ALLOCATIVE EFFICIENCY OF PIG PRODUCTION IN ENUGU STATE, NIGERIA

[1] Ivoke, G E, [2]Obi JI, [1]Ameh, J N [4]Chukwu MF and [1]Ume, SI
[1]Department of Agricultural Extension and Management. Federal College of Agriculture, Ishiagu, Ivo Local Government Area of Ebonyi State, Nigeria

[2]Department of Animal Health and Production. Federal College of Agriculture, Ishiagu, Ivo Local Government Area of Ebonyi State, Nigeria

Department of Cooperative Economics and Management. Federal College of Agriculture, Ishiagu, Ivo Local Government Area of Ebonyi State, Nigeria

[4]Department of Marketing. Federal College of Agriculture, Ishiagu, Ivo Local Government Area of Ebonyi State, Nigeria

Corresponding Author: umesmilesi@gmail.com

ABSTRACT
The allocative efficiency of pig production in Enugu State, Nigeria was studied using one hundred and twenty production was studied. The respondents were selected using a multi-stage random sampling technique. A structured questionnaire and oral interview were used to elicit information for the study. Percentage responses and allocative efficiency indices were used to analyse the objectives. The result showed that none of the pig farmers achieved allocative efficiency by equating the value marginal product (VMP) to their factor prices. All the resources (farm size, labour, medication, capital and feed) considered were not effectively utilized as they are over-utilized. The constraints to pig production in the study area were the high cost of drugs and vaccines, high cost of feed and poor access to credit. The study concludes that pig production in the area was allocatively inefficient. There is a need to strengthen and expose farmers to the practical results of using appropriate quantities of inputs and adhering to good field management practices by relevant government and Non – government agencies concerned. Also, farmers should be exposed to credit facilities through microfinance banks and, among others at low interest rates.
Keywords: Allocative Efficiency, Constraints, Pig Production, Nigeria

INTRODUCTION

The role of pig production in economic development is widely recognized, as it provides significant contributions to food security, employment, income generation, and foreign exchange earnings. Pigs are an essential source of animal protein and manure, which is used as organic fertilizer and even for generating cooking gas. Moreover, pigskin and bristle are utilized in the production of light leather and brushes (Okolo, 2011). Globally, pig farming has emerged as a lucrative enterprise, especially in non-Islamic societies, owing to the animal's unique characteristics. Onyekuru, Ukwuaba, and Aka (2020) highlighted inherent traits such as the ability to thrive in marginal conditions, high fecundity, feed conversion efficiency, early maturity, short gestation period, and minimal space requirements, all of which make pig rearing highly sustainable and economically viable.

Despite these advantages, pig production in Nigeria has experienced a significant decline in recent years. Factors contributing to this decline include poor-quality feeds, inadequate veterinary services, farmer illiteracy, disease outbreaks, limited access to credit, substandard housing, low-quality breeds, high feed costs, inadequate infrastructure, limited markets for pig products, and the absence of processing industries (Osondu, Ijioma, Anyiro, & Obike, 2014; Onyekuru et al., 2020). These challenges result in low productivity, which can be mitigated by improving resource use efficiency. According to Ume, Ezeano, and Onunka (2018), efficiency in pig production refers to the effective use of productive resources such as land, feed, labour, vaccines, and drugs to maximize output while minimizing wastage. Efficiency is especially critical in resource-constrained settings like Nigeria, where the development of new technologies is often limited (Ike & Udeh, 2011).

One key determinant of productivity in pig farming is allocative efficiency, which refers to the ability of farmers to make input decisions that optimize resource utilization relative to their costs. Nwaru (2010) defines allocative efficiency as the extent to which inputs are used up to a level where their marginal contribution to production value equals the marginal factor cost. Similarly, it reflects the farmer's ability to achieve the optimal mix of inputs that results in maximum output (Dipeolu & Akinbode, 2016; Wilcox, Ugwumba, Achike, Agbagwaa, & Uche, 2016). Addressing inefficiencies in resource allocation is vital for improving productivity, reducing costs, and enhancing the sustainability of pig production systems.

To achieve better nutrition, food security, employment opportunities, and improved labour utilization through pig farming, enhancing allocative efficiency is imperative. This study was conceived against the backdrop of limited information on allocative efficiency in pig production in the study area. Specifically, this study aims to estimate the allocative efficiency of pig farmers and identify the constraints hindering pig production in the region.

METHODOLOGY

Enugu State, located in southeastern Nigeria, lies between latitudes 6°30'N and 7°10'N of the Equator and longitudes 6°35'E and 7°30'E of the Greenwich Meridian. The state, with Enugu as its capital, comprises eighteen Local Government Areas (LGAs) and spans a land area of 16,727 square kilometres. According to the 2006 National Population Census (NPC), Enugu State had an estimated population of approximately 4.17 million people. It shares boundaries with Abia and Imo States to the south, Ebonyi State to the east, Benue State to the northeast, Kogi State to the northwest, and Anambra State to the west.

The state experiences two main seasons: the rainy season, which occurs from April to October, and the dry season, lasting from November to March. Temperatures in the region range between 18°C and 34°C, creating a favourable environment for agricultural activities. Approximately 60–70% of the population engages in agriculture, including crop farming, marketing of agricultural produce, and animal husbandry. Other livelihoods in the area include civil service, petty trading, vulcanizing, driving, carpentry, and mechanics.

A purposive and multi-stage random sampling technique was adopted to select the study area and respondents. In the first stage, five LGAs—Udi, Ezeagu, Nsukka, Enugu South, and Enugu East—were purposively selected based on their high levels of pig production. In the second stage, two communities were randomly selected from each LGA, resulting in a total of ten communities. In the third stage, one village was randomly chosen from each community, giving a total of ten villages. Finally, six pig farmers were randomly selected from the lists of pig farmers provided by local leaders in each village, yielding a sample size of sixty respondents for the study.

Data collection was carried out using structured questionnaires supplemented with informal and oral interviews. To achieve the study's objectives, various analytical tools were employed percentage response, gross margin analysis, and allocative efficiency index.

Model Specification

Gross margin analysis.

GM = TR – TVC ………………………………………………1

i.e. GM = $\sum_{1-1}^{n} P_1 Q_1 - \sum_{j-i}^{m} r_i x_i$ ………………………………………. 2

The net farm income can be calculated by gross margin less fixed input. The net farm income can be expressed as thus:

NFI = $\sum_{1-1}^{n} P_1 Q_1 - \left[\left(\sum_{j-i}^{m} r_i x_i \right) + k \right]$ ……………………………………3

Where:

Gm = gross margin (₦), NFI = net farm income (₦), p1 = market (unit) price of output (₦), q = quantity of output (kg)

Ri = unit price of the variable input (kg), xi = quantity of the variable input (kg) , k = annual fixed cost (depreciation) (₦)

I = 1 2 3 …….. N

J = 1 2 3

Multiple Regression Analysis

Multiple regression is used to obtain allocative efficiency indices b_i coefficient was estimated using ordinary least squared regressions method. The explicit production function was estimated by

$Y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + e$ ……………………… (4)
Where:
Y = value of pork output (₦), x_1 = farm size (ha), x_2 = labour (manday),
x_3 = Seed (kg), x_4 = fertilizer (kg), x_5 = capital (₦)
$x_1 – x_5$ = coefficient of the parameters to be estimated, while e_1 was the error term and b_0 was the coefficient.
Four functional forms of the multiple regressions were employed to select the one that provided the best fit. The functional forms tried were:

Linear function $Y= b_0 + b_1\ x_1\ b_2\ x_2 + b_3\ x\ _3 + b_4\ x_4 + b_5\ x_5 + ei$ …………………. (5)
Double log function Y:-$\ln(y) = \ln b_0 + b_1\ln x_1 + b_2\ln x_2 + b_3\ln x_3 + b_4\ln x_4 + b_5\ln x_5 + ei$ … (3)
Semi log ; $Y = \ln b_0 + b_1\ln x_1 + b_2\ln x_2 + b_3\ln x_3 + b_4\ln x_4 + b_5\ln x_5 + ei$ ………………… (6)
Exponential function; $\ln Y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + ei$....………… (5)
The choice of the best functional form was based on the magnitude of the R^2 value, the high number of significance, size and signs of the regression coefficients as they conform to *apriori expectation*.
Allocative Efficiency Model;
The efficiency ratio was used to determine the efficiency of resources used in pig production. The estimated coefficients of the relevant independent variables were used to compute the Marginal Value Products (MVP) and their corresponding Marginal Factor Costs (MFC). The equation is
R=MVP/MFC…………………………………………………………………(7)
Where r = efficiency ratio; MVP = Marginal Value Product of variable input; MFC = Marginal Factor Cost
The value of MVP was computed using the regression coefficient of each input of pig and the price of the pork was expressed as stated below:
MVPx= bi × Py …………………………………………….(8)
Where
Py = price per unit of output, bi = regression coefficient of input i (i = 1, 2, ...n)
MVPxi = Marginal Value Product of input xi The prevailing market price of pig inputs was used as the Marginal Factor Cost (MFC) .
The values of the ratios are interpreted thus: i. If r < 1, implies that the resource was over-utilized- hence signifying that increment of the resource in question will boost the profitability of pig production.
ii. If r > 1, means under-utilization of the resource. The implication is that there is an inverse relationship between the said resource and profit
iii. If r = 1 implies efficient resource use.

RESULTS AND DISCUSSION

Determinants of Pig Production

The double-log multiple regression analysis was selected as the lead equation based on statistical and econometric criteria (Table 1). The coefficient of multiple determination (R^2) was 0.7889, indicating that 78.89% of the variation in the dependent variable (pig production) was explained by the independent variables included in the model. The remaining 21.11% of the variation was attributed to factors not captured in the model, represented by the error term.

Table 1: Estimated Multiple Regression Production Function for Pig Production

Variable	Linear	Exponential	+Double Log	Semi Log
Constant	5.024	3.6753	6.3800	3.1337
	(4.006)***	(4.167)***	(3.557)***	(3.445)***
Farm size	2.423	0.3351	0.1224	0.0021
	(2.911)**	(0.3112)	(1.3091)*	(0.3990)
Feed	0.0932	0.2897	0.1239	1.7213
	(0.0226)	(0.5560)	(2.0982)**	(-0.1657)
Medication	0.5277	0.4517	0.0276	-2.654
	(-1.0056)	(1.4900)**	(-3.1190)***	(2.0018)**
Labour	0.3877	0.0018	0.3601	-0.2215
	(3.434)***	(4.032)***	(1.096)*	(0.1701)
Capital	-0.3722	-0.0519	0.3441	0.0134
	(-2.0917)	(-1.4116)	(0.674)	(0.1129)
R^2	0.5623	0.0268	0.7889	0.6442
F Value	3.0991***	6.4401***	9.0074***	4.5541***

Source: Field Survey, 2014

*****, **, *** significant at 1.0%, 5.0% and 10.0% levels of probability respectively. The figure in parenthesis is the t-ratio.

The coefficient for farm size was positive and significant at the 1% probability level, indicating that a 1% increase in farm size would result in a 0.1224% increase in pig production. This finding aligns with prior expectations and corroborates Ume et al. (2018), who highlighted that farm size serves as a proxy for wealth status and managerial ability, both of which enhance productivity.

Feed, with a coefficient of 0.1239, was positive and statistically significant at the 5% probability level. This result is consistent with the findings of Dipeolu and Akinbode (2016), who noted that feed is a critical input in animal production, often constituting the largest cost component. To mitigate feed costs, farmers frequently use substitutes such as food waste (e.g., spent grains from brewing), household scraps, or byproducts from food processing industries. These practices reduce overall costs while maintaining production levels.

Labour input also showed a positive and significant relationship with pig production at the 5% probability level, suggesting that increased labor input reduces allocative inefficiency. This finding contradicts Adetunji and Adeyemo (2012), who noted that labor availability is often a constraint in pig farming due to the reluctance of many workers to handle pigs for fear of bites. Moreover, the limited availability of laborers willing to work in pig farming leads to high labor costs, reducing profitability in the sector.

Interestingly, the coefficient for medication was negatively correlated with pig production and significant at the 10% risk level. This finding highlights the challenges associated with high costs and the prevalence of substandard and adulterated veterinary drugs in developing countries, as noted by Ume, Onwujiariri, and Nnadozie (2020). The lack of adequate regulation and auditing of imported drugs exacerbates these issues. Additionally, the poor distribution of veterinary services in rural areas often compels farmers to rely on unqualified practitioners, resulting in significant livestock losses.

This finding is further supported by Dietze (2011), who emphasized that vaccines and medications used in rural areas are frequently ineffective due to improper storage conditions, such as a lack of cold-chain facilities caused by erratic power supply. Farmers relying on these ineffective treatments experience substantial losses, leading to business failures. These challenges underscore the need for improved regulation of veterinary inputs, better infrastructure for storage and distribution, and capacity building to address inefficiencies in livestock farming (Dipeolu & Akinbode, 2016).

Allocative Efficiency in Pig Production

The allocative efficiency indices of production in the study area are presented in Table 2.

Table 2: Allocative Efficiency Indices of pig production

Variable	$\overline{Y}$	$\overline{X}$	**Bi**	**MPP**	**MVP**	**MFC**	**R**	**(D)%**
Farm size	4600	94.8	0.1224	5.9.	559.32	20000	0.028	-34.71
Feed	4600	16.87	0.1239	33.45	564.30	1000	0.5456	-83.28
Medication	4600	14.6	0.0276	8.50	12.41	9000	0.0014	--0.018
Labour	4600	12.90	0.3601	128.37	1655.58	4500	0.379	-1.64
Capital	4600	-17.89	0.3441	13.422	4.62	2000	0.0031	-321.58

Source: Field Survey, 2024

Table 2 indicates that none of the variables considered had an efficiency ratio equal to 1, which would signify optimal utilization of resources. Instead, the ratios of Marginal Value Product (MVP) to Marginal Factor Cost (MFC) for all the variables—labour (0.379), medication (0.0014), farm size (0.028), feed (0.5456), and capital (0.0031)—were less than 1. This finding implies that the resources were over-utilized, leading to inefficiencies in production. Over-utilization suggests that the current levels of these inputs exceed what is necessary for profit maximization, thereby reducing overall economic efficiency in pig production.

The over-utilization of these resources can be attributed to various factors. For instance, the use of family labor and indigenous knowledge-based technologies (ITK), which are often employed without substantial cost implications, contributes to the excessive application of labor and other inputs. Similarly, the reliance on domestic refuse and low-cost traditional feed sources may explain the over-utilization of feed. Ume et al. (2018) and Ume et al. (2020) corroborated this assertion, especially in the context of family labor, where minimal or no wages are paid, leading to its unregulated use in pig farming.

To optimize profit and enhance resource efficiency in pig production, the levels of all over-utilized inputs need to be adjusted. Specifically, resources such as labor, medication, farm size, feed, and capital should be reduced by approximately 16.4%, 1.8%, 34.71%, 83.28%, and 32.12%, respectively, from their current levels. These reductions will align resource use with their marginal contributions to production, ensuring a more efficient allocation of inputs and improving profitability in pig farming in the study area.

Elasticity of Production

Table 3: Elasticity of Production and Return to Scale of Pig Production

Variable	Elasticity of Production
Farm size	0.1224
Feed	0.1239
Medication	0.0276
Labour	0.3601
Capital	0.3441
Return to Scale	0.8542

Source: Field Survey, 2024

The elasticity of production measures the responsiveness of output to a unit change in input. In this study, the elasticity of pig production was estimated directly from the Cobb-Douglas production function coefficients. As shown in Table 3, the production elasticity for each input resource was less than one, indicating an inelastic relationship between the inputs and pig output. This inelasticity signifies over-utilization of resources, as the additional inputs result in less-than-proportionate increases in output.

Furthermore, the return to scale, calculated as the sum of the elasticities of all inputs used in pig production, was 0.8542. This value, being less than one, suggests that pig production in the study area operates in the inelastic stage of the production function (Stage 1). In this stage, farmers experience diminishing returns, meaning that increasing all inputs by 1% would result in only a 0.8542% increase in output. This finding aligns with Wilcox et al. (2016), who observed that farmers in Stage 1 of the production function fail to maximize the productive potential of their resources.

Table 4: Constraints to Pig Production in the Study Area

Constraints	Frequency	Percentage (%)
Poor access to credit	55	91.7
High cost of drugs and vaccines	48	80.0
Location of veterinary posts	25	41.6
Lack of extension services	20	33.3
High cost of feed	42	70.0
Poor road	16	26.6

Source: Field Survey, (2024) *Multiple Responses

Additionally, Table 4 highlights several critical constraints to pig production in the study area. Approximately 91.67% of respondents reported lacking access to credit facilities, which hinders their ability to purchase inputs such as feed and pay for labour. Credit availability is essential for expanding production, as it allows farmers to invest in necessary resources (Ume et al., 2020). Furthermore, 70% of respondents noted difficulties in procuring feed due to its high cost. This issue is exacerbated by the competition for grains and feed supplements between livestock and humans, as documented by Petrus, Mpofu, Schneider, and Nepembe (2011). Similarly, Ikwap et al. (2014) confirmed that high feed costs remain a persistent challenge in livestock production.

Moreover, 80% of respondents identified the high cost and limited availability of drugs and vaccines as a major challenge. The high cost, coupled with issues such as adulteration and inefficient distribution, makes it difficult for farmers to access effective veterinary services (Ume et al., 2018). In contrast, only 26.67% of respondents cited poor road infrastructure as a constraint, likely due to ongoing road rehabilitation efforts in the rural areas of the state.

CONCLUSION AND RECOMMENDATIONS

The findings reveal that pig farmers in the study area failed to achieve optimal resource allocation (r=1). Instead, inputs such as farm size, capital, feed, medications, and labour were over-utilized (r>1), leading to inefficiencies in production. The key constraints identified include high feed costs, limited access to credit, and high costs and unavailability of veterinary drugs and vaccines.

To enhance pig production in the study area, the following recommendations are proposed:

1. Farmers should be provided with access to affordable credit through microfinance institutions, commercial banks, and other credit facilities. This would enable them to invest in necessary inputs and expand their production.

2. Adequate funding should be allocated to veterinary research institutes to ensure the availability of high-quality, locally adapted veterinary drugs and vaccines. This would reduce reliance on imported products that may not fully suit local conditions.

3. Incentives should be provided to grain and feed producers by the government and NGOs to increase the domestic supply of feeding materials. This approach would mitigate the high feed costs caused by growing demand from an expanding population.

REFERENCE

Abiola J. O., Omotosho O. O., Adeniyi O. M., Ayoade G. O. (2015): Socio-demographic Characteristics of Swine Producers and Swine Management Practices in Ibadan, Oyo State, Nigeria. Alexandria. *Journal of Veterinary Sciences* 47(1):18–23.

Adetunji M. O., Adeyemo K. E. (2012): Economic efficiency of pig production in Oyo State, Nigeria: a stochastic production frontier approach. *American Journal of Experimental Agriculture* 2(3): 382 – 394.

Dietze, K. (2011). Pigs for Prosperity. FAO Diversification booklet number 15

Dipeolu, A.O and S.O Akinbode (2016). Technical, Economic and Allocative Efficiencies of Pepper Productionin South-West Nigeria: A Stochastic Frontier Approach; *Journal of Economics and Rural Development;*Vol .17. No.1; Pp:24-33

Ike, P.C., and I. Udeh (2011). Comparative analysis of allocative efficiency in input use by credit and non-credituser small-scale poultry farmers in Delta State, Nigeria. *Asian Journal of Agricultural Sciences* 3: 481-486

Ikwap, K., Jacobson, M., Lundeheim, N., Owiny, D. O., Nasinyama, G. W., Fellstrom, C. and Erume, J. (2014). Characterization of pig production in Gulu and Soroti districts in northern and eastern Uganda. *Livestock Research for Rural Development* 26: 74 - 91.

National Population Commission (NPC, 2006). National Population Census Figure, Abuja, Nigeria.

Nwaru, J. C., (2010). Allocative efficiency in Table egg production in Owerri agricultural zone of Imo State, Nigeria. *Proceedings of the 44th Annual Conference of Agricultural Society of Nigeria held at Tadoke Akintola University of Technology Ogbomoso, Oyo State Nigeria, pp.29-34.*

Okolo, C.I. (2011). Tropical Tips on Intensive Pig Production: Animal Management and Health Issues. Technical Notes: Tapas Institute of Scientific Research and Development. Pp 240-246.

Onyekuru N.A., Ukwuaba I.C. and Aka E.O. (2020). Economics of piggery enterprise in Nigeria: a case study of Udi Local Government Area of Enugu State, Nigeria. *Agro-Science*, **19 (2)**, 6-12. DOI: https://dx.doi.org/10.4314/as.v19i2.2

Osondu C. K., Ijioma J. C., Anyiro C. O., and Obike K. (2014): Economic Analysis of Pig Production in Abia State, Nigeria. International Journal of Applied Research and Technology 3(3): 3 – 10.

Petrus, N. P., Mpofu, I., Schneider, M.B. and Nepembe, M. (2011).The Constraints and Potentials of Pig production among communal farmers in Etayi Constituency of Namibia. Pig Edition /Practice, instruction .pdf.

Ume, S I. Nweke,J, Ucha, S and Idahosa,S J (2018) Allocative Efficiency in Okra (Abelmoschus Spp) Production in Ayamelum Local Government Area of Anambra State, Nigeria.Archives of Current Research International; ***15(1): 1-7***

Ume S I Onwujiariri E B and Nnadozie AKO(2020)Pig Farmers' Socioeconomic Characteristics as Determinant to Pig Production and Profitability in the Tropics *International Journal of Research and Review Vol.7; Issue: 4; April 2020 Website: www.ijrrjournal.com*

Ume SI, Ezeano CI, Onunka BN, (2018). Technical efficiency of pig production in Enugu north agricultural zone of Enugu state, Nigeria. International Journal of Research and Review. 2018; 5(9):61-69.

Wilcox G. I.1, Ugwumba C. O. A., Achike A. I., Agbagwaa C.and Uche F.B (2016).Allocative efficiency *and socio-economic determinants of allocative efficiency cocoyam production among smallholder farmers in South-South Nigeria*. International Journal of Environmental & Agriculture Research (IJOEAR)-2, (9); 57- 67