ALLOCATIVE EFFICIENCY ANALYSIS IN MARKET AGE OF BROILER PRODUCTION IN IMO STATE, NIGERIA.

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Abstract
The study focused on allocative or pricing efficiency analysis of market age of broiler production in Imo State, Nigeria. The main objective was to determine the allocative efficiency of resources in broiler brooding and broiler rearing enterprises. To achieve this, the study area was zoned into three, following the existing zoning arrangement of the Imo State Agricultural Development Programme (ADP). Nine Local Government Areas (L.G.As)were randomly selected and a total of 90 broiler farmers (made up of 45 brooding farmers and 45 rearing farmers) were selected. A set of structured pre-tested questionnaire was administered on the farmers to obtain required information. Data collected were analyzed using multiple linear regression technique, allocative efficiency indices and returns to scale analysis. Results show that broiler brooding farmers were more allocatively efficient in the use of input resources than the broiler rearing farmers. None of the farmer groups operated at constant returns to scale and therefore, did not maximize profit. Brooding farmers operated at the increasing returns to scale while the rearing farmers operated at the decreasing returns to scale. It is recommended that brooding farmers should employ more resources since by so doing, the can increase output because they're still operating at increasing returns and segment one of the production function.

INTRODUCTION
The concept of efficiency has been given various interpretations. Efficiency itself is concerned with the relative performances of the processes used in transforming a set of inputs into output. The pioneering work of (Farrel, 1957) distinguished three types of efficiency, technical, allocation and economic efficiencies. Technical efficiency is synonymous with productivity and it is born out of technique used in production. It is the ability of firms to employ the best practice or technology in the production process so that the minimum possible resources are used to achieve the best or optimum output level (Carlson, 1972; Timmer, 1980).

Allocative efficiciency is the kind which takes unit prices of inputs into consideration. It is the choice of input level which is consistent with relative factor price. In other words, a firm is said to be efficient in allocation of resources if it is capable of equating the marginal value product (MVP) of the input of its unit price hence, it is also referred to as pricing efficiency. This means that the farm has the ability to maximize profit with respect to that input factor. It is a microeconomic concept which depicts the tangency of price line and isoquant. When technical and pricing efficiencies occur together, economic efficiency results.

Broiler is a meat type chicken bred for marketing a early age and matures faster than other types of chickens (Williamson and Payne, 1988). In the livestock market today, broilers are offered for sale at different ages and sizes depending on circumstances and purposes. The market age in broiler production is the age at which producers target to offer their stock for sale. Most outstanding among them are: four weeks brooded (brood and sale); seven to 12 weeks reared (mature types); and above 12 weeks reared (over-aged). Broiler producers show their interests in the production of one or a combination of any of these three types. On this, Oluyemi and Roberts (1979) had pointed out that the exact time for marketing broilers depended on different marketing situations involving the relative costs of chicks and feeds and market preferences.

Nigeria is faced with the problem of malnutrition particularly in terms of protein intake (Shaib, 1984). Malnutrition is still widespread due to the decrease in protein intake occasioned by the scarcity and unaffordable prices of animal protein foods sources such as milk, meat, egg and fish (Asiabaka et al., 1999; Obasi, 2003). The minimum protein intake per day of 65g, as recommended by the World Health Organization (WHO), is yet to be attained, instead, the per capita consumption per day is about 6.5g representing 10% (Oluyemi and Roberts, 1979; Ibe, 2000). The issue is that of protein availability and its configuration. It is recommended that more than one third of the minimum protein intake for an adult per day should be of animal origin. This is because animal protein contains the essential amino-acids which are more balanced and readily available to meet nutritional needs than plant protein (Onyenuga, 1971; Ojo, 2003).

However, animal products contributed only about 15-20% of the protein intake of the nation (FRN, 1997). Irrespective of the fact that Nigeria is endowed with abundant livestock production facilities, she has remained a net importer of livestock products (Abubakar, 1998). Developing the poultry industry, especially the broiler sub-sector, is observed to be the fastest way of bridging the protein deficiency gap in Nigeria (Ikpi, 1979; Akinwumi, 1997). Though there

have been some still far exceeds the supply. In Nigeria poultry production has not increased at the rate than can meet the increasing population. While food production increases at the rate of 2.5% its demand increases at 3.5% (CBN, 2004). Poultry plays a significant role in GDP of the country as up to 10% of the population are engaged in poultry production (Okonkwo and Akubuo, 2001).
Producers will meet the demand if resources are efficiently used in the production system. Awoke and Okorji (2004) observed that resources use in developing countries such as Nigeria is faced with problem of under utilization of capacity which is associated with low returns. For instance, problem of demand and supply militated against efficient use of land resources.

However, such information are lacking on enterprise type in broiler production in Imo State of Nigeria. A comparative analysis of efficiency of resource-use among broiler farmers in Imo State would therefore provide empirical evidence of gaps that may exist in the farmer's current level of technology. These gaps would serve as intervention points for relevant stakeholders for arresting any difference that may precipitate animal protein crises in Imo State and Nigeria in general, as inefficiency directly translates to low productivity and profitability. Hence, the study sets to discover resource use efficiencies among the market ages in broiler production, otherwise called broiler brooding and rearing enterprises. It will identify and provide better information about the variables of variations in efficiency of resources use among the groups of farms. It will try to formulate policy measures that will reduce the difference if any.

Analytical Framework
A rigorous comparison of the allocative efficiency of any two groups of farms requires that they are characterized by a constant returns to scale, the same to neutral production function and same configuration of inputs and output prices (Onyenweaku, 1994). In order to examine the allocative efficiencies of the two groups of farms, estimate the following implicit production function for each group (Nwaru and Nnadozie, 2006).

$$Y = f(x_1, x_2 \ldots xn) + ei$$

Four functional forms are to be tried for each data set and the best fit chosen as lead equation. Allocative efficiency is determined by equating the marginal value product (MVP) of the ith input to its price or marginal factor cost (MFC)
That is MVP = Px_1 or $Pyf_1 = Px_1$
Px_1 (i = 1, 2 …n) unit price or marginal factor cost.
P_y = unit output price

$$f_i = \frac{\partial y}{\partial x}$$

= marginal physical product (MPP) of ith input.

For all resources measured in physical units the allocative efficiency index, wij for each farmer type is given as:

$$\frac{MVPxi}{Pxi} \quad \frac{Pyfi}{Pxi} = wij$$

Where i is a particular resource and j is the farmer type. For any resource that is measured in monetary terms, we have MVpxi = Pyfi w_{ij} Absolute or maximum allocative efficiency for a particular group of farms is confirmed with respect to a given resource if wij = 1. The resource is over-used if $w_{ij} < 1$ and under-utilized if $w_{ij} > 1$. The two groups of farmers achieve equal allocative efficiency if $w_{ij} = w_{i2}$ One may be interest to show the extent to which a particular resource should be increased or decreased from the current level of use in order to achieve absolute allocative efficiency, evaluate the following formula:

$$Kij = (1 - w_{ij}) 100$$

Where Kij is the percentage by which the level of use of a particular resource should be increased or decreased to achieve maximum allocative efficiency. A negative Kij implies that an increased use of the resource is required and vice versa. If Kij is zero, then absolute allocative efficiency has been achieved.

Methodology
The Study Area
The study area is Imo State of Nigeria. Imo State is situated in the Southeastern geographical zone of Nigeria. It lies between longitudes $6^0 35^1$ and $7^0 28^1$ E and Latitudes $5^0 10^1$ and $5^0 37^1$ N, covering an area of 3,289.49km^2. It is bounded on the east by Abia State, on the west by Delta State, on the north by Anambra and Ebonyi States and on the west by Rivers State. The State falls within the tropical rainforest zone with an average annual rainfall of up to 2550m, and temperature and relative humidity of 27^0C and 75% respectively (Kenkwo and Egeonu, 2000; Metrological Unit, Ministry of Land and Survey, 2006). It has estimated population of 3.7million with a growth rate of 2.8% per annum. For ease of administration of agricultural programmes, the state was divided into three agricultural zones namely; Owerri, Orlu and Okigwe. Farming is the major occupation of the people of which livestock production forms a significant portion.

Sampling Technique
Multi-stage sampling method was employed. This involved the division of the state into three clusters based on the existing three agricultural zones, Orlu, Owerri and Okigwe. Each of the zones is made up of several Local Government Areas as follows: **Owerri zone** comprising Owerri Municipal, Owerri North, Owerri West, Ahizu mbaise, Ezinihite mbaise, Aboh Mbaise, Ngor-Okpala, Mbaitolu, Ikeduru, Ohaji/Egbema, and Oguta; **Orlu zone** made up of Orlu, Orsu, Oru East, Oru West, Ideato North,

Ideato South, Njaba, Nkwerre, Nwangele, and Isu; and **Okigwe zone** consisting of Okigwe, Onuimo, Ehime, Ihitte-Uboma, Obowu and Isi-Ala Mbano. In all, the State has 27 Local Government Areas (LGAs). Three LGAs were randomly selected from each of the zones. This gave a total of nine LGAs for the study. Broiler production was broadly stratified into brooding enterprise and rearing enterprise. In each of the enterprises, therefore, random samples of ten farmers of five brooding and five rearing enterprises were selected in a Local Government Area. In all, therefore, a sample size of 90 respondents was selected from the nine LGAs.

Methods of Data Collection

A reconnaissance survey, involving visit to the three zones, was carried out. During he visit, broiler producers' statistics were sought as well as recruitment of enumerators who helped to collect information in the areas. Nine enumerators, one from each LGA were selected and trained. Data were collected from both primary and secondary sources. Primary data were collected from the farmers who engaged in broiler brooding and those in rearing using a set of structured questionnaire. Information were collected in the areas of socio-economic factors of broiler producers, inputs of feeds and medication, labour use, access to extension services and credit, farm size, enterprises types, wages, input and output prices, etc. Secondary data were collected from published research work in related areas in the form of literature review.

Method of Data Analysis

Data collected were analyzed using multiple linear regression technique, allocative efficiency indices and returns to scale analysis.

For the allocative efficiency, the model is specified thus:

MVP_{xi} - P_{xi} or $P_y fi = P_{xi}$

Where; fi = $\frac{\sigma y}{\sigma x}$ marginal physical product (MPP) of the ith input.

P_{xi} (i = 1,2, ….6) = unit price ith input

P_y = Unit output price

MVP_{xi} (i = 1,2 ….6) = marginal value product of the ith input

Results and Discussion

Allocative Efficiency of Brooding and Rearing Enterprises

Tables 1 and 2 contain regression results of fitted numerical data to production functions of brooding and rearing enterprises. The models were estimated in four functional forms. Based on statistical and econometric reasons, double-log equation was chosen as the lead equation for the brooding enterprise. In the model, the coefficient of determination was 0.744. This meant that up to 74% of variations in output were explained by the explanatory variables of the model. The intercept, feed, farm size, and capital were statistically significant at 1%, 5% or 10% levels. This shows that they exert direct influence on output. Labour was negatively signed because brooding did not require much mandays of labour since it was not labour intensive business.

Table 1: Estimated Production Function for Brooding Enterprise

Variable	Linear	Exponential	Semi-log	Double-log
Intercept	19015	10.38313	-589023	4.1726
	(1.19)	(67.99)***	(-4.55)***	(4.73)***
Labour	-170.519	0.00118	-4516.119	-0.08940
	(-0.45)	(0.33)	(-0.22)	(-0.65)
Feed	0.35493	0.00000841	-65.8356	0.14464
	(1.03)	(2.55)**	(-0.01)	(1.75)*
Farm size	9.17294	0.00030181	23919	0.43349
	(0.46)	(1.59)	(1.57)	(0.89)
Medication	4.70073	0.00002707	7872.52	0.39074
	(2.09)**	(1.26)	(0.89)	(5.54)***
Other inputs	23.39020	0.0001646	60587	0.39173
	(7.71)***	(5.70)***	(5.86)***	(5.54)***
Capital	9.311664	0.00008419	9776.681	0.39173
	(1.62)*	(1.54)	(0.95)	(2.10)**
R^2	0.555	0.5166	0.5402	0.744
R^{-2}	0.522	0.4803	0.5057	0.7252
F-ratio	16.68***	14.25***	15.66***	38.82***

Source: computed from field survey data, 2011

NB: Figures in parenthesis are the t-values
*** - Significant at 1% Level
** - Significant at 5% Level
* - Significant at 10%Level

Table 2: Shows estimated production function for rearing enterprise in four functional forms. Double-log equation was chosen as lead equation. This was because it gave the best fit. The coefficient of determination of the model was 0.956, indicating that 96% of the variations in output was explained by the variations in the set of explanatory variables. Intercept, feed, farm size, medication, other inputs and capital were statistically significant at the 1%, 5% or 10% levels of probability. This indicated that they exerted major influences on output. All the parameters had the expected signs. Labour was not significant because broiler-rearing did not require much man-days of labour, rather, it was capital intensive.

Table 2: Estimated Production Function for Rearing Enterprise

Variable	Linear	Exponential	Semi-log	Double-log
Intercept	33609	10.50717	-1896463	4.10451
	(1.59)	(53.02)***	(-4.65)***	(6.36)***
Labour	63.14551	0.00690	-53356	0.05787
	(0.23)	(2.65)**	(-1.12)	(0.76)
Feed	1.71474	0.00000361	248936	0.4298
	(6.83)***	(1.53)	(3.75)**	(4.10)***
Farm size	325.7037	0.00119	-32141	0.45602
	(3.95)***	(1.54)	(-0.46)	(4.17)***
Medication	2.39855	-0.0000197	35195	-0.33648
	(0.60)	(-0.52)	(0.90)	-(1.80)*
Other inputs	-0.51232	0.000415	-63782	0.20450
	-(0.16)	(1.39)	(-1.85)*	(4.27)***
Capital	3.39949	0.00003683	24783	0.3305
	(2.00)	(2.01)**	(0.76)	(2.26)**
R^2	0.9395	0.659	0.7273	0.9563
R^2	0.9342	0.629	0.7036	0.9525
F-ratio	178.43	22.24	30.67	251.86

Source: Field Survey Data, 2011.

NB: Figures in parenthesis are the t-values.
*** - Significant at 1% Level;
** - Significant at 5% Level;
* - Significant at 10% Level;

Allocative Efficiency Indices for Brooding and Rearing Enterprise

Table 3, shows that none of the farmer groups achieved absolute allocative efficiency in the use of the six resources and therefore failed to maximize profit. They grossly under-utilized labour, farm size, capital and other inputs. However, broiler brooding farmers nearly achieved absolute allocative efficiency in the use of feed but over-utilized medication and veterinary service, thus, they were better off in the use of the two resources than the broiler rearing farmers. The rearing farmers were only better off in the use of capital than the brooding farmers. This was because rearing required more space and other poultry equipment than the brooding business, which could be carried out in a small space such as movable cages. This is in agreement with the findings of Onubuogu (2007), who concluded that broiler rearing farmers, in Owerri North Local Government Area of Imo State, were allocatively more efficiency than brooding farmers in the use of capital.

To arrive at the allocative efficiency indices, value of marginal product of individual inputs were divided by their corresponding marginal factor costs. The unit factor cost of capital and other inputs of the function was the index of commercial banks' interest on savings account of 2010. The same table suggested required changes to be made by the farmer groups. The brooding farmers should increase the use of resources by 372%, 63%, 16800%, 41460% and 5763% of labour, feed, farm size, other inputs and capital respectively. However, they should decrease the use of medication and veterinary services by 60%. This is because, little medical attention such as inoculation and administration of vitamins were required in four weeks brooding of birds. Use of veterinary doctor's services might not be necessary especially in small-scale outfits.

The rearing farmers were expected to increase the use of labour, feed, farm size, medication, other inputs and capital by 1351%, 1071%, 22759%, 189%, 47327% and 6852% respectively. That meant that these farmers grossly under-utilized all the resources.

Table 3: Allocative Efficiency Indices for the Brooding and Rearing Enterprises

Geometric Means	Brooding	Rearing
Output (N)	64031.97	152518.81
Labour (manday)	34.97	48.47
Feed (N)	15184.79	36775.73
Farm size (No. of birds)	233.92	146.21
Medication (N)	1677.99	2153.85
Other inputs (N)	1127.46	2458.32
Capital (N)	1562.18	2229.84
Marginal Value product (#)		
Labour	1094.21	3365.95
Feed	2195.72	15806.21
Farm size	35490.68	80009.62
Medication	89.86	724.45
Other inputs	440.54	502.73
Capital	611.95	73.69
Marginal Factor Cost		
Labour	232	232
Feed	1350	1350
Farm size	210	350
Medication	230	250
Other inputs	1.06	1.06
Capital	1.06	1.06
Allocative Efficiency Indices (Wij)		
Labour	4.72	14.51
Feed	1.63	11.71
Farm size	169	228.59
Medication	0.391	2.89
Other inputs	415.60	474.27
Capital	577.31	69.52
R**equired Change in Wij (Kij)**		
Labour	-3.72	-13.51
Feed	-0.63	-10.71
Farm size	-168	-227.59
Medication	0.609	-1.89
Other inputs	-414.60	-473.27
Capital	-576.31	-68.52

Source: Field survey data, 2011

Returns to Scale

Elasticity of Production (EP) for Brooding and Rearing Enterprises

In Table 4, returns to scale of the two groups of farms were derived through summation of the elasticity of production for various resources. With the double-log functions as lead equation for the two groups of farmers, regression coefficients were the direct elasticity of production. The table showed that none of the farmer groups operated at constant returns to scale, that is, at the boundary between stages one and two of the production function. The brooding farmers were operating at stage one, the increasing returns segment. This is an irrational stage of the production function because addition of a unit input gives more than proportionate output. Output cannot be optimized here and therefore production has to be pushed further. These famers had more room for expansion.

The rearing farmers with inelastic production were operating at stage two of the production function. Addition of a unit gave less than proportionate output. However, this is the rational stage of the production function because output can be optimized and profit maximized here. Therefore, the rearing farmers were operating at decreasing returns to scale.

Table 4: Elasticity of Production (EP) for Brooding and Rearing Enterprises

Variable	Brooding	Rearing
Labour	-0.0894	0.05787
Feed	0.1446	0.4298
Farm size	0.43349	0.45602
Medication	0.05355	-0.33648
Other inputs	0.39074	0.20450
Capital	0.39173	0.3305
EP	1.324	0.8447

Source: Field Survey Data, 2011.

Conclusion

The broiler farmers did not achieve allocative efficiency by equating the value marginal product (VMP) to their factor prices. They therefore did not optimize input use and maximize profit. The brooding farmers that were operating at the increasing returns to scale (segment one of production function) can increase output by employing more resources. The rearing farmers that were already operating at segment two (rational segment) of the production function can optimize input use and maximize profit by reducing the amount of resource use to correspond with marginal factor cost.

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