger State Ministry of Livestock and Fisheries into a department/unit under Niger State Ministry of Agriculture and Rural Development. This trend is causing ripples and has become source of concerns to like minds given that the state food security coupled with security of lives and properties are being jeopardised, given that a sector which accommodate almost 40 percent of the teeming population is on the verge of vanish. Poverty, inefficiency and unemployment have been suggested by many empirical evidences as areas of great concerns to policy planners as well as policy makers in developing countries. Farming in general, has to use available inputs as efficiently as possible to achieve optimum production, because inefficiency of resource utilization can seriously jeopardize and hamper food production, availability and security. To optimize production and ensure sustainability there is need for judicious management of the resources employed in agriculture. The need to efficiently allocate productive resources as well as analyze profitability for development purposes cannot be over emphasized, because any attempt at studying efficient allocation of resources and measuring profitability on the farm represents an important source of achieving growth in the economy. Given these scenario, this research aimed at contributing towards better

understanding of production efficiency of poultry producers' in Niger state with a view to predict their allocative efficiencies using stochastic frontier cost function giving that previous studies on poultry broiler enterprise both state-wise and country-wise exclusively focused on technical efficiency in spite of availability of input and output prices (Emokaro and Emokpae, 2014; Adesiyan, 2014; Aboki *et al.*, 2013; Ohajianya *et al.*, 2013; Ashagidigbi, 2011; Abubakar, 2010). However, the only literature documented evidence which adopted stochastic frontier cost function on broiler production was conducted in Ghana by Etuah (2014). Another major motivation of this study stems from the belief that understanding the levels of inefficiency or efficiency can help address profit gains in poultry production, because findings from this study will help in identifying the most efficient means of combining increasingly scarce resources so as to minimize costs and maximize profit from poultry production, which will assist in solving problems of credit deadlock in poultry enterprises in the study area in particular and the state in general. Ability to measure cost efficiency will help decision makers to monitor the performance of these units under study and will serve as a means of providing information on cost efficiency in view of the prevailing risks for prospective investors in poultry production in the study area. The broad objective of this study was to investigate cost efficiency of poultry broiler agriprenuers' in Niger State of Nigeria. The specific objectives were to:

i. describe the socio-economic characteristics of the broiler producers' in the study area;
ii. evaluate income distribution among broiler producers' in the study area;
iii. estimate costs and returns to poultry broiler production in the study area;
iv. determine the cost efficiency and factors affecting cost efficiency in poultry broiler production in the study area; and,
v. identify and prioritize constraints affecting poultry broiler agriprenuers' in the study area.

Statement of Hypotheses

H_{01}: Inefficiency effects are absent in cost frontier.
H_{A1}: Inefficiency effects are present in cost frontier.
H_{02}: inefficiency scalar is non-stochastic.
H_{A2}: inefficiency scalar is stochastic.
H_{03}: Unequal distribution of efficiency scores.
H_{A3}: Equal distribution of efficiency scores.

MATERIALS AND METHODS

Research Methodology

Niger state is located in the north-central part of Nigeria, lying between longitude $3^0\ 30^1$ and $7^0\ 20^1$ east of the Greenwich Meridian and latitude $8^0\ 20^1$ and $11^0\ 30^1$ north of the equator with approximately 80,000 square kilometre landmass having varying physical features like hills, lowland and rivers; annual precipitation is between 1100mm and 1600mm with average monthly temperature hovering around 23˚C to 37˚C and enjoys luxuriant vegetation with vast northern guinea savannah in the north and fringe (southern guinea savannah) in the southern part of the state which favours arable crop cultivation and livestock keeping.

The study used cross-sectional data elicited *via* questionnaires coupled with interview schedule from 97 broiler agriprenuers' selected *viz.* multi-stage sampling technique. The sampling wise procedure is as follows: convenient selection of one agricultural zone out of the three agricultural zones in the state, namely Kuta due to cost and time constraint of the researcher; purposive selection of two LGAs' *viz.* Chanchaga and Bosso due to preponderance of poultry entrepreneurs and readily available market demand; determining 50% proportionate sample size from each selected LGA in the sampling frame issued by NAMDA; and, lastly random selection of representative sample size from each selected LGAs, thus, given a total sampling size of 97 active broiler agriprenuers' for the study. In ascending order of outlined objectives, data were analysed using descriptive statistics, cost concepts and income measures, Gini coefficient–Lorenz curve, neo-classical parametric model (stochastic frontier cost function) and poultry broiler constraint index.

Table 1: Sampling Frame of Active Poultry Broiler Agriprenuers'

LGAs	Population	Sample Size
Bosso	93	47
Chanchaga	99	50
Total	**192**	**97**

Source: NAMDA, 2016

Model Specification

1. *Gini Coefficient:* It is a statistical measure of dispersion developed by an Italian statistician named Corrado Gini and published in his paper "variability and Mutability" (Italian: *Variabilitae mutabilita*). The Gini index is defined as a ratio of the areas on the Lorenz curve. The formula is specified as follows:

G = A/0.5 = 2A=1-2B …….. (1)

2. Cost concepts and Income measures

Cost concepts and income measures are widely used because of their relevance in decision-making process. This means that these costs serve as a basis to expand the size of the farm, to buy the requisite capital assets in the long run and the requisite inputs in the short run. The researchers re-modified the cost concepts developed by Subba *et al*., (2016) and Dr. Sen's committee report (1979), and are specified below:

a. Cost Concepts: Costs related to groundnut production are split up into various cost concepts such as A, B, C and D

Cost A_1: Total Variable costs (Explicit costs)
Cost A_2: Total Variable cost (Economic cost)
Cost A_3: Total cost (Explicit costs)
Cost A_4: Total cost (Economic cost)
Cost B_1: The following items are included in Cost B_1
Wages of hired labour
Wages of permanent labour
Market rate of fertilizer and manure
Market rate of seed
Imputed value of own seed
Imputed value of manure
Market value of pesticides and pesticides
Land revenue and other tax
Depreciation of farm implements/ equipment's
Miscellaneous expenses
Cost B_2: Cost B_1 + rent paid for leased in land
Cost C: Cost B_1 or B_2 + interest on fixed capital excluding land + rental value of owned land
Cost D: Cost C + imputed value of family labour

b. Income Measures

Farm business income = Gross income – Cost B_1/B_2
Family labour income = Gross income – Cost C
Net income = Gross income – Cost D
Farm investment income = farm business income – imputed value of family labour

3. Cobb-Douglas stochastic cost frontier function

Following Sadiq and Singh (2016), the stochastic frontier cost model is given below:

Implicit form

$C = g(P_i, Y; b) + (V_i + U_i)$ …….. (2)

C = Total cost of production
g = suitable Cobb-Douglas function

P_i = Price vector of input variable
Y = Output
b = Coefficient
V_i = Error term
U_i = Inefficiency
Explicit form

$$LnC = \beta_0 + \beta_1 LnP_1 + \beta_2 Ln P_2 + \beta_3 Ln P_3 + \beta_4 Ln P_4 + \beta_5 Ln P_5 + \beta_6 Ln P_6 + \beta_7 LnP_7 + \beta_8 LnY + (V_i + U_i) \quad \ldots\ldots (3)$$

Where,
Ln = represents the natural logarithm
C = Total costs of production (₦)
P_1 = Costs of chicks (₦)
P_2 = Costs of feeds (₦)
P_3 = Cost of labour (₦)
P_4 = Costs of water (₦)
P_5 = Costs of medications (₦)
P_6 = Depreciation on capital input (₦)
P_7 = Electricity charges (₦)
Y =Output (number of chicks)
V_i = Error beyond the control of i^{th} farmer (uncertainty)
U_i = Error within the control of i^{th} farmer (risk)
B_0 = intercept
β_{1-n} = coefficient of parameters to be estimated

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 \ldots + \delta_n Z_n \quad \ldots\ldots (4)$$

Where,
Z_1 = Age of farmers (years)
Z_2 = Household size (numbers)
Z_3 = Educational level (formal =1, otherwise =0)
Z_4 = Experience of farmers (years)
Z_5 = Access to credit (yes =1 otherwise =0)
Z_6 = extension services (yes =1, otherwise =0
Z_7 = Cooperative membership (yes =1 otherwise =0)
Z_8 = Disease outbreak (severe =1 otherwise =0)

4. *Poultry Broiler Constraint Index (PBCI):* Following Swain(2013), PBCI was used to rank constraints in poultry broiler enterprise and it is given below:

$$\mathbf{PCI = 1/n\ (} \sum_{i-1}^{n} Wi - Ci) \quad \ldots\ldots (5)$$

Where:
W_i = weight of constraint ranking
C_i = number of farmers in a category that respond to a constraint
i = i^{th} farmer
n = number of respondents

RESULTS AND DISCUSSION

Socio-Economic Profile of Boiler Agriprenuers'

Table 2 shows socio-economic profile of poultry broiler producers in the study area. Findings showed that majority of the producers fall within the active age bracket (17-49) recommended by FAO to be economically viable for agricultural production as evidenced by the mean age of 35±7.5, indicating productive, active and energetic labour force that is capable to surmount encountered challenges in the course of production *viz.* responsiveness to adopt poultry production innovations faster as well as invest more in production. Attraction of youths towards this enterprise could be attributed to its inherent

potential profitability and viability. Majority (50.5%) of the producers had between 1-3 years of experience, indicating that the enterprise in the study area is at nascent stage which is true, because the driving livestock empowerment programme by Niger state government was initiated in year 2012/2013. It is a known fact that experience is a key factor affecting production, and the more the years of experience acquired by farmer, the more exposed and versatile he becomes which in turns would yield expectant efficiency in production.

The enterprise was found to be exclusively male dominated, a fact traceable to ranging reasons such as women playing supportive role like food cooking, other house chores and trading; though majority (75.3%) of them were married, indicating how marital status became an important factor in broiler production especially that labour is expensive.

Results also showed that majority (53.6%) have a household size of 4-6 persons, which falls within the range recommended by FAO to be fair and sustainable with respect to canon of standard of living for a typical agrarian setting in Africa. Addendum, there are more hands at home for labour used in the farms which explain why hired labour is minimized.

Study found majority of the respondents to be literate (83.5%), implying an easy driving force for adoption of new technologies and efficient utilization which will trigger "catch-up effect" in productivity enhancement, because education will not only increases his efficiency and productivity, but enhances his ability to comprehend and evaluate innovative technologies; and majority owned the land they used for poultry keeping, which were likely inherited being indigenes of the community, thus, an added advantage because farmers that owns parcels of land tend to be more productive.

Also, majority (73.3%) of the producers did not restrict themselves to poultry farming as occupation only but rather add other secondary activities, indicating that broiler producers in this vicinity adopt diversification strategies by participating in both farm/non-farm/off-farm activities which would increase their income base.

Study further showed that majority had no access to credit, did not belong to any co-operative associations and had no access to extension services.

The implication is that, productivity catalyst of this venture will be hampered, therefore, urgent measures should be put in place to correct these anomalies: farm credit for long has been identified as a major input in development of agricultural sector in Nigeria because it determines access to all resources which farmers relied upon, thereby improving and sustaining production efficiency; agricultural extension *viz.* advisory services and programmes forges to strengthen the farmers' capacity to develop by providing access to agricultural information; while co-operative membership serves as a veritable medium for enhancing farmers' bargaining powers and other pecuniary advantages. Albeit, it was found that majority of the farms were located/situated in the rural areas, which is pros in terms of gingering rural economy and reduction in pollution, and cons viz. cost mismatch given that farms situated in the urban areas are likely to be cost efficient due to market proximity as well as a quick access to innovative technologies thereby reducing their marketing costs.

Table 2: Socio-Economic Profiles of Broiler Agriprenuers' in the Study Area

Characteristics	Frequency	Percentage	$\bar{X}$ ± SD
Age			
≤ 19	1	1.0	
20-29	27	27.8	
30-39	39	40.2	
40-49	28	28.9	
≥ 50	2	2.1	
Total	**97**	**100**	**35±7**
Experience			
1-3	49	50.5	
4-6	25	25.8	

7-9	9	9.3	
≥ 10	14	14.4	
Total	**97**	**100**	**5±4.17**
Gender			
Male	84	86.60	
Female	13	13.40	
Total	97	100	
Marital status			
Married	73	75.3	
Single	22	22.7	
Widowed	1	1.0	
Divorced	1	1.0	
Total	97	100	
Household size			
≤ 3	8	8.2	
4-6	52	53.6	
7-9	25	25.8	
≥ 10	12	12.4	
Total	**97**	**100**	**6±3.92**
Education			
Formal	81	83.5	
Informal	16	16.5	
Total	**97**	**100**	
Land acquisition			
Owned	79	81.4	
Rent	18	18.6	
Total	**97**	**100**	
Occupational status			
Farmer	26	26.8	
Farmer/Artisanal	38	39.2	
Farmer/Civil servant/Artisanal	5	5.2	
Farmer/Civil servant	28	28.9	
Total	**97**	**100**	
Access to credit			
Yes	17	17.5	
No	80	82.5	
Total	**97**	**100**	
Extension services			
Yes	32	33.0	
No	65	73.0	
Total	**97**	**100**	
Co-operative membership			
Yes	22	22.7	
No	75	77.3	
Total	**97**	**100**	
Farm location			
Rural	51	52.6	
Urban	46	47.4	
Total	**97**	**100**	

Source: Field survey, 2016

Evaluation of Income Distribution among Broiler Agriprenuers'

A perusal of Table 3 revealed the estimated Gini coefficient index to be 0.467, implying low equality in income distribution among the producers in the study area. This can be observed graphically from Lorenz curve which is fairly farther from the line of equality (Figure 1). Therefore, it can be inferred that broiler poultry enterprise in the study area was dominated mostly by low and medium income stream, an indication of government and non-governmental programmes success in driving the over-saturated labour market in the state back to agriculture. This justified the earlier results which stated that majority of poultry broiler entrepreneurs' in the study area did not restrict themselves to only broiler venture but combined both farm/non-farm/off-farm activities to assuage their income stream. Furthermore, this indicates little inconsistency in livelihood status of broiler farmers in the study area; therefore, policies aimed at income redistribution using tax and tax exemption policies as an instrument should be made effective so as to bridge income gap and make the enterprise competitive and viable.

Table 3: Income Distribution of Poultry Broiler Agriprenuers' in the Study Area

Index	Estimate
Gini coefficient	0.467
Population value index	0.472

Source: Field survey, 2016

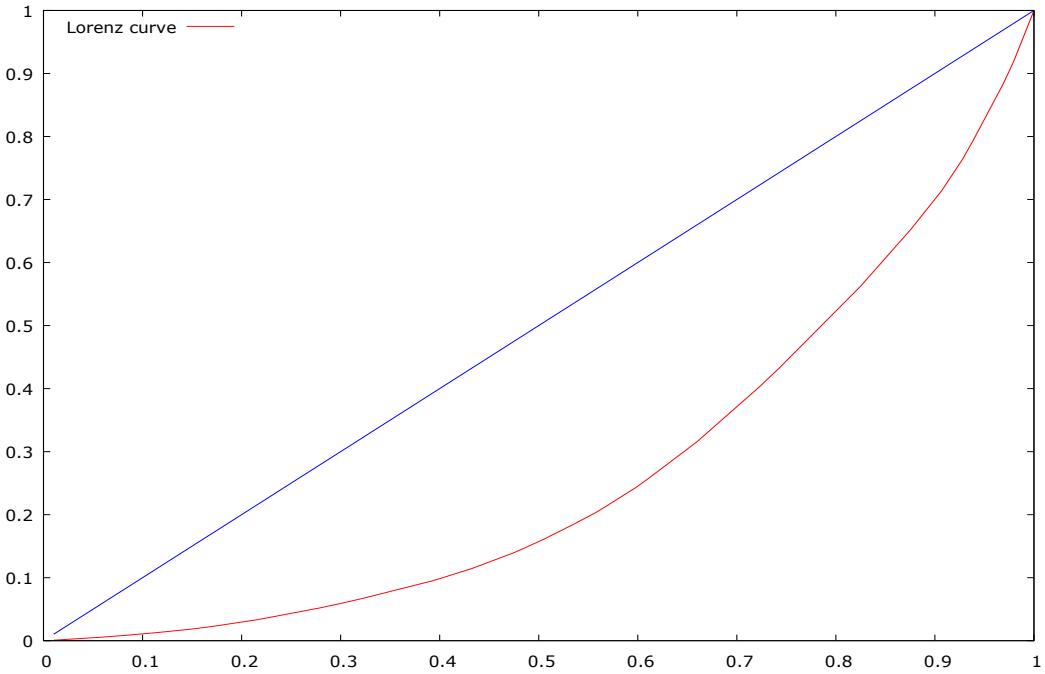

Figure 1: Income Distribution of Poultry Farmers in Niger State

Costs and Returns Estimates of Broiler Production

Estimated costs and income measures of poultry broiler production per 45 birds are presented in Table 4. A perusal of the table showed the estimated total cost incurred to be ₦38035.83, with total variable cost been ₦25307.72 and total fixed cost been ₦12728.11. However, total variable cost accounted for 66.54% (highest) while fixed cost contributed 33.46% to the total cost incurred. Decomposition analysis of cost component showed cost incurred on brooding chicks to be highest (29.05%) followed by interest on owned fixed capital (24.66%), while kerosene (0.39%) and liter (0.06%) had least costs. This agrees with the *a priori* expectation that brooding stock is an important variable cost item that greatly determines productivity and profitability of poultry broiler production.

Table 4: Costs and Returns Estimates of Broiler Production per 45 Birds

Items	Quantity	Unit Price (₦)	Cost (₦)	Percentage
a. Input cost				
Variable cost				
Family labour	2.34 mandays	1500	3510	9.23
Hired labour	1.23 mandays	1500	1845	4.85
Brooding chicks	54 chicks	204.64	11050.56	29.05
Feeds	30.58kg	113.36	3466.55	9.11
Liter	2.17kg	10	21.7	0.06
Drugs	0.1695kg	1851.82	313.88	0.83
Water	253litre	1	253	0.66
Kerosene	1litre	150	150	0.39
Leather	-		569.55	1.50
Vaccines	-		330.79	0.87
Veterinary services	-		196.69	0.52
Imputed interest on working capital	(12% of ₦30000)		3600	9.47
TVC			**25307.72**	**66.54**
Fixed cost				
Electricity	51.83kw/hr	14	725.62	1.90
Imputed rental value of owned land	-		610.82	1.60
Interest on owned fixed capital (12% of 78151.74)	-		9378.21	24.66
Depreciation			2013.46	5.30
TFC			**12728.11**	**33.46**
Total cost			**38035.83**	**100**
Cost concepts				
Cost A1			18197.72	
Cost A2			25307.72	
Cost A3			20936.80	
Cost A4			38035.83	
Cost B1			24536.80	
Cost B2			24536.80	
Cost C			34525.83	
Cost D			38035.83	
b. Returns				
Rental value of leased out land			610.82	
Manure	161.58kg	10	1615.80	
Broiler	45 birds	1500	67500	
Total Income			**69726.62**	
Farm business income			**45189.82**	
Family labour income			**35200.79**	
Farm investment income			**41679.82**	
Gross cash margin			**51528.90**	
Gross economic margin			**44418.90**	
Net cash income (AP)			**48789.82**	
Net income (EP)			**31690.79**	
ROI (cash)			**2.83**	
ROI (economic)			**1.76**	
RORCI (AP)			**2.33**	
RORCI(EP)			**0.83**	

Source: Field survey, 2016
Note: AP-Accounting profit; EP-Economic profit; ROI-Return on naira invested; RORCI-Rate of return on invested capital

Furthermore, the estimated accrued total revenue was ₦69726.62, while gross cash margin, gross economic margin, net cash income and net income were ₦51528.90, ₦44418.90, ₦48789.82 and ₦31690.79 respectively. Also, the estimated ROI (cash) value was 2.83, indicating that for every ₦1 invested, ₦2.83kobo was made as revenue, while the estimated ROI (economic) value was 1.76, implying that for every ₦1 invested, ₦1.76kobo was made as revenue. The RORCI which is the ratio of profit to total cost of production indicate what business earns through capital outlay. The results showed the estimated RORCI (accounting profit) (233%) and RORCI (economic profit) (83%) to be greater than the prevailing banking rate of 12%, thus, indicating that poultry broiler keeping in the study area is profitable. This is consonant with the findings of Ibekwe *et al.,* (2015) and Kala *et al.,* (2007) who in their various studies reported that poultry broiler production was profitable.

Reliability Test
The reliability of a measure indicates the consistency and stability with which the instruments measures the concept and helps to assess the 'goodness' of a measure. The value of estimated Cronbach's alpha coefficient use as a guideline for reliability test was 0.8022, indicating consistency and reliability of the instruments adopted, given that the Cronbach's alpha coefficient for all the variables is very close to unity (Table 5).

Table 5: Cronbach's Alpha Reliability Test

Items	Estimates
Average inter item covariance	0.158
Number of items in the scale	18
Scale reliability coefficient (Cronbach's alpha)	0.8022

Source: Field survey, 2016

Maximum Likelihood Estimation of Cost Frontier
Maximum likelihood estimates parameters of stochastic cost frontier model are given in Table 6a. The diagnostic statistics viz. estimated variance parameters in respect of sigma squared (σ^2) and gamma (γ) are 0.1943 and 0.999, respectively, and both significant at 1 percent probability level. The significance of estimated sigma squared (σ^2) implied correctness and fitness of the distribution assumption of the specified composite error term; while the significance of estimated gamma (γ) implied that 99.9% deviation in actual total cost from the minimum cost (frontier) among the sampled producers was due to differences in their cost efficiencies; thus, the null hypothesis which specifies that inefficiency effect in cost frontier is absent is rejected while the alternative hypothesis is accepted.
All the estimated parameters of the variable included in the model *viz.* cost of chicks, cost of feeds, cost of labour, cost of water, cost of medication, cost of electricity, depreciation and output (number of birds) which is the only physical term included in the model conform to *a prior* expectation, having the expected signs and all statistically significant at 1% probability level, meaning that these variables were significantly different from zero and thus important in broiler production. The cost elasticities with respect to all inputs used in the production analysis are positive; implying that a unit increase with respect to each variable input would increase total cost of production by their respective parameter coefficient. That is, ₦1.00 increase in the cost of chicks will increase total cost by 15kobo, ₦1 increase in the cost of feeds will increase total cost by 11kobo, ₦1 increase in the cost of labour will increase total cost by 9kobo, ₦1 increase in the cost of water will increase total cost by 2kobo, ₦1 increase in the cost of medication will increase total cost by 3kobo, ₦1 increase in electricity charges will increase total cost by 7kobo, ₦1 increase in depreciation will increase total cost by 49kobo and 1 additional stock of chick will

increase total cost by 61kobo. However, all the cost variables in the model are positive, implying that cost function monotonically increases in input prices. The result of economies of scale computed as inverse coefficient of cost elasticities with respect to the output (chicks) as the only output included in the model indicates that economies of scale prevailed among the sampled farmers as evident by the computed ***Es* (1.58)** which is greater than 1. The economic implication of this value is that the sampled technical units despite being small scaled in nature expand their production capacity to reduce their cost to the lowest minimum in course of production regardless of their operational holdings which indicates that the technical units are experiencing decreasing-positive return to scale (rational production region).

Table 6a: Maximum Likelihood Estimates of Stochastic Frontier Cost Function

Variable	Parameter	Coefficient	SE	T-Ratio
General model				
Intercept	β_0	1.7841	0.1319	13.526***
Cost of brooding chicks (₦)	β_1	0.1466	0.0135	10.876***
Cost of feeds (₦)	β_2	0.1064	0.0068	15.691***
Cost of labour (₦)	β_3	0.0881	0.0078	11.279***
Cost of water (₦)	β_4	0.0209	0.0062	3.391***
Cost of medication (₦)	β_5	0.0285	0.0062	4.634***
Electricity charges (₦)	β_6	0.0660	0.0088	7.476***
Depreciation (₦)	β_7	0.4916	0.0061	80.79***
Output (no. of birds)	β_8	0.6051	0.1445	4.187***
Economies of scale (Es)		1.58		
Inefficiency model				
Intercept	δ_0	-0.4860	0.567	-0.857^{NS}
Age	δ_1	-0.0139	0.016	-0.873^{NS}
Household size	δ_2	-0.0088	0.0285	-0.309^{NS}
Education	δ_3	-0.3986	0.0313	-12.757***
Experience	δ_4	-0.0372	0.0125	-2.989***
Access to credit	δ_5	-0.2074	0.2826	-0.734^{NS}
Extension contact	δ_6	0.8216	0.2060	3.988***
Co-operative membership	δ_7	0.7979	0.1796	4.443***
Farm location	δ_8	0.0651	0.1803	0.361^{NS}
Disease outbreak	δ_9	-1.2878	0.3157	4.079***
Diagnostic statistics				
Sigma squared	σ^2	**0.1943**	**0.0257**	**7.555*** **
Gamma	γ	**0.999**	**0.00000218**	**459198.80*** **
Log likelihood function		**98.678**		

Source: Frontier 4.1 computer print-out

The results of estimated coefficients of control/stimulus variables included in inefficiency model showed coefficients of five of the nine estimated parameters to be significant at different probability levels (Table 6a). The significant parameters are education, farming experience, extension services, cooperative membership and disease, while the non-significant variables are age, household size, access to credit and farm location.

The coefficient of education, farming experience and disease, carried negative signs and are significant at 1%, implying inverse relationship with cost inefficiency, while extension contact and co-operative

membership, carried positive signs and are significant at 1% probability level, indicating positive relationship with cost inefficiency.

The negative coefficient of education implies that farmers with formal education are more cost efficient than those farmers with no formal education. This conforms to the assumption that farmers' literacy would have positive effect on efficiency level as they embody skills that can improve their overall efficiency. The negative coefficient associated with farming experience indicates that the most experienced farmers in the poultry broiler production are more cost efficient, meaning as farming experience increases, the more enlightened he becomes and more cost efficiency he is expected to be. Also, the positive coefficient of extension contact implies that farmers with no access to extension are more cost inefficient than those with extension access: this is true because they are less likely to be exposed to innovative technologies which will enhance their production and strengthen his capacity to develop; the positive coefficient associated with cooperative membership implies that farmers who did not belong to cooperative associations are more cost inefficient than those who belong, because they are less likely to benefit from bargaining power in output marketing, bulk discount in input purchase and other pecuniary advantages.

The negative coefficient associated with disease outbreak means that farmers with less or no cases of disease outbreak are more cost efficient, that is, cost efficiency of a farm increase if there is no case of a disease outbreak. The results in Table 6b showed decomposition analysis of the attendant risk of cost waste associated with the socio-economic variables, thus, justifying and substantiating the inefficiency effects results in Table 6a.

Table 6b: Key Factors Explaining Cost Inefficiency and Cost Wasted

Characteristics	Number	Cost Efficiency Score	Actual Cost Incurred	Cost Wasted
Education				
Formal	81	1.01	161275.00	1612.75
Informal	16	1.18	288130.00	51863.40
Experience				
1-3	49	1.25	417700.00	104425.00
4-6	25	1.15	301130.00	45169.50
7-9	9	1.04	141073.00	5642.92
≥ 10	14	1.01	91280.00	912.80
Extension contact				
Yes	32	1.02	101130.00	2022.60
No	65	1.19	15365.00	2919.35
Co-operative membership				
Yes	22	1.02	105630.00	2112.60
No	75	1.15	141730.00	21259.50
Diseases outbreak				
Yes	27	1.21	101140.00	21239.40
No	70	1.03	96020.00	2880.60

Source: Authors' computation

Furthermore, to validate the use of stochastic frontier, diagnostic statistic result *viz.* LR test was found to be significant as evidenced by the calculated Chi^2 (χ^2) which is greater than the tabulated Chi^2 (χ^2), indicating fitness of the inefficiency model (Table 6c). This implies that the parameters in the inefficiency model are different from zero, thus, meaning that the traditional response function (OLS) is not an adequate representation of the data. Therefore, the null hypothesis 2 which specify that inefficiency scalar is nonstochastic is strongly rejected while the alternative hypothesis 2 is accepted.

Table 6c: Generalized Likelihood Test of Hypothesis of Parameters in Inefficiency Model

H_0	LLF	χ^2-cal	χ^2-tab	Decision
H_0: γ =0	18.68	101.59	20.09	Reject H_0

Source: Frontier 4.1 computer print-out

Cost Efficiency Scores of Broiler Agriprenuers'

Cost efficiency scores summary for broiler farms in the studied area are presented in Table 7. The estimated mean cost efficiency of the farms was 1.19, implying that an average broiler farm in the studied area has cost that are approximately 19% above the minimum defined by the frontier. In other words, 19% of costs incurred by these farmers are wasted relative to the best practiced farms producing the same broiler and facing the same technology.

The higher the value of cost efficiency, the more inefficient the broiler farm is. Therefore, for the average farmer to be on the frontier, he/she has to cut his costs by 19%, and for him to be on the same level with the best cost inefficient farmer he/she has to cut his costs by 18%.

Also, for the worst cost inefficient farmer to be on the frontier surface, he/she has to cut his costs by 259%; and for him to be on the same surface with the average farmer, he/she has to cut his costs by 201.7%, while for him to be on the same surface with the best cost inefficient farmer he/she has to cut his costs by 255.5%.

However, the frequencies of occurrence of the predicted cost efficiency between 1.0 and 1.19 is 68%, representing about 68% of the farmers, implying that, majority of the farmers are fairly efficient in producing at a given level of output using cost minimizing input ratios which reflects the tendency of the farmers to minimize resource wastage associated with production process from cost perspective.

Table 7: Deciles Frequency Distribution of Cost Efficiencies of Broiler Agriprenuers'

Efficiency Level	Frequency	Percentage
1	9	9.2
1.01-1.19	57	58.8
1.20-1.39	19	19.6
1.40-1.59	5	5.2
1.60-1.79	5	5.2
2.00-2.99	1	1.0
3.00-3.99	1	1.0
Total	**97**	**100**
Mean	**1.19**	
Mode	**1.01**	
Maximum	**3.59**	
Minimum	**1.00**	
Standard deviation	**0.34**	

Source: Frontier 4.1 computer print-out

Hypothesis Testing of Cost Efficiency Scores Distribution

The result of hypothesis 3 testing indicates high equality in efficiency scores distribution among farmers' as evidenced by Gini coefficient index value of 0.099 (Table 8) as well as substantiated justification from the Lorenz curve which was very close to the line of equality (Figure 2).

Table 8: Hypothesis 3 Testing of Cost Efficiency Scores Distribution

Item	Estimate
Gini coefficient index	0.099
Population value index	0.100

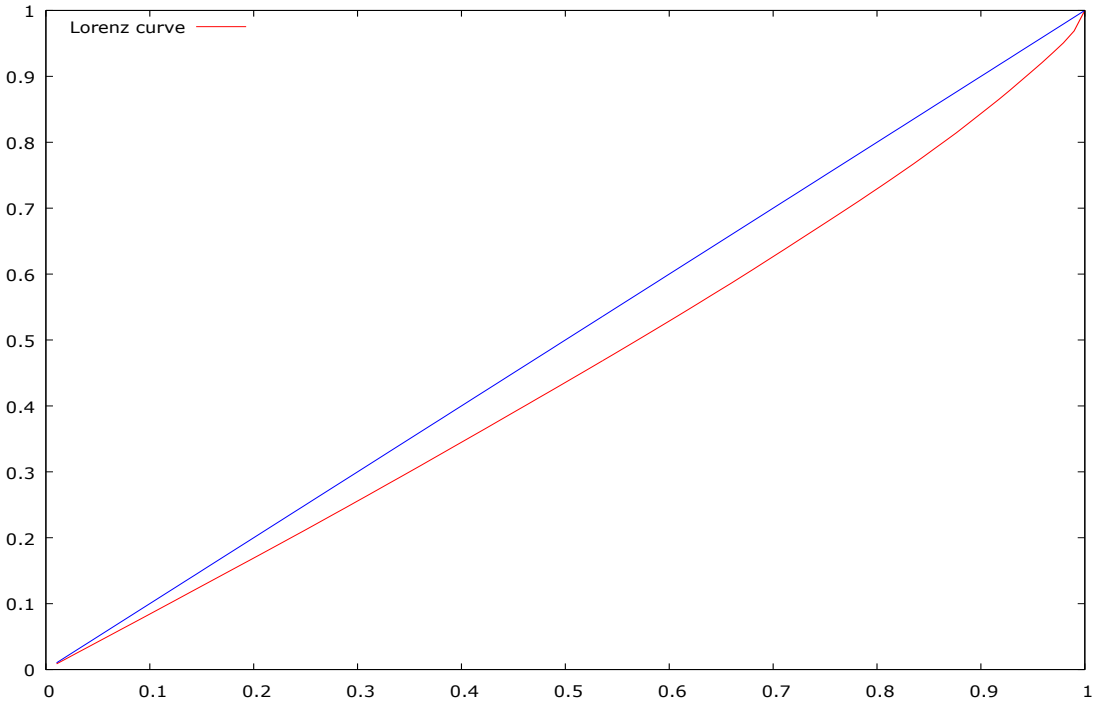

Figure 2: Hypothesis Testing of Efficiency Scores Distribution

Challenges Faced by Poultry Broiler Agriprenuers'

Table 9 showed various challenges faced by broiler entrepreneurs' from the most severe to less severe problems. The major problem ranked in descending order were erratic power supply, high cost of housing, high cost of feeds, paucity of capital, high cost of brooding chicks, high cost of labour and high mortality rate, while inadequate extension contact, pests and diseases outbreak and inadequate veterinary services were the less severe constraints faced by the producers in the study area. Various researchers in Nigeria, for example, Darko (2010), Asare-Baodu (2010) have documented similar problems in their studies. These problems would no doubt adversely affect the production and supply chain of poultry products. Therefore, onus lies on all the stakeholder to remedy these problems in order to steer supply and demand with respect to place, time and utilities because proper pricing system is generally perceived as the best organizational structure to achieve more efficient production in terms of type, quantity, quality and consumption decision.

Table 9: Constraints Affecting Broiler Agriprenuers'

Constraints	Weighted Value	Mean	Rank	Remark
High feed costs	244	2.5	3	High
High labour costs	209	2.2	6	High
High cost of brooding chicks	225	2.3	5	High
High cost of housing	250	2.6	2	High
High mortality rate	158	1,6	7	Moderate
Pest and diseases outbreak	117	1.2	9	Low
Veterinary services	115	1.2	9	Low
Paucity of capital	224	2.4	4	High
Inadequate extension services	124	1.3	8	Low
Erratic power	263	2.7	1	High

Source: Field survey, 2016
PCI mean value = 1.5

Conclusion and Recommendations

A productive and literate working population; exclusively dominated by men who are mostly married, with sustainable household size typical to African setting and marginal years of experience given that the driven empowerment programme was launched not long ago. Though, most of the producers had no access to credit, extension service delivery and did not participate in social organization, which would likely affect their efficiency.

Also, the enterprise was mostly dominated by small-medium income stream people, thus, a plus to government in deriving people back to agriculture, most especially youths who dominate the over bloated labour market in the state.

Furthermore, the enterprise was viable and profitable, and can serve as a means of sustaining livelihood if efficiently managed. A relative economy of scale coupled with marginal cost waste, is an indication that despite being small scale resource poor entrepreneurs', they are fairly efficient in resource utilization and are expanding their present level of production which would decrease their cost of production in the long run.

Based on the foregoing information's the following recommendations are given:

- Policies made by government to encourage local production of poultry should be implemented by all the agencies concerned in order to reduce the cost of production.
- The government should work assiduously on the erratic power supply and provide incentives such as subsidies on input items such as brooding chicks, vaccines, feeds, etc. in order to avert cost-push inflation effect, thus, enhancing efficiency in the supply chain of poultry production.
- Also, broiler agripreneurs' need to acquire requisite skills in inputs production using locally sourced materials thereby minimizing costs incurred, increase excise duty and strengthening the supply chain.
- Broiler agripreneurs' should be willing and ready to take risks by adopting new innovative technologies that can increase their production efficiency.
- Broiler agriprenuers should be enjoined to form or participate in existing and functional social association in order to explore pecuniary advantages inherent in these societies.
- Also, the machinery of gender sensitization encouraging women to partake in broiler enterprise should be in motion in order to ease them out of the vicious cycle of poverty, because they are the most victims of economic woes due cultural and religious conditions.

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