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Allocative Efficiency and Returns to Scale among Fadama II Broiler Farmers in Imo State, Nigeria

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Abstract
This study investigated the efficiency of resource use and Returns to Scale among broiler farmers in Imo State. Data were collected through a multi-stage sampling from 50 broiler farmers in the State with the aid of structured questionnaire. Data collected were analyzed using descriptive statistics, Efficiency Index, Elasticity of Production technique and the Ordinary Least Square Regression model. The results from this study showed that 68% of the respondents engaged in farming as their primary occupation with mean age of 47.1 years and mean farm size of 563 birds. The farmers made an average Net Revenue of ₦291,192.10 with 66Kobo Return on Investment. Medication (significant at 1%), farm size (significant at 5%), feed and other inputs (significant at 1%) were the major factors affecting broiler output. The farmers operated at increasing Returns to Scale with 1.1408 Elasticity of Production (EP). It was concluded that broiler enterprise among the Fadama II farmers in Imo State is profitable but there is inefficiency in resource allocation. It was therefore recommended that the farmers either keep labour constant and increase their farm size or keep the farm size constant and decrease their use of labour input for increased profitability of their enterprises.
Keywords: Allocative efficiency, Returns to Scale, broiler production, Fadama II farmers

1. Introduction

The objective of resource management is to ensure efficient use of resource and to maximize resource productivity (Onyebinama, 2000). The main aim is to find ways of increasing output per unit of input and obtaining desirable inter-firm, intra-firm and inter-sector transfer of production resource in order to provide the means of raising our economic level (Awoke, 2003). There are distinctly two types of efficiency; technical and allocative. Markovits (2008) defines allocative efficiency as the type of economic efficiency in which the economy or producers produce only that type of goods and services which are more desirable in the society and also in high demand. Sullivan and Sheffrin (2003) defines technical efficiency as a means in which natural resources are transformed into goods and services without waste, that producers are doing the best job possible of combining resources to make goods and services. Technical efficiency is just one component of overall economic efficiency. In economics, the term economic efficiency refers to the use of resources so as to maximize the production of goods and services. An economic system is said to be more efficient than another (in relative terms) if it can provide more goods and services for the society without using more resources (Barr, 2004).

A more recent effort towards boosting production and enhancement of farmers' welfare is the introduction of the second National Fadama Development Project. This Fadama II project is a follow up to the phase I (one) equally funded by the World Bank between 1993 and 1999. The National Fadama Development Project (NFDP) was established to ensure all year round growing of crops in all the states of the federation through the exploitation of shallow aquifers and surface water potentials in each state using tubewells, wash bores and petrol-driven pumps technology (World Bank, 1992). The NFDP II came with a lot of innovations which include that the participation in the project was not limited to Fadama crop farmers, but extended to all users of Fadama resource pastoralists, fishers folks, hunters, gatherers, poultry farmers, service providers as well as vulnerable and marginalized groups (Imo State Fadama Development Project, 2007)

Optimum resource allocation for profit maximization is a major challenge facing farmers in Nigeria and in Imo State. According to Awoke and Okorji (2004), resource use in developing countries such as Nigeria is said to be faced with the problem of under-utilization of capacity which is associated with low returns. Ogunfowora et al. (1974) had earlier reported that resources were not efficiently allocated in small-scale farms because of traditional style of production. Okon (2005) blamed such inefficiency of resource use on the dominance of elderly men and women in our farms. High cost of labour, gender discrimination and emigration are factors which militate against efficient use of labour while non-availability of improved inputs, high cost of loan and rigorous processes of obtaining loans hamper efficient utilization of capital. This also conforms to the research

results of Gueye (1998) who reported that small–scale poultry farmers are regarded as security risk and financial institutions are usually unwilling to grant loans to them.

Fadama II poultry farmers use production resources to gain output. But their resource use performances are not yet well known especially among the broiler poultry farmers in Imo State. It therefore, becomes important to investigate the use of production resources among Fadama II poultry farmers and determine how efficiently these resources are used in Imo State, Nigeria.

2. Methodology

Imo State, one of the beneficiaries of Fadama II projects, is situated in the South east rainforest vegetation belt of Nigeria, between Longitudes $6^0 35'$E and $7^0 30'$E and Latitudes 4^0 and $6^0 35^1$ N (Areola et al., 1999). The selection of respondents was based on the adoption of multi-stage random sampling technique from a list of the Fadama II poultry farmers in the State. In the first stage, the three (3) agricultural zones were selected, and then a random sample of five (5) Fadama II participating Local Government Areas were selected, from the list of Fadama II poultry project Local Government Area's. Secondly, two Fadama Community Associations (FCA's) were selected randomly each from the five Local Government Areas of Fadama II project which gave a sample size of ten (10) Fadama Community Associations. Third Stage involved the random selection of five broiler farmers of the Fadama User Groups (FUGs) from the ten (10) Fadama Community Associations, which gave a sample size of fifty (50) broiler poultry Farmers. Primary data were collected using a set of structured questionnaire which was administered to the respondents. Data were collected on socio-economic characteristics of the farmers, input of feeds, medication, labour use, output size, farm size capital usage. Data analysis was done using descriptive statistics, efficiency index, elasticity of production technique and the ordinary least square regression.

$$\text{Factor Productivity} = \frac{\text{Total product}}{\text{Total input}} \quad \ldots(1)$$

The higher the value above 1, the greater the factor productivity.

$$\text{Net Profit} = TR - TC \quad \ldots(2)$$

Where TR = Total Revenue
TC = Total Cost

$$TC = TVC + TFC \quad \ldots(3)$$

The Allocative Efficiency formula is stated as follows:-

$$VMP_{xi} = P_{xi} \quad \text{or} \quad P_y f_i = Px_i \quad \ldots(4)$$

Where;
VMP_{xi} = Value of Marginal Product of the ith input
P_{xi} = Unit price of ith input
P_y = Unit output price
$f_i = \delta_y / \delta_x$ = Marginal Product (MP)

The Regression model is expressed as:

$$Y = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + \ldots + b_6 X_6 + e \quad \ldots(5)$$

Y = Output (₦)
X_1 = Labour (₦)
X_2 = Feed input (₦)
X_3 = Farm size (₦)
X_4 = Medication (₦)
X_5 = Other inputs (₦)
X_6 = Capital input (₦)
e = Stochastic error term

3. Results and discussion

Table 1 shows the socioeconomic characteristics of the Fadama II broiler farmers studied. These characteristics include their age, sex, level of education attainment, primary occupation, farm size and household size.

Table 1: Socioeconomic Characteristics of Fadama II Broiler Farmers

Variables	Frequency	Percentage
Age (Yrs) **Mean = 47.1**		
21 – 30	5	10
31 – 40	10	20
41 – 50	18	36
51 – 60	8	16
61 – 70	7	14
71 – 80	2	4
Sex		
Male	28	56
Female	22	44
Level of Education		
Primary	10	20
Secondary	16	32
Tertiary	24	48
Primary Occupation		
Farming	34	68
Civil service	9	18
Trading	3	6
Student	2	4
Artisan	2	4
Farm size (No. of Birds)		
101 – 200	2	4
201 – 300	2	4
301 – 400	5	10
401 – 500	13	26
501 – 600	9	18
601 – 700	7	4
701 – 800	2	4
801 – 900	5	10
901 – 1000	3	6
Mean = 563 birds		
Household size (Mean = 6)		
1 – 2	3	6
3 – 4	6	12
5 – 6	17	34
7 – 8	11	16
9 – 10	8	16

Source: Field Survey, 2013

The results from Table 1 shows that about 36% of the Fadama II farmers were found in the age range of 41-50 years showing that most broiler farmers are middle-aged, with mean age of 47.1 years. Also, majority (56%) of the farmers were males. Okoli et al. (2004) observed that the higher number of men in the business shows the fact that agro-livestock businesses are being used to supplement family income. Table 1 shows that all the respondents had formal education with a minimum level of secondary school education. The finding also showed that majority (48%) of the studied poultry farmers had tertiary education. This implies that the average Fadama II broiler poultry farmer is well educated, and as such is expected to be efficient in the production of broilers. Investigation into the major occupation and type of occupation showed that farming occupation took precedence (68%) over all other occupations among the respondents. The implication of having farming as major occupation among the respondents is that they are likely to make efficient use of production resources because they are paying full attention to the business. The farmers studied had a mean farm size of 563 birds and mean household size of 6 persons.

Costs and Returns Analysis

This is to establish whether the broiler poultry farmers were making profit or not in the broiler enterprise. Table 2 shows the average costs and returns (per production cycle) of Fadama II broiler poultry farmers in the study area.

Table 2: Average Costs and Returns of the Broiler Poultry Farmers per Production Cycle

Item	Unit Price (₦)	Amount (₦)
REVENUE		
Sales of birds	1,450.00	733,700.00
COSTS		
Variable Costs (VC)		
Labour/wage	11,404.22	34,212.66
Feed/25kg/bag	2,180.00	270,320.00
Farm Size/no. of birds	141.58	79,710.00
Medication/farm		6,675.00
Other inputs		5,329.13
Total Variable Cost (TVC)		**396,246.79**
Fixed Costs		
Rent/year	5,250.37	15,751.11
Sanitation levy/month	3,000.00	9,000.00
Depreciation(Asset)	7,170.00	21,510.00
Total Fixed Cost (TFC) (Capital)		**46,261.11**
Total Cost (ATC)		**442,507.90**
Net Revenue	**161612.11**	**291,192.10**
Return on Investment (RI)		**0.66K**

Source: Field Survey, 2013

Table 2 indicated that the farmers made an average revenue of ₦733,700.00 while average cost of production was ₦442,507.90 This gave a Net Revenue of ₦291,192.10 of the total revenue. The farmers realized 66 Kobo from every ₦1.00 invested in the project. This shows that the business was profitable and economically viable. The Fadama II poultry farmers in Imo State had better Returns to Scale when compared with the study of Onyeagocha et al. (2010), which reported that the poultry farmers in Akwa Ibom State realized 18k per ₦1.00 invested in the poultry production, and feed constituted 49.23% of the cost of production. In this study of Fadama II farmers in Imo State, feed input took chunk of 61% of the total cost of production and was the single highest cost item followed by the cost of birds.

Allocative Efficiency of the Farmers

Table 3 presents the estimated production function of the poultry farmers in the four functional forms.

Table 3: Estimated Production Function for the Poultry Production

Variable	Linear	Exponential	Semi-log	Double-log
Intercept	33609	10.50717	-1896463	4.10451
	(1.59)	(53.02)***	(-4.65)***	(6.36)***
Labour (X_1)	63.14551	0.00690	-53356	0.05787
	(0.23)	(2.65)**	(-1.12)	(0.76)
Feed (X_2)	1.71474	0.00000361	248936	0.4298
	(6.83)***	(1.53)	(3.75)***	(4.10)***
Farm Size (X_3)	325.7037	0.00119	-32141	0.45602
	(3.95)***	(1.54)	(-0.46)	(4.17)
Medication (X_4)	2.39855	-0.0000197	35195	-0.33648
	(0.60)	(-0.52)	(0.90)	(-1.80)*
Other inputs (X_5)	-0.51232	0.0000415	-63782	0.20450
	(-0.16)	(1.39)	(-1.85)*	(4.27)***
Capital (X_6)	3.39949	0.00003683	24783	0.3305
	(2.00)**	(2.01)**	(0.76)	(2.26)**
R^2	0.9395	0.6592	0.7036	0.9563
$\overline{R^2}$	0.9342	0.6295	0.7036	0.9525
F-ratio	178.43***	22.24***	30.67***	251.86***

Source: Field Survey, 2013
NB Figure in parenthesis are t-values
*** = Significant at 1% level
** = Significant at 5% level
* = Significant at 10% level

The coefficient of multiple determinations (R^2) was 0.956 implying that; labour, feed, farm size, medication, other inputs and capital account for about 96% of the variations in the level of output of boilers in the state. This finding is contrary to the finding of Onyeagocha et al. (2010), who reported an R^2 of 59% from a study in Akwa Ibom State after the avian influenza epidemic. This implied that the variables included in the model significantly explained the variation in the production levels. Feed, capital, medication and other inputs were seen to be the major factors that significantly influence the output of the farmers. Feed and other inputs were statistically significant at 1% level, capital was significant at 5% level while medication was significant at 10% level of probability. This is in tandem with the result of Ohajianya (2005) who reported that labour, capital, feed, drugs, day old chicks and utilities constituted the major factors influencing output in poultry production in certain parts of Imo State. It also agrees with the findings of Echebiri et al. (2006) who reported that feeds, drugs and day old chicks are the major determinants in broiler production in Abia State. The F-ratio was significant at 1% showing that the joint effect of the included variables was significant.

Table 4 shows the allocative efficiency indices obtained from the Fadama II broiler farmers studied.

Table 4: Allocative Efficiency Indices for the Broiler Enterprise

Item			Indices
Geometric mean			
Output (₦)			419,486.00
Labour/wage/month (₦)			34,212.65
Feed/25kg/bag (₦)			120,557.48
Farm Size/no.of birds (₦)			79,710.00
Medication (₦)			6675.00
Other Inputs (₦)			5329.13
Capital (₦)			6857.21
Marginal Value Products (₦)			
Labour	₦	X_1	0.0579
Feed	₦	X_2	0.4298
Farm Size	₦	X_3	0.4560
Medication	₦	X_4	-0.3365
Other Inputs	₦	X_5	0.2045
Capital	₦	X_6	0.3305
Marginal Factor Cost			
Labour			1.00
Feed			1.00
Farm Size			1.00
Medication			1.00
Other Inputs			1.00
Capital			1.00
Allocative Efficiency Indices			
Labour			0.0579
Feed			0.4298
Farm Size			0.4560
Medication			-0.3365
Other Inputs			0.2045
Capital			0.3305

Source: Field Survey, 2013

Table 4 contains allocative indices of the farmers. On the average, the farmers did not achieve absolute allocative efficiency. Absolute allocative efficiency is achieved on a factor when its allocative index is equal to unity. The farmers over-utilized labour input because the ratio of the marginal value product to the factor cost of labour is less than unity (i.e. 1). It means that for the farmers to maximize profit, they should decrease their use of the variable input such that labour input is reduced by 94.21%, feed is decreased by 57.02%, farm size is decreased by 54.40% etc. This is in line with the finding of Onyeagocha et al. (2010). The unit factor cost of capital and other inputs are the opportunity costs of employing them in poultry production. In this case, the opportunity cost is the interest rate for borrowed capital.

Returns to Scale of Farmers

Elasticity of Production of Farmers

Table 5 contains the returns to scale of the farmers. This was derived through summation of elasticity of production of various input resources used. With the double-log function as lead equation for the functions relating inputs and outputs, the regression coefficients were the direct elasticities of production.

Table 5: Elasticity of Production (EP) for the broiler Farms

Variable	Elasticity
Labour	0.0578
Feed	0.429
Farm Size	0.456
Medication	-0.336
Other inputs	0.204
Capital	0.330
EP	**1.1408**

Source: Field Survey, 2013

Table 5 shows that the farmers collectively did not operate at constant returns to scale. That is at the point where the elasticity of production is unity. This point is usually achieved at the boundary between stage one and stage two of production function. At this boundary, marginal product of an input is equal to the average product of the input. If a farm is operating at constant returns to scale, it means that the farm has achieved absolute allocative efficiency. In this case, the elasticity of production (EP) was 1.1408. This shows that the farmers were operating at increasing returns to scale which is at stage one of the production function. This agrees with Echebiri et al. (2006) and Onyeagocha et al. (2010) in their different studies in Abia and Akwa Ibom States respectively, that poultry the farmers operated at increasing returns to scale. This therefore implies that the farmers had more room for expanding production. This therefore goes a long way to fortify the findings that the poultry farmers grossly under-utilized their input resources and therefore were allocatively inefficient.

4. Conclusion and Recommendation

It was observed from this study that Fadama II poultry farmers in Imo State operated at increasing returns to scale, with the opportunity of profitably increasing their scale of production. Feed, medication, capital and other inputs were the most significant factors affecting poultry production among the Fadama II farmers, however, these resources were over-utilized. It is, therefore, concluded that even as the Fadama II poultry farmers in Imo State are making profit from their enterprises, they are not allocatively efficient in their use of resources. It is therefore recommended that the farmers either keep labour constant and increase their farm size or keep the farm size constant and decrease their use of labour input for increased profitability of their enterprises.

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