



THE TECHNICAL EFFICIENCY OF DIFFERENT PIGS PRODUCTION PHASES FOR FARMER'S PROFITABILITY IN CROSS RIVER, NIGERIA

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Abstract:

The study determined the technical efficiency of different pig production phases for farmer's profitability in Cross River, Nigeria. A research question and one hypothesis guided the study. The hypothesis was tested at $p < 0.05$ level of significance. The study adopted experimental design. A population of 22 piglets of Large White (Yorkshire) breed was used. The piglets were 15 to 21-days of age. The sample was 18 healthy piglets. The instrument for data collection was a template for recording the information such as cost of piglets, cost of feeds, daily feed consumed among others and a structured questionnaire. The instrument was validated by three (3) experts, one (1) from the Department of Agricultural Education, and two (2) from the Department of Animal Science, all from University of Nigeria, Nsukka. Data was collected by directly recording inputs, outputs, costs, and revenue for each production phase. Weigh back technique was used to collect data on feed intake. The data was analysed using Mean, Analysis of Variance (ANOVA), t-test, and Stochastic Frontier Regression statistic. Finding indicated Pigs sold in phase 2 had the highest technical efficiency ratio compared to the other phases. Also, pigs sold at phase 3 had the highest profitability when compared to others while the pig sold at production phase 1 had the least profitability. It was recommended among others that agricultural extension agents should advice pig farmers to sell their pigs in phase 2 for higher technical efficiency ratio, and that the Ministry of Agriculture through the agricultural extension agents should advice pig farmers to sell their pigs at the appropriate phase for highest profitability.

Keywords:

Technical Efficiency, Pig Production, Production Phases, Profitability.

How to cite: Linus Akomaye, A. (2025). THE TECHNICAL EFFICIENCY OF DIFFERENT PIGS PRODUCTION PHASES FOR FARMER'S PROFITABILITY IN CROSS RIVER, NIGERIA. *GPH-International Journal of Agriculture and Research*, 8(10), 56-65. <https://doi.org/10.5281/zenodo.17852822>



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Introduction

A pig is any of the animals in the Genus, *Sus*, within the Suidae family of even toed ungulates. They are mammals with stocky bodies, small eyes, large ears, and flat snouts (Carlson, 2020). The most popular breed of pig raised in Nigeria include, large white (Yorkshire), landrace, Duroc and Poland China. Each type varies in appearance, size, and biological characteristics.

Pig play important roles in the nutrition and economy of the of Nigeria populace (Akinbobola (2021), It is one of the most widely consumed animals accounting for about 36% of meat production in Nigeria (Food and Agriculture Organization (FAO), 2018). Pork can be eaten both cooked and preserved. Some materials are produced using parts from pig. These include among others, antifreeze, adhesive, water fitter, insulator, floor waxes, crayons, and chalk adhesive (United State Department of Agriculture USDA, 2016). Pig manure is widely used as organic fertilizer. Fat from pig (lard) is used in the production of shaving cream, soap, make-up, etc. The skin of a pig can be used to produce football and clothing items. The pancreas is used in the production of insulin. Pig production provides a veritable source of income for farmers and the national economy.

Irekhere (2012) observed that pig production contributes about 10% of the total annual revenue derived from animal production. Compared to other livestock. Pigs possess qualities which endear them to farmers. The outstanding qualities which grant pig potential advantages over other livestock and make them suitable for profit-based business venture in Nigeria are numerous. The National Agricultural Advising Services (NAAS) (2021) identified these advantages to include high feed conversion efficiency, utilization of a wide variety of feed stuffs into valuable nutritious meat, high prolificacy, little investment on buildings and equipment; and quick returns since the marketable weight of fatteners can be achieved within a period of 5 – 8 months.

Pig production enterprises can be categorized into farrow to finish, farrow to wean, wean to finish, feeder pig production, seed stock production, and pure-bred production. Pig production phase refers to the stage at which pigs are reared and sold by the farmers. This essentially depends on the pig production enterprise(s) a farmer chooses(s) to embark on. Segunle (2012) identified the grower and finisher phases. While some farmers sell their stock at grower phase (up to a market weight of 18 to 20kg), others sell at the finisher phase (30kg and above). The finisher phase of pig production enterprise is the stage at which the pigs have reached maturity (market/table size), aged between 14 – 25 weeks and attain a weight of between 60-100kg (Agada, 2019). The cost of production as well as the unit price per pig at different phases vary depending on the efficiency in the utilization of production resources.

Efficiency is attained or achieved by using the lowest number of inputs to produce greatest amount of output. Efficiency means reducing the wastage of amount of input used in production. Efficiency in production encompasses economic, productive, and technical efficiency among others. Economic efficiency considers the allocation of resources and reflects the optimal allocation of resources that maximizes overall well-being of the business. Economic efficiency describes a state where resources are allocated in a way that maximizes production of goods and services at the minimum cost and waste level. In an economically efficient situation, resources are allocated in a way that maximizes total societal welfare,

considering both production efficiency and the distribution of goods and services (Segunle, 2012). Economic efficiency entails the choice of the best combination of resources for a particular level of output which is determined by the price of both the inputs and outputs. According to Welker (2017), economic efficiency is attained when the variable inputs of production such as feeds, medication, labour, utilities among others are utilized in such a way that expense incurred are at their lowest level and at the same time realize the highest output by pig farmers. Economic efficiency in the context of this study is a situation where the pig farmer utilizes available inputs in a manner as to get highest output relative the cost of inputs used. Economic efficiency is measured as the function of the actual value of an economic variable divide by the potential value of the economic variable. Economic efficiency depends on level of prudence in the use of resources to attain productive efficiency.

Productive efficiency focuses on the production process and assess whether a firm is producing goods or services at the lowest possible cost given the existing technology, labour, and other resources. Agada (2019) pointed out that a firm that achieves productive efficiency operate at the lowest point on its production cost curve, minimizing waste and ensuring cost-effectiveness. Such an entity operates at maximum capacity. Productive efficiency means making goods and prudent use of resource such as feed, medication, labour, utilities, income, and fund in the production of pigs for marketing, to reduce unnecessary waste of resource and be profitable in the business operation. It entails using the least amount of these resources at the lowest cost but yielding the highest output. According to Kenton (2018), Kaka, Shamsudin, Radam and Latif in Terfa (2020), productive efficiency is achieved when a product is created at its lowest average total cost. Productive efficiency is measured by dividing the output rate by the standard output rate multiplied by 100. It is based on the ability of an enterprise to produce the highest number of units of a good which is related to technical efficiency.

Technical Efficiency is viewed as the effectiveness with which a given set of input is used to produce an output (Tejvan, 2017). Technical efficiency measures how well a firm utilizes its resources (inputs) to produce a given level of output. It assesses whether a firm is using the optimal combination of input example (Labor, Capital, Materials) to maximize its production efficiently (Welker, 2017). Firms that operate with high technical efficiency produce more output for a given set of inputs, reducing wastage and costs. An enterprise shows technical efficiency if it produces the maximum output from the minimum quantity of inputs. According to Carvalho, Zilli, Mendes and Bonaning (2015), if a pig farmer produces more piglets with less input than other farmers, such is considered technically efficient. Technical efficiency is concerned mainly with the physical relationship between input and output. The technical efficiency is obtained by dividing the actual output from a given inputs by the maximum potential output divide by 100. In pig production, technical efficiency refers to the utilization of inputs such as feeds, medication, labor, utilities among others during production such that pigs are reared at minimal use of resources and wastage is reduced during production process. Efficiency in production implies that expenses incurred are at their lowest ebb and at the same time yielding the highest output for the pig farmer.

Profit is a financial benefit that is realized after the amount of revenue gained from a business activity exceeds the expenses, costs, and taxes needed to sustain a business activity. It is the surplus remaining after total costs are deducted from total revenue (Tobin & Collins,

2017). Conventionally, profit is an absolute number determined by the amount of income or revenue above and beyond the cost or expenses incurred. It also refers to the total income earned by the enterprise during the specified period after expenses are paid. Profit is conventionally calculated by subtracting expenses from total revenue. The value, worth, or strength of the profit depends on the ratio of the profit to the total revenue of the business which is described as profit margin.

Profit margin is a financial metric that measures profitability of a business by calculating the percentage of profit earned relative to its total revenue. It is often expressed as a percentage and can be calculated using the formula: $\text{Profit margin} = \text{Net Profit} \div \text{total Revenue} \times 100\%$. High profit margin indicates efficient cost management and profitability, while low margin may suggest challenges in controlling cost or pricing strategies. Profitability is a broader concept that assesses how effectively business generates profit relative to its resources and investments. It is measured using various financial ratios and metrics, such as profit margin, return on investment (ROI), return on assets (ROA) and return on equity (ROE). Profitability indicates the overall success and sustainability of a business (Agada, 2012). Profitability provides knowledge of the economic state of the business and helps entrepreneurs to be efficient in their management decisions and not to be wasteful in their spending, their time and money thus yielding a positive economics of production. Economics of production refers to utilizing the minimum quantity of resources by the pig farmer to obtain maximum benefit. It entails wisely allocating the various inputs such as feeds, medication; utilities and litter among others which the pig farmer spends money on to avoid wastage of those resources to be profitable. Profitability indicates the overall success and sustainability of a business (Agada, 2012). Profitability provides knowledge of the economic state of the business and helps entrepreneurs to be efficient in their management decisions and not to be wasteful in their spending, their time and money thus yielding a positive economics of production. Economics of production refers to utilizing the minimum quantity of resources by the pig farmer to obtain maximum benefit. It entails wisely allocating the various inputs such as feeds, medication; utilities and litter among others which the pig farmer spends money on to avoid wastage of those resources to be profitable. Most often, pig farmers encounter several constraints which threaten the profitability of the business.

In Cross River State, pig farmers sell their pigs at almost any stages of production (grower stage to the finishing stage) all to make profit. However, it is not certain which phase yields the highest returns on investment. Most farmers believe that the longer the pigs stay in the farm after the initial maturity, the higher the weight gain and the higher the price when disposed. Also, the longer the pigs stay on the farm, the more the resources spent on feeds and other variable cost, thus increasing cost of production. For the pig farmer to make a profit, the income from the sale of the pig and its products must be higher than the cost of rearing.

Farmers most often focus on the profit which is an absolute number and think less or are unaware of the profitability of the farm business which is a broader concept that assesses how effective a farm business generates profit relative to its resources and investments; and indicate overall success and sustainability of the pig farm enterprises. Most farmers do not really know the best age or stage of maturity to market their pigs for highest profitability. Pig

farmers most often incur greater cost of production relative to the profit when they eventually dispose the pigs. This reduces their profit and profitability as well as the sustainability of such farms leading to premature death and fold up of most pig production enterprises. This situation reduces the pig farmers' income and earnings, increases the cost of production, raises the rate of poverty, threatens the survival of the farms, and pose a threat to national food security, thus the need to determine the technical efficiency of pigs sold at different phases of production.

Purpose of the study

The general purpose of the study was to determine the technical efficiency of different pig production phases for farmer's profitability for farmer's profitability in in Cross River State, Nigeria.

Research Question

This study answered this research question, Is the technical efficiency of different pig production phases for farmer's profitability in Cross River State?

Research hypotheses

These null hypotheses guided the study. There is no significant difference in the technical efficiency of pigs sold at different production phases.

Methodology

The study adopted experimental research designs. The study was carried out in Cross River State, Nigeria. The population for the study was 22 piglets of Large White (Yorkshire). The piglets were between 15 to 21-days of age. At this age, the piglets had reached weaning stage and are able to feed on other feed materials. The pigs were raised and finally sold out in three phases of 10, 14, and 18 weeks of rearing. The sample for the study comprised 18 healthy piglets. The 18 piglets were selected through purposive sampling. The instrument for data collection was made up of templates. The templates were used for recording the information such as cost of piglets, cost of feeds, and daily feed consumption rate among others. The template comprised of summary sheet for the phases of production, daily feed consumption record, purchase record, sales record, The instrument was validated by three experts, one from the Department of Agricultural Education, Faculty of Vocational and Technical Education, and two from the Department of Animal Science, Faculty of Agriculture, University of Nigeria, Nsukka.

Experimental procedure

In the first two weeks of the arrival of the piglets to the farm, all the piglets were raised together. They received the same type and quantity of feeds. All the pigs were vaccinated on arrival at the farm. At the end of the first two weeks, the piglets were randomly allocated to three groups A, B and C with each group having six piglets. All the treatment groups received the same treatment throughout the period of the experiment. It was also

assumed that the conditions in each of the pens, the health of the piglets, the feed quantity and quality were all the same.

At the end of the first twelve weeks of rearing, two piglets were randomly selected from each group. One was sold live, and the amount realized recorded while the other slaughtered, meat processed, sold and amount realized recorded. This marked the first phase of production. At the end of sixteen week of rearing (phase 2), two pigs were randomly selected from each group, one was sold live and the other slaughtered, the meat sold, and the amount realized recorded. At the end of twenty week of rearing (phase 3), the remaining two pigs in each of the three groups were picked, one each was sold live while the remaining one from each group was slaughtered, the meat sold, and the amount realized was recorded. At each of the phases, data on the feed intake of the pigs, average body weight, and daily weight gain among others as well as the cost of inputs such as piglets, vaccines, labor, and facilities were recorded.

Measures were taken to control the extraneous variables in the study. Where a pig could not be sold at the end of a particular phase of production due to non-availability of buyers, the weight of the pigs was taken and the prevailing market price for the size of pig was taken as the selling price. For the slaughtered pig, the carcass weight was taken and the prevailing market price per kilogram weight of the meat was taken as the selling price. Also, to control for the age of the piglets, a range of 15 – 21 days old piglets were purchased as taken to be of the same age. This allowed for uniformity in the treatment procedures.

Methods of data collection

Data in the study was collected by recording inputs, outputs, costs, and revenue for each production phase. Weigh back technique was used as a method of data collection regarding the feeding. The weigh back technique is a method in which the pigs were served a specified quantity of feed every morning. In the morning of the following day, the remaining quantity of feed was weighed again. The quantity of feed consumed was determined by subtracting the quantity of feed left from the quantity of feed served.

Data on the feed intake of the pigs, average body weight, and daily weight gain among others were measured and recorded. The data on the feed intake was obtained by subtracting the leftover feed every morning from the feed supplied the previous day, while average body weight was obtained by dividing the total weight of the pigs in the group by the number of pigs measured. The daily weight gain was obtained by subtracting the previous day's weight from the current day's weight. The cost of inputs such as piglets, vaccines, labour, and facilities were recorded in each phase of production. At 12 weeks, 16 weeks, and 20 weeks, one pig was randomly selected from each of the groups, sold and the amount recorded. Also, one pig from each of the groups was slaughtered, the meat processed, sold and the amount recorded. In all the phases, the faeces of the pigs were collected on daily bases, sold and the money realized was included as part of income for each of the phase. At the end of this procedure, the different phases were calculated and evaluated to determine which phase recorded the highest technical efficiency.

Methods of data analysis

The Stochastic Frontier Regression Analysis was used to test hypothesis of the study.

Results

Research Question:

What is the technical efficiency of different pig production phases?

Data for answering research question is presented in Table 1.

TABLE 1

Stochastic Analysis of the Technical Efficiency of Pigs sold at Different Production Phases

Phases	No. of Pigs	Quantity of Feed (kg)	Water (Litres)	Medication (Litres)	Technical Efficiency	Percentage %
1	18	300	350.84	25.14	0.79648	79.65
2	12	120	150.73	11.97	0.89081	89.08
3	6	100	130.29	9.58	0.88764	88.76

Data presented in Table 1 on the Stochastic Analysis of the technical efficiency of different pig production phases revealed that Phase 2 had the highest technical efficiency of 0.890 (89.08%), followed by Phase 3 with a technical efficiency of 0.887 (88.76%), while Phase 1 had the least technical efficiency of 0.796 (79.65%). All the phases from 1 to 3 were reasonably efficient with technical efficiency ranging from 0.7965 to 0.891, although Phase 2 had the highest technical efficiency.

Hypothesis: There is no significant difference in the technical efficiency of pigs sold at different production phases.

TABLE 2

Stochastic Frontier Regression Analysis of the Relationship between the Technical Efficiency Variables and Average Body Weight of the Pigs

Frontier normal/normal model		Number of obs = 9				
		Wald chi2(6) = 3661.01				
		Prob> chi2 = 0.0000				
Log likelihood = 23.4125						
Weight	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
Frontier						
Feed	0.0298517	0.0024517	8.09	0.000	0.0150219	0.0246322
Water	0.0591098	0.0079167	8.73	0.000	0.0535933	0.0846263
Medication	0.0380244	0.0043386	6.69	0.000	0.0205209	0.0375278
Kerosene	-0.8943191	0.0691461	-12.93	0.000	-1.029843	-0.7587952
Cons	-0.4103823	0.2617868	-1.57	0.117	-0.9234749	0.1027104

Data presented in Table 2 showed the stochastic frontier regression analysis of the relationship between the technical efficiency variables and average body weight of the pigs. In this frontier model, three phases were observed. The Wald chi-square with a probability of

0.000, which was significant at 0.05 showed that Frontier analysis fits this model. The result showed that feed, water, and medication were positively related to the average body weight of the pigs and were significant at 0.05.

Findings of the study

The findings on the technical efficiency of different pig production phases of pigs sold in different production phases showed that Pigs reared in phase 2 had the highest technical efficiency ratio followed by phase 3 and 1 respectively. The relationship between the technical efficiency variables were found to be statistically significant.

Discussion of Findings

Pigs reared in phase 2 had the highest technical efficiency ratio followed by phase 3 and 1 respectively. This finding aligns with those of several researchers such as Babatunde and Fetuga, (2020), and Stolba, (2019). who found that the growing phase had an average technical efficiency score of 0.85, indicating that farms in this phase were able to produce 85% of the maximum possible output given their inputs.as against the breeding and finishing phases which had an average technical efficiency score of 0.78 and 0.82 respectively. The higher technical efficiency could be attributed to improved feed conversion ratios during this phase (Turner, 2019), enhanced management practices, such as vaccination and health monitoring Stolba, (2019), and optimal weight range for growth and feed efficiency (Jacquie, 2015). Jacquie (2015) found higher market demand for finished pigs at the finishing phase, typically occurs when pigs reach a weight of 99.79kg -108.86kg and offers the highest technical efficiency. The findings also align with those of Paulk (2014) who found that pigs sold at the phase 2 and 3 yields a higher percentage of pork and other products thus the higher technical efficiency.

Implication of Findings

The findings from this study have far reaching implications for profitability and sustainability of pig farms, wellbeing of pig farmers, poverty reduction, and food security

1. For the profitability and sustainability of pig farms: the findings of the study if implemented, would make pig farms to become more profitable and sustainable. Farmers will make more profit when they sell their pigs either live or slaughtered at the appropriate phase of production. This will minimize the waste of feeds and other production resources, maximize profit, and encourage the farmers to stay in business; reduce the rate of attrition of pig farms and promote their sustainability.
2. For the wellbeing of the farmers and their standard of living: the implementation of the findings will make farmers to sell their pigs at the most appropriate age and phase of rearing and make higher profits. Higher profits will mean more income and greater access to the necessities of life, lead better lives and enjoy a higher standard of lives. Further, if the strategies for improvement identified in this study are implemented, pig farmers will address most of the constraints they face in production and promotes their production efficiency and increase the scale of production.

3. For poverty reduction and national economic development: The findings of this study if implemented will lead to a more vibrant and profitable pig production sub sector, enhances the income of rural pig farmers, and reduce poverty. When farmers earn more from their farm businesses, they contribute not only to their rural economies, but to the national economic development.
4. For Food security: food security exists when food is available, accessible, and utilized by the people on a sustainable basis. The findings of this study if implemented will ensure an increase in the production of pigs and pig products and their ready availability on a sustained and affordable basis. An increase in the production of pigs because of the implementation of the strategies identified in this study will raise the intake of animal protein and reduce the prevalence of malnutrition related diseases, especially among rural dwellers.
- 5.

Conclusion

Pig production is a highly profitable enterprise and contribute to reducing poverty and promote food security. Based on the findings of this study, it is concluded that pig production is most profitable and pig farmers will make more profit when they sale their pigs at the third phase of production, while the technical efficiency is highest when pigs are sold in phase 2.

Recommendations

Based on the findings and the conclusion of the study, it is recommended that:

1. The agricultural extension agents should advice pig farmers to sell their Pigs in phase 2 for higher technical efficiency ratio. This advice can be given during their regular meetings with the farmers in their farms or designated points.
2. The Ministry of Agriculture through the agricultural extension agents should advice pig farmers to sell their pigs at the appropriate phase for highest profitability.
3. Farmers should be educated on the roduction (phase 3) to provide more feeds for the highest feed intake which will translate to the highest average body weight.

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