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Total factor productivity (TFP) of productive resources used in homestead poultry broiler farms in Niger State of Nigeria

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ABSTRACT

The present research measured the total factor productivity (TFP) of productive resources used in homestead poultry broiler farms in Niger State of Nigeria, using structured questionnaire complemented with interview schedule to collect cross-sectional data from a drawn sample size of 97 active broiler producers *via* multi-stage sampling design. The data analyses were performed using

descriptive and inferential statistics. Findings from the study showed evidence of productive labour force in the enterprise, literate farming population with sustainable household size typical of African agrarian setting. The enterprise was found to be profitable in the studied area. Furthermore, findings showed that marginally above the sampling population were productive in the utilization of their input resources which may be due to technical awareness of the modern poultry management techniques in the studied area. Thereafter, it was observed that gender status, experience, capital source and operational capital were the factors undermining farmers TFP. Therefore, study recommended gender sensitization and the need for public private partnership synergy to explore the untapped potentials in this sub-sector in the studied as almost half of the farmers were found not to be productive in the utilization of their resources.

Keywords: TFP; Resources; Poultry; Homestead; Nigeria

1. INTRODUCTION

According to FAO as reported by Sahel (2014), growing populations, economies and incomes are fuelling an ongoing trend towards higher consumption of animal protein in developing countries. FAO forecasted that Nigerians are expected to consume two thirds more of animal protein, with meat consumption rising nearly by 73%. As at 2013, the estimated worth of Nigerian poultry industry which comprised of approximately 165 million birds which produced 650,000 metric tonnes of eggs and 290,000 metric tonnes of poultry meat stood at ₦80 billion ($600 million). The sector has been receiving continuous support and attention from policy makers. In the year 2003, the Federal government banned the importation of Chicken importation (with the exception of day-old-chicks), thus, spurring growth in domestic poultry production.

Statistics have shown that the total production of poultry chicken product has been exhibiting cyclical trend from the year 2009 till date with the changes been attributed to increase in plant size and not productivity which remained stagnant over the past four to five decades (FAO, 2016). However, statistics highlighted that between 2009 and 2011 over 3 million metric tonnes worth of poultry products were imported into the Republic of Benin, with the preponderance of these products ending up in the Nigerian market (Sahel, 2014). If this is reflected in overall assumptions, estimated poultry meat consumption in Nigeria is approximately 1.2 million metric tonnes. This implies inadequacy in the present production and supply chain of poultry products. However, previous studies have shown that increase in livestock production in Nigeria was propelled by average expansion rather than higher intensification and productivity of resources (Olayide, 1976; Eze *et al*., 2012).

In spite of these challenges, an annual growth of 20% in the poultry industry between 2010-2020 which will be driven by rapid growing middle class and the country's large population has been projected by analysts (Sahel, 2014). Despite the fact that the country's poultry industry is extremely fragmented with most of the birds been raised in 'backyards' or on poultry farms with less than 1,000 birds, the number of researches been conducted has demonstrated the importance of the sub-sector to the economy of the country.

In order to make the sub-sector vibrant and secure a lead in the market, there is need to address the challenge of total factor productivity (TFP) of poultry producers in the country. In lieu of the aforementioned, Niger state was chosen as a pilot site for this research given the cost constraints of the researchers. The TFP, as a measure of overall productivity, has gained recognition not only for its theoretical correctness, but also for its peculiarity among policy makers and economic analyst, as TFP provides the society with an opportunity to increase the society welfare. The broad objective was to determine the TFP of broiler farmers in the studied area, while the specific objectives were to describe the socio-economic profile of the broiler producers; to estimate the costs and incomes of poultry enterprise in the studied area; to determine the TFP and the factors influencing TFP of broiler producers; and, to identify and x-ray the problems affecting poultry enterprise in the studied area.

2. RESEARCH METHODOLOGY

The study was conducted in Niger state of Nigeria, and the coordinates of the state are latitudes 8°20'N and 11°30'N of equator and longitudes 3°30'E and 7°20'E of the Greenwich Meridian time. The vegetation of the state is northern guinea savannah with sparse of southern guinea savannah. Agriculture is the major occupation in the study area complemented with civil service jobs, artisanal, craft work, *Ayurveda* medicine and petty trade. The research relied on cross sectional data obtained from 97 active homestead poultry broiler farms drawn from the studied area sampling frame using multi-stage sampling design. The sampling procedure were: convenient selection of Kuta agricultural zone out of the 3 existing agricultural zones in the state due to time and costs constraints of the researchers; purposive selection of two Local Government Areas (LGAs) *viz*. Chanchaga and Bosso due to high density of

poultry entrepreneurs coupled with readily available demand driven-market; proportionate sampling of 50% of the respondents across the board of the selected LGAs in the sampling frame provided by NSAMDA; and, a representative sample size of 97 active broiler farmers using simple random technique were drawn for the study. The data were elicited using structured questionnaire complemented with interview schedule on fortnight basis during the 2016 production period. The collected data were analyzed using descriptive and inferential statistics. The first and last, second and third objectives were achieved using descriptive statistics, cost concepts and income measures; and, the conventional approach of measuring TFP developed by Key and Macbride (2003) and the Tobit regression model.

Table 1 Sampling frame of active poultry broiler producers

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

Source: NAMDA, 2016

Empirical models

Cost concepts and Income measures

Following Subba *et al*. (2004; 2016) the cost concepts and income measures are specified below:

a. Cost Concepts: Costs related to broiler production are split up into various cost concepts such as A_1, A_2, B, C and D

Opportunity/Implicit cost: costs of self-owned and self-employed resource i.e. imputed cost

Accounting/Explicit cost: costs for purchasing and hiring of inputs and input services i.e. paid out costs/cash costs/ nominal/money cost

Economic cost: Opportunity cost + Accounting cost

Cost A_1: The following items are included in Cost A_1

Wages of hired labour

Market rate of feeds

Market rate of brooding stocks, liter, H_2O, kerosene etc

Electricity tariff

Market value of drugs and vaccines

Land revenue, cess and other tax

Depreciation on farm implements/equipment's

Interest on working capital

Miscellaneous expenses

Cost A_2: Cost A_1 + rent paid for leased in land

Cost B: Cost A_1 or A_2 + interest on fixed capital excluding land + rental value of owned land

Cost C: Cost B + imputed value of family labour

Cost D: Cost C + 10% of TVC as management cost (Sidharth and Pankaj, 2012)

b. Income Measures

These are the returns over different cost concepts. Different income measures are derived using the cost concepts. These measures are given below:

Farm business income = Gross income – Cost A_1 or A_2 ..... (1)

Family labour income = Gross income – Cost B ..... (2)

Net income = Gross income – Cost D ..... (3)

Farm investment income = Farm business income – Imputed value of family labour – Imputed management cost (OR) Net income + Imputed rental value of owned land

Return on Naira invested (ROI) = $\frac{\text{Gross margin}}{\text{Total variable cost}}$ ..... (4)

Rate of return on capital invested (RORCI) = $\frac{Net\ farm\ income}{Total\ cost}$ ..... (5)

Note: Unit of plant = 200 birds (Subba *et al*., 2004; 2016)

Plant = Enterprise (Sidharth and Pankaj, 2012)

Total factor productivity (TFP)

Following Key and Macbride (2003) the TFP approach adopted is given below:

$TFP = \frac{Y}{TVC}$ ..... (6)

$TFP = \frac{Y}{\sum P_i X_i}$ ..... (7)

Where, Y is output quantity (kg), TVC is total variable cost, P_i is the unit price of ith variable input and X_i is the quantity of ith variable input. This methodology neglect the TFC as it does not affect the both the profit maximization and the resource use efficiency conditions as the study focused on small scale farmers. Total fixed cost is constant as it is sunk.

From cost theory:

$AVC = {}^{TVC}/_{Y}$ ..... (8)

Where, AVC is average variable cost in Naira (₦). Therefore, the transpose of AVC will be TFP:

$TFP = \frac{Y}{TVC} = \frac{1}{AVC}$ ..... (9)

As such, TFP is the inverse of the AVC. The partial productivity estimate is the marginal product given as MP = $\Delta TFP/\Delta X$

Tobit model

The original Tobit model developed by James Tobin a Nobel laureate economist (Tobin, 1958) was adopted for this study and it is given below:

$Y_i^* = \alpha + X\beta + \varepsilon_i$ ..... (10)

Where Y_i* is censored variable. Now

$Y_i = 0$ *if* $Y_i^* \leq 0$

$= Y_i^*$ *if* $Y_i^* > 0$

$Y_i^* = \alpha_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 \ldots\ldots\ldots\ldots\ldots\ldots + \beta_n X_n + \varepsilon_t$ ..... (11)

Where:

Y_i* = TFP index of i^{th} farmer

X_1 = Gender (male =1, female = 0)

X_2 = Marital status (married =1, otherwise = 0)

X_3 = Age (year)

X_4 = Household size (number)

X_5 = Educational level (year)

X_6 = Farming Experience (year)

X_7 = Farm ownership (yes =1, otherwise = 0)

X_8 = Main occupation (farming =1, otherwise = 0)

X_9 = source of capital (own saving = 1, otherwise = 0)

X_{10} = Access to credit (yes =1, otherwise = 0)

X_{11} = Extension contact (yes = 1, otherwise = 0)

X_{12} = Co-operative membership (yes = 1, otherwise = 0)

X_{13} = Farm location (urban =1, otherwise = 0)

X_{14} = Disease outbreak (yes =1, otherwise = 0)

X_{15} = Family labour (manhour)

X_{16} = Hired labour (manhour)

X_{17} = Medication (kg)

X_{18} = Liter (kg)

X_{19} = H_2O (litre)

X_{20} = Kerosene (litre)

X_{21} = Electricity (kW/hr)

X_{22} = Feeds (kg)

X_{23} = Chicks density (kg)

X_{24} = Income (₦)

α = Intercept
β_{1-n} = Parameter estimates
ε_i = Error term

Kendall's Coefficient of Concordance (W)

Following Sadiq *et al.*(2017) the Kendall's coefficient of concordance developed by Kendall and Smith (1939) and Wallis (1939) is given below:

$$W = \frac{12S}{k2n\,(n2-1) - kT} \quad \text{..... (12)}$$

Where;
S = Sum over all subjects
k = Number of respondents ranking the attributes or objects
n = Number of attributes or objects that is evaluated by respondents
T = Tie-correction factor

$$T = \sum (t_k^3 - t_k) \quad \text{..... (13)}$$

't_k' is the number of tied ranks in each (k) of g groups of ties. The sum is computed over all groups of ties found in all m variables of the data table. T is 0 when there are no tied values.

The Chi^2 (χ^2) statistic is given as follow:

$$\chi^2 = k\,(n-1)\,W \quad \text{..... (14)}$$

Where;
k = Number of respondents
n = Number of objects or attributes being ranked
W = Kendall's coefficient of concordance (KCC)

Friedman's Chi-square Statistic

The Friedman's Chi-square statistic is given below (Friedman, 1937):

$$\chi^2_r = k\,(n-1)\,W \quad \text{..... (15)}$$

Where;
χ^2_r = Friedman's chi^2 statistic
k = Number of respondents
n = Number of objects or attributes being ranked
W = Kendall's coefficient of concordance (KCC)

The mean benchmark for constraint assessment

In order to have better insights of the constraints the assessment mean model adopted by Aydin and Tasci (2005) as reported by Purnomo and Lee (2010). The mean of 3.25 was determined after identifying the critical level: 2.5 plus (3 interval/4 categories = 0.75)

Average Variance extraction (AVE) and Composite Reliability (CR)

The AVE formula suggested by Hair *et al.* (1998) is given below:

$$\boldsymbol{AVE} = \frac{(\sum_{i=1}^{n} \lambda_i^2)}{(\sum_{i=1}^{n} \lambda_i^2) + (\sum_{i=1}^{n} \delta_i)} \quad \text{..... (16)}$$

The formula for calculating composite reliability is specified as follow:

$$\boldsymbol{CR} = \frac{(\sum_{i}^{n} \lambda_i)2}{(\sum_{i}^{n} \lambda_i)2 + (\sum_{i=1}^{n} \delta_i)} \quad \text{..... (17)}$$

Where λ is the standardized factor loadings and δ is indicator measurement error.

3. RESULTS AND DISCUSSION

Socio-economic profile of the broiler farmers in the studied area

Shown in Table 2 are the socio-economic profiles of the poultry broiler farmers in the studied area. The results showed that most of the labour force that participated in the enterprise were active and economic virile; they maintain fair family size typical to African setting and have few years of poultry management experience as indicated by the mean age of 35.22 $\pm$ 7.34; mean family size of 7 $\pm$ 3.9 and mean experience of 5 $\pm$ 4.2, respectively. Female farmers' participation in the enterprise was very marginal when compared

to their male counterpart which may be attributed to economic and religion constraints; and married people were the majority in the sampling population that relied on the enterprise for livelihood sustenance. The literacy level of the farming population was very high, majority possessed title of ownership i.e. owned the farmers they raised their birds in and few were full-time poultry entrepreneurs. The farmers' access to credit, extension contacts and social participation were found to be very poor and most of the farmers used their own savings as the capital for the poultry investment during the period of study. A slight difference in the results was observed between the number of farms located in the rural and urban area and most of the farms were affected by outbreak of poultry diseases during the period of study. With the exception of source of capital, discrepancies were observed in the distribution proportion of each of the socio-economic characteristics considered as evident by their chi^2 statistics probability levels which were different from zero at 10% probability level.

Table 2 Socio-economic profile of the broiler farmers

Variables	Frequency	Percentage	Variables	Frequency	Percentage
Age			**Total**	**97**	**100** $[38.36^{***}]$
≤ 19	1	1.0	**Occupation**		
20-29	27	27.8	Farmer	26	26.8
30-39	39	40.2	Farmer Artisanal	38	39.2
40-49	28	28.9	Farmer/Civil servant (CS)	5	5.2
50-59	2	2.1	Farmer/Artisanal/CS	28	28.9
Total	**97** (35.22 ± 7.3)	**100** $[59.65^{***}]$	**Total**	**97**	**100** $[23.78^{***}]$
Household size			**Access to credit**		
≤ 3	8	8.2	Yes	17	17.5
4-6	52	53.6	No	80	82.5
7-9	25	25.8	**Total**	**97**	**100** $[40.92^{***}]$
≥ 10	12	12.4	**Extension contact**		
Total	**97** (6.8 ± 3.9)	**100** $[48.86^{***}]$	Yes	31	32
Experience			No	66	68
≤ 3	49	50.5	**Total**	**97**	**100** $[12.63^{***}]$
4-6	25	25.8	**Social participation**		
7-9	9	9.3	Yes	22	22.7
≥ 10	14	14.4	No	75	77.3
Total	**97** (4.9 ± 4.17)	**100** $[39.21^{***}]$	**Total**	**97**	**100** $[28.96^{***}]$
Gender			**Farm location**		
Male	84	13.4	Urban	47	48.5
Female	13	86.6	Rural	50	51.5
Total	**97**	**100** $[51.97^{***}]$	**Total**	**97**	**100** $[0.09^{NS}]$
Marital status			**Disease outbreak**		
Married	73	75.3	Yes	70	72.2
Single	24	24.7	No	27	27.8
Total	**97**	**100** $[142.79^{***}]$	**Total**	**97**	**100** $[19.06^{***}]$
Education			**Source of capital**		
Non-formal	16	16.5	Own savings	92	94.8
Formal	81	83.5	Formal credit	5	5.2
Total	**97**	**100** $[43.56^{***}]$	Total	97	100 $[78.03^{***}]$
Farm ownership					
Owned	79	81.4			
Rented	18	18.6			

Source: Field survey, 2016 Note: *** NS; are 1% risk level and Non-significant; while values in ( ); [ ] are mean and standard error; and, Chi^2 respectively

Cost concepts and income measures of poultry broiler enterprise in the studied area

The poultry farmers, like any other entrepreneurs, would be interested in the profitability of the farm enterprise, and for this purpose efforts were made to estimate the cost incurred and the accrued revenue to the farmers' efforts.

Presented in Table 3 are the cost concepts and income measures of poultry broiler enterprise in the studied area. The disaggregation figures showed the incurred economic and accounting costs of an enterprise to be ₦225774.20 and ₦163461.80 respectively; and the accrued accounting revenue of ₦307327.40. The proportion of incurred total economic variable cost (TEVC) and total economic fixed cost (TEFC) in the economic cost of an enterprise were 53.70% and 46.30% respectively; while the proportion of incurred total accounting variable cost (TAVC) and total accounting fixed cost (TAFC) in the accounting cost of an enterprise were 58.25% and 41.75% respectively.

Table 3 Cost concepts and income measures of broiler enterprise

Items	Quantity	Unit price (₦)	Amount (₦)	Items	Amount (₦)
Variable costs				Total fixed accounting cost	68252.06
Family labour	52.13 manhours	200	10426.29	Total accounting cost	163461.80
Hired labour	26.45 manhours	200	5289.92	Total variable economic cost	121236.10
chicks	239.64	204.64	49040.33	Total fixed economic cost	104538.10
Feeds	135.87 kg	113.36	15402.17	Total economic cost	225774.20
Liter	1577.37 kg	10	15773.66	Cost A_1	154899.40
H2O	46.36 litres	1	46.36	Cost A_2	179061.80
Kerosene	6.48 litres	150	971.55	Cost B	203224.30
Electricity	230.32 kw/hr	14	3224.43	Cost C	213650.50
Drugs	1.94 kg	800	1552.93	Cost D	225774.2
Vaccines	-	-	3036.45	**Income measures**	
Veterinary services	-	-	872	Implicit revenue	-
IV of interest on working capital	12 % @ 130000	-	15600	Explicit revenue	307327.40
Total variable cost (TVC)			**121236.10**	Economic revenue	307327.40
Fixed costs				Accounting gross margin	212117.60
Depreciation on capital items			44089.65	Accounting net farm income	143865.50
Economic rent (lease-in)			24162.40	AROI	2.23
Imputed economic rent (owned land)			24162.40	ARORCI	0.88
Imputed managerial cost	10% of TVC		12123.61	Account cost of production	817.31
Total fixed cost (TFC)			**104538.10**	Farm business income	128265.50
Total cost (TC)			**225774.20**	Family labour income	104103.10
Returns				Economic gross margin	186091.30
Manure quantity	732.74 kg	10	7327.37	Economic net farm income	81553.21
Broiler quantity	200 birds	1500	300000	Farm investment income	117839.20

Total revenue (TR)			**307327.40**	EROI	1.54
Cost concepts				ERORCI	0.36
Total variable opportunity cost			26026.29	Economic cost of production	1128.87
Total fixed opportunity cost			36286.01		
Total opportunity cost			62312.30		
Total variable accounting cost			95209.79		

Source: Field survey, 2016 Note: IV means Imputed value

Furthermore, the profitability decomposition figures revealed an economic gross margin cum net farm income of ₦186091.30 and ₦81553.21 respectively, while the accounting gross margin cum net farm income were ₦212117.60 and ₦143865.50 respectively. The economic and accounting ROIs were 1.54 and 2.23 respectively, implying that for every ₦1 invested in the enterprise, the invested ₦1 was returned, and an economic and accounting profit of ₦0.54kobos and ₦1.85kobos respectively, were gained. This profit margin should stimulate financing from the lending institutions because if poultry farmers in the studied area are funded with ₦130000 at commercial interest rate of 12%, the farmer will return the principal of ₦130000, an interest rate of ₦15600 and still retain ₦161727.40. Therefore, at the enterprise level, it can be concluded that poultry farming is a profitable venture in the studied area because of the remunerative or considerable profit margin. The rate of return per unit of capital invested (RORCI) which indicates what is earned by the business through capital outlay revealed an economic RORCI (36%) and accounting RORCI (88%) that were greater than the prevailing commercial bank lending rate of 12%, implying that if a poultry broiler entrepreneur takes a loan from the bank to finance poultry enterprise, in respect of economic and accounting RORCIs, he/her will be 24% and 76% respectively better off on every one naira spent after paying the loan at the prevailing interest rate.

Measurement of broiler farmers TFP and factors determining TFP

The summary statistics of the TFP showed that most (48.5%) of the farmers were not productivity as their TFP indexes were below the optimal scale, an indication of poor input mix allocation in the production process (Table 4a). Only 20.62% of the farmers were found to be optimally productivity as their TFP indexes hovers around the optimal scale. Though, these set of farmers were productive, but their output index was just marginally higher than the input index. Furthermore, 30.91% of the broiler farmers fall within the super-optimal category, an indication of high productivity. In addition, it depict how super efficient these farmers were in the utilization of their input mix which yielded high broiler output in their respective farms. It can be inferred that marginal above average of the farming population were productive in the utilization of their productive resources.

Table 4a Distribution of TFP index of broiler farmers in the studied area

TFP Index	Frequency	Percentage
Sub-optimal (< 1.00)	47	48.5
Optimal (1.00 – 1.09)	20	20.62
Super-optimal (≥ 1.10)	30	30.91
Total	**97**	**100**
Mean	**0.981**	
Minimum	**0.219**	
Maximum	**2.504**	
SD	**0.301**	
CV	**0.307**	

Source: Field survey, 2016

Table 4b Factors determining TFP of broiler farmers in the studied area

Variables	Coefficients (MPP)	Standard error	t-stat	VIF
Constant	-0.00134	0.00093	1.445^{NS}	-
Gender	-0.00047	0.00026	1.757*	1.478
Marital status	-7.3613E-05	0.00019	0.395^{NS}	2.162
Age	1.70402E-05	1.3883E-05	1.227^{NS}	2.795
Household size	-1.8302E-05	2.24005E-05	0.817^{NS}	1.916
Education	0.000175	0.00026	0.680^{NS}	1.563
Experience	-4.00156E-05	2.1409E-05	1.869*	2.861
Farm ownership	0.000229	0.00021	1.111^{NS}	1.520
Occupation	0.000112	0.00017	0.661^{NS}	1.523
Source of capital	0.000542	0.00031	1.750*	1.941
Access to credit	-0.000137	0.00020	0.676^{NS}	1.967
Extension contact	0.000115	0.00018	0.643^{NS}	1.396
Co-operative mem.	9.0009E-05	0.00022	0.407^{NS}	1.460
Farm location	4.8116E-05	0.00013	0.361^{NS}	1.590
Disease outbreak	7.6899E-05	0.00016	0.477^{NS}	1.630
Family labour	6.2601E-07	1.41257E-06	0.443^{NS}	1.673
Hired labour	-8.3846E-06	5.06618E-06	1.655*	1.389
Medication	-5.7225E-05	2.26372E-05	2.528**	1.387
Liter	-1.6943E-08	1.00534E-08	1.685*	2.733
H_2O	8.8348E-06	2.21623E-06	3.986***	1.401
Kerosene	6.5238E-06	3.18883E-05	2.046**	1.252
Electricity	-1.0663E-06	6.33623E-07	1.683*	1.892
Feeds	3.2339E-06	1.26741E-06	2.552**	1.791
Income	0.000121	6.25815E-05	1.926*	1.893
Chicks density	-4.8632E-07	1.70127E-07	2.859***	1.705
LR chi^2	355.24***			
Normality test			41.99***	

Source: Field survey, 2016

Shown in Table 4b are the MLE determinants of total factor productivity (TFP) of broiler farms in the studied area. The significance of the LR chi^2 at 1% degree of freedom implies that the parameter estimates were different from zero at 10% probability level, and the model is best fit for the specified equation. In addition, the multicollinearity test exonerated the explanatory variables from the problem of collinear relationship as established by their respective variance inflation factors (VIF) which were less than 10.00 VIF benchmark value. However, the test for normality of the residuals showed abnormal skew in the distribution of the error terms as evidenced from the probability value of t-statistic value (42.00) which is different from 10% risk level. Though, non-normality is not considered a serious problem given that data are not normally distributed in most situations. The socio-economic variables and production inputs found to have significant influence on TFP were gender, experience, source of capital and income; and, chick density, feeds, hired labour, medication, liter, electricity, H_2O and kerosene, respectively. The marginal implications of a unit increase in experience and being a female broiler farmer; and, a unit increase in income level and using owned/equity capital would decrease TFP by 0.00004 and 0.00047; and, would increase TFP by 0.00012 and 0.00054, respectively. In most cases experienced farmers are conservative when compared to young ones who are innovative, and they would likely stick to the archaic poultry management system, thus affecting their TFP. Also, experienced farmers are found of exhibiting complacency thereby jettisoning innovative poultry management techniques. In addition, experienced farmers hardly devote time supervising their farms as after series of achievements in the enterprise they diverse most of their attention/commitment to profitable new enterprise(s) (mostly fish farming), hence, affecting their efficiency in optimizing TFP. Limited access of female farmers to productive resources

due to religion and cultural barriers rear its negative consequences on female broiler farmers in optimizing their TFP. Farmers whose investment is their equity capital would be judicious in the utilization and protection of their equity to optimize TFP (profit maximization) as there is no insurance for loss of their economic capital. Additional increase in the stream of farmers income level would encourage farmers to deferred their present consumption by invest more in the poultry enterprise in anticipation for higher future returns, thus increasing the TFP efficiency.

The marginal implications of unit increase in the utilization of feeds, H_2O and kerosene would decrease the broiler TFP by 3.23E-06, 8.84E-06 and 6.52E-05 respectively, an indication of marginal efficiency in the utilization of the aforementioned inputs. However, the marginal implications of unit increase in the stock density of chicks, use of hired labour, liter, medication and electricity would decrease broiler TFP by 4.86E-07, 8.38E-06, 1.69E-08, 5.72E-05 and 1.07E-06 respectively, an indication of marginal inefficiency in the utilization of these productive resources.

Constraints of broiler farmers in the studied area

A cursory review of the results identified five problems *viz.* epileptic power supply, high cost of housing, high cost of feeds, capital paucity and high cost of brooding stocks, to be the very severe constraints affecting poultry broiler production in the studied area as their mean scores exceeded the severe benchmark score of 3.25. The remaining identified constraints were not a major threat as their mean score values were below the benchmark score. In descending order the major constraints received rank 1st to 5th while the minor constraints received rank 6th to 11th. The grand mean value indicated that the respondents have strong perception on the identified major problems as the barriers affecting poultry enterprise in the studied area. In addition, 87.37% of the sampling population chose the first five problems as the major problems affecting their poultry enterprises. With respect to the ranking, the significant estimated KCC value of 0.728 indicated strong agreement among the respondents with respect to this ranking (Table 5a).
To find the common factors affecting poultry farm in the studied area, the 11 identified constraints were subjected to factor analysis (Table 5a).The empirical result showed that the sample size achieved good sampling adequacy as evidenced from the KMO test value of 0.718 and the Bartlett's test of Sphericity which indicated that non-zero correlations exist at 1% significance level i.e. the correlation matrix is not an identity matrix. The latent criterion results indicated that the 11 variables subjected to the exploratory factor analysis should be extracted to form four dimensions as their Eigen-values were greater than the cut-off criterion value of 1 considered satisfactory in social sciences (Hair *et al.*, 2006 as cited by Sadiq *et al.*, 2017), and in addition they accounted for 66.87% of the variation in the data. The estimated Conbach's Alpha test value across the four factors were greater than the cut-off point of 0.60 suggested by Churchill (1979) to be appropriate for exploratory research, hence, an indication of high internal consistency and reliability of the poultry constraint scales. According to Francis *et al.*(2000), the behaviour of individual items in relation to others within the same factor provides confirmation of content validity because the highest factor loading is central to the domains assessed by these factors. These evidences proved the appropriateness of the sample for the multivariate analysis. The respective factor loadings of the extracted factors exclude those whose absolute loading values were less than 0.40. The extracted four factors were christened market barrier (F1), institutional barrier (F2), sanitary barrier (F3) and management barrier (F4).

Table 5a Constraints affecting broiler farmers in the studied area

Constraints	Mean	Market barrier (F1)	Institutional barrier (F2)	Sanitary barrier (F3)	Management barrier (F4)
Paucity of capital	3.36 (4th)	**0.759**			
Cost of housing	3.58 (2nd)	**0.738**			
High labour cost	3.18 (8th)	**0.702**			
High feed cost	3.52 (3rd)	0.695			
High cost of brooding stock	3.32 (5th)	0.513			
Inadequate veterinary service	2.19 (13th)		0.847		
Inadequate extension service	2.28 (11th)		0.843		
Mortality rate	2.62 (10th)			0.812	
Pest and diseases	2.23 (12th)			0.783	
Poor production management	2.74 (9th)				0.807
Epileptic power supply	3.59 (1st)				0.711
Expected mean $(\overline{X})$	**3.25 (7th)**				
Kendall's coefficient (KCC)	**0.728**				

Chi2 (χ^2)	**618.01*** **				
Friedman's Chi2 (χ^2)	**618.01*** **				
Eigen-value		**2.719**	**2.203**	**1.273**	**1.160**
% of variance		**24.72**	**20.03**	**11.57**	**10.55**
Cronbach's Alpha		**0.719**	**0.821**	**0.601**	**0.650**
Kaiser-Meyer-Olkin test	**0.718**				
Bartlett's Test of Sphericity (χ^2)	**281.92*** **				

Source: Field survey, 2016

The first factor christened "market barrier" with an Eigen-value of 2.72; highly loaded on capital paucity, high cost of housing, high labour cost, high feed cost and high cost of brooding stocks; and explained 24.72 % variance, showed the farmers concern on poor market outlet for broiler product, thus, the need for efficient market which would guarantee them remunerative prices for their output. The second factor, christened "institutional barrier" had an Eigen-value of 2.20, accounted for 20.03% variance and highly loaded on poor veterinary and extension service delivery, displayed farmers concern on inaccessibility and inadequacy of technical support from the government institution in the studied area. The third factor christened "sanitary barrier" which captured mortality rate and pest and diseases outbreak, with an Eigen-value of 1.27 and 11.57% explained variance, showed farmers' apprehension on poor sanitary measures which can likely wipe out their farms, thus, a call for frequent quarantine to curtail these disasters/menaces. The last factor christened "management barrier" loaded on poor production management and epileptic power supply with an Eigen-value of 1.16 and accounted for 10.55% of variation, showed farmers concern on management ineptitude and call for overhauling of agribusiness policies in order to sustain poultry sub-sector in the studied area.

Since the measurement model has acceptable fits, the four-factor construct with their respective indicators were used to estimate CFA. In addition, unidimensionality was achieved as evidenced from the small size of the modification indices and estimated residuals. A perusal of Table 5b showed all the criteria of goodness of fit statistics and other measures of statistics to be acceptable for the CFA structural equation model. It is worth to note that one could ignore the absolute fit index of minimum discrepancy Chi^2 if the sample size is greater than 200 (Hair *et al.*, 1998; Jöreskog and Sörbom, 1984).

Table 5b CFA Goodness of fit statistics

Category	Fit statistic	Value	Acceptance level	
Absolute fit	Discrepancy Chi^2 (χ^2)	0.1423	> 0.05	Wheaton *et al.*(1977); Bentler (1989)
	RMSEA	0.053	< 0.08[a] or 0.10[b]	Browne and Cudeck (1993)[a]; Hair *et al.*(1998)[b]
	GFI	0.933	> 0.90	Joreskog and sorbom (1984)
Incremental fit	AGFI	0.853	> 0.80	Henry and Stone (1994); Scott (1994)
	CFI	0.965	> 0.90	Bentler (1990)
	NFI	0.983	> 0.90	Bollen (1989); Bentler and Bonett (1980)
	TLI/NNFI	0.939	> 0.90	Bentler and Bonett (1980)
	IFI	0.969	> 0.90	-
	RFI	0.766	-	-
	SRMR	0.0798	< 0.10	-
	PNFI	0.438	-	-
Parsimonious fit	χ^2/df	29.71	< 3.0	Marsh and Hocevar (1985)

Source: SEM computer print-out

Note: *RMSEA = Root mean squared error of approximation; GFI = Goodness-of-fit index; AGFI = Adjusted goodness-of-fit index; CFI = Comparative fit index; NFI = Normed fit index; TLI = Tucker-Lewis index; NNFI = Non-Normed fit index; IFI = Incremental fit index; SRMR = Standardized root mean square error residual; and, PNFI = Parsimony adjusted NFI*

A cursory review of the convergent validity showed all the constructs to have good convergent validity as each indicator of the construct factor loadings (CFL) exceeds 0.50 with their respective factor loadings as reflective indicators exceeding 0.60. The average variance extraction (AVE) ranged from 0.50 to 0.88, while the composite reliability (CR) ranged from 0.67 to 0.94. The results of the discriminant validity showed each AVE construct to be higher than its squared correlation with other constructs. The empirical results showed that the factor loadings of Factor 1, 2, 3, and 4 accounted for 73%, 65%, 77% and 82% of the average variance in the market, institutional, sanitary and managerial barriers respectively. Therefore, relying on these results we can conclude that the measurement model exhibits a high degree of convergent and discriminant validities (Table 5c).

Table 5c CFA for convergent and discriminant validity of constraints

Construct	CFL	AVE	CR	Factor correlations			
				F1	F2	F3	F4
Market (F1)	0.719	0.70	0.92	**0.84**			
Institutional (F2)	0.821	0.78	0.92	0.160	**0.88**		
Sanitary (F3)	0.601	0.88	0.94	0.182	0.009	**0.94**	
Management (F4)	0.650	0.50	0.67	1.719	1.184	0.371	**0.71**

Source: SEM computer print-out

Note: *All items loading in CFA were significant at P < 0.001 level. The diagonal values are the square roots for each construct*

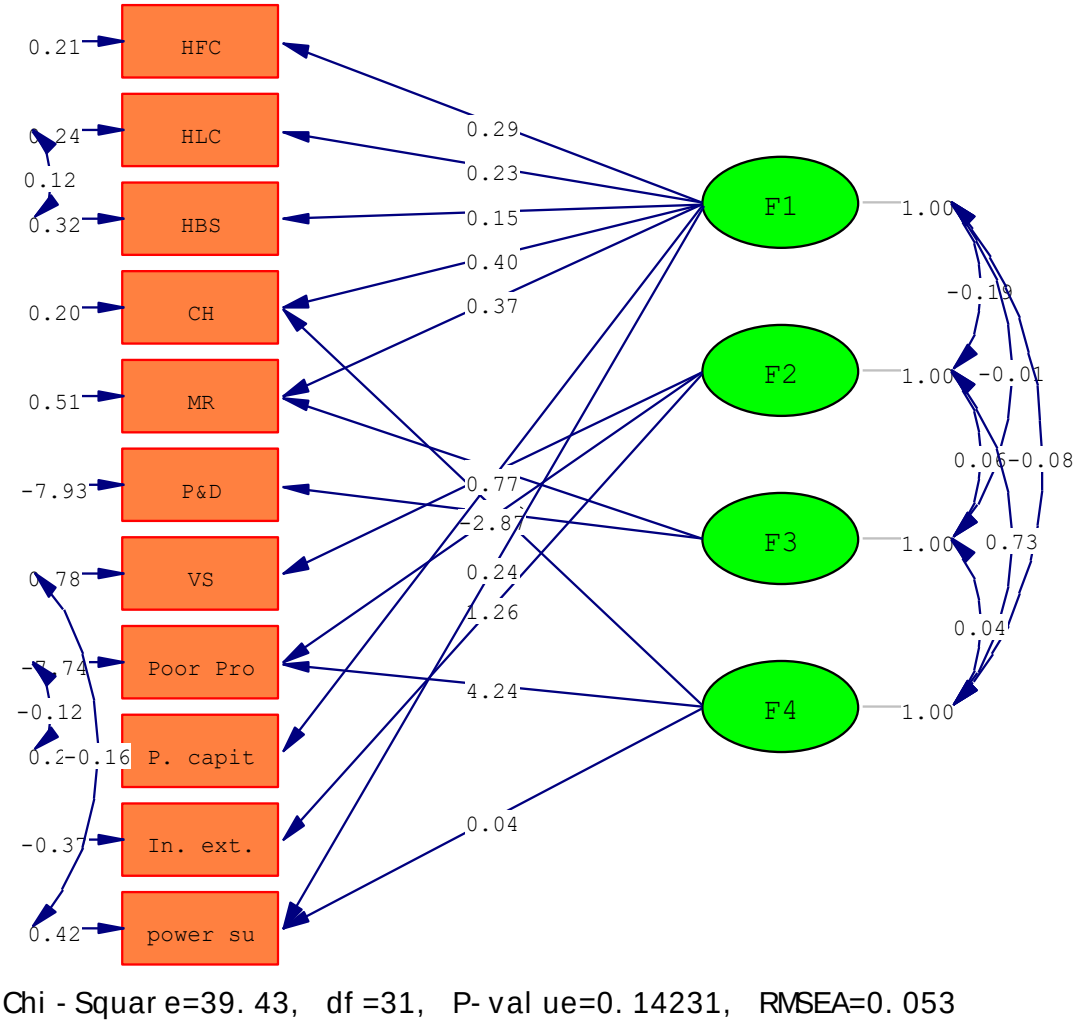

Figure 1 Path diagram of CFA

The path analysis was used to estimate simultaneously the processes of the influence of the variables on others, direct, indirect and total effects of the variables (Figure 1). The results showed that each latent variable has a direct effect on the items loaded on them. The latent variables *viz.* market restraint and institutional restraint has correlation likewise the latter have correlation with sanitary barrier and managerial restraint.

4. CONCLUSIONS AND RECOMMENDATIONS

The farming population was economically virile and literate, possessed fair household size and most of the farm they operated on is there personal asset. However, they are faced with limitation of access to credit, extension service delivery and poor social participation; and, the farming population is skewed towards male gender. The enterprise was found to be profitable. Barely above average of the sampled population were productive in the use of their resources as their productivity was found to range between optimal and super optimal levels i.e. equal or above the TFP index frontier scale which may be due technical awareness of the modern poultry management techniques in the studied area. Though, the empirical identified issues causing inefficiency in the farmers' productivity were gender, experience, capital source, chick density, hired labour, medication, liter and electricity consumption. Based on the above scenario, the following recommendations were made:

- Tacit sensitization of the community leaders on the active role of women in agricultural enhancement and the successes so far recorded in other parts of the country should be brought to bear so that more women in the studied area will be able to participate in poultry enterprise, thus, easing them out of the vicious cycle of poverty.
- The mechanism of public-private partnership should be put in place in order to make this sub-sector more vibrant and sustainable in the studied area and the state in general.
- Extension agents need to educate farmers more on the technical know-how of poultry management so that the almost half of the leftover farmers can optimize their productivity by enhancing their efficiency in the allocation of their productive resources in the studied area.

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