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Resource Use Efficiency And Agricultural Production: A Theoretical Examination Of Upland Rice Production In Nigeria

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ABSTRACT

Resource use efficiency is an important concern in agricultural production because farmers depend on limited resources to produce food and generate income. In rice production, the efficient use of land, seed, fertilizer, labour and agrochemicals is important for improving productivity and profitability. This paper examines resource use efficiency in upland rice production, with particular attention to the relationship between production resources, agricultural productivity and constraints affecting resource allocation. The paper has two objectives: to clarify the concepts of resource use efficiency and agricultural productivity in relation to upland rice production, and to examine how production inputs, resource allocation and production constraints influence resource use efficiency among upland rice farmers. A qualitative secondary content analysis was adopted. The main documentary source was a dissertation on resource use efficiency among upland rice farmers in the Federal Capital Territory, Nigeria, together with the empirical studies reviewed and cited in the dissertation. The analysis was guided by the microeconomic theory of production, particularly the relationship between inputs and output and the principle of allocative efficiency. The evidence shows that farm size, seed, fertilizer and labour contribute positively to rice output, although the resources are not all used at their economically optimal levels. Fertilizer was found to be under-utilized, while farm size, seed, agrochemicals and labour were over-utilized. The analysis also shows that limited access to credit, inadequate funds, high labour costs, high input costs, pests and diseases, transportation costs, land access and poor access to extension services can affect farmers' ability to allocate resources efficiently. The paper concludes that improving rice production requires not only increased access to productive resources but also better allocation and management of those resources.

Keywords: resource use efficiency, agricultural productivity, upland rice, production inputs, resource allocation, Nigeria.

1.0 INTRODUCTION

Rice has become one of the most important food crops in Nigeria. Its importance has increased because of population growth, changes in food preferences and the growing demand for rice as a major food item. The demand for rice in Nigeria has increased steadily since the 1970s, partly because of population growth and changes in the consumption of traditional cereals such as sorghum and millet. The increasing importance of rice in household consumption has created pressure on domestic production to meet growing demand (Cadoni & Angelucci, 2013; Seck et al., 2012).

Although Nigeria has considerable potential for rice production, domestic production has not always been sufficient to meet the level of demand. This has made improvement in rice productivity an important agricultural concern. The problem is not only the quantity of land cultivated or the number of farmers

involved in rice production. The way available production resources are used is also important. Rice production requires land, seed, fertilizer, labour and agrochemicals, and these resources involve financial costs. Their use must therefore be considered in relation to the output and returns obtained from them (Muhammad-Lawal et al., 2013; Udoh & Falake, 2016).

Resource use efficiency is important because farmers operate with limited resources. When a farmer uses too much of a particular resource, the cost of production may become unnecessarily high. On the other hand, when too little of an important input is used, the farmer may fail to achieve the expected level of production. The efficient allocation of agricultural resources is therefore important for improving productivity and profitability (Farrell, 1957; Olayide & Heady, 1982).

Farrell (1957) explained efficiency in relation to the ability of a production unit to obtain the maximum possible output from a given set of inputs. His approach introduced the idea of the production frontier, which provides a basis for distinguishing between efficient and inefficient production. A farm operating on the production frontier is considered technically efficient, while a farm producing below the frontier has the possibility of improving output with the resources available.

Resource use efficiency also has an allocative dimension. A farmer may be technically capable of producing a particular quantity of rice but may still use an inappropriate combination of inputs. Allocative efficiency therefore considers whether resources are used in the right proportions, taking their costs and the value of the additional output into account (Olayide & Heady, 1982). This distinction is important because a farm can be profitable and still use some resources inefficiently.

Agricultural productivity is closely related to resource use efficiency. Productivity is concerned with the relationship between the resources used in production and the output obtained. Improvements in agricultural productivity can result from better use of land, labour, capital and other production resources (Udoh & Falake, 2016). Oni et al. (2012) also emphasized the importance of increasing output per unit of input and achieving better allocation of resources in agricultural production.

The concern with resource use efficiency is particularly important in upland rice production because farmers often operate small farms and face limitations relating to finance, input costs, labour and agricultural services. Studies reviewed in the dissertation have shown that resource use efficiency varies across rice production systems and locations. Bamiro and Aloro (2013), for example, examined technical efficiency in swamp and upland rice production in Osun State and reported substantial differences in technical efficiency between the two production systems. Nwinya et al. (2014) also examined the economics of upland and lowland rice production in Ebonyi State and highlighted the importance of production resources in determining the economic performance of rice farming.

Evidence from other rice producing areas further demonstrates the importance of efficient resource allocation. Sani et al. (2016) examined resource use efficiency among rice producers in Kano State, while Fred et al. (2012) examined resource use efficiency in rice production under the Kpong Irrigation Project in Ghana. Dominic et al. (2019) also examined technical and resource use efficiency among smallholder rice farmers in Northern Ghana. These studies indicate that the availability and use of production resources are important considerations in understanding rice productivity.

The dissertation from which this paper is developed examined resource use efficiency among upland rice farmers in the Federal Capital Territory, Nigeria. The study covered Gwagwalada, Kwali and Abaji Area Councils, which were identified as important rice producing areas in the Federal Capital Territory. The study involved 212 upland rice farmers and focused on the 2023 cropping season.

The findings of the study provide an important basis for examining resource allocation from a theoretical perspective. The study found that upland rice production was profitable, with a gross margin of ₦868,516.31 and a gross margin ratio of 74%. However, profitability did not mean that all resources were efficiently utilized. Farm size, seed, agrochemicals and labour were over-utilized, while fertilizer was under-utilized. This finding demonstrates the difference between profitability and resource use efficiency.

The study also found that farm size, fertilizer and labour had significant positive effects on rice output, while seed had a positive effect at the 10% level. Agrochemicals had a positive but statistically insignificant effect in the estimated Cobb-Douglas model. The production function produced an R^2 of 0.85, while the return to scale was 1.098, indicating increasing returns to scale.

The resource use findings must also be understood in relation to the constraints faced by farmers. Bureaucracy in accessing credit, inadequate funds, high cost of labour, pests and diseases, high cost of inputs, transportation costs, lack of access to land and poor access to extension agents were identified as important constraints. The limited access to credit was particularly notable, as only 3.77% of the farmers reported having access to credit.

These conditions suggest that farmers' decisions concerning resource allocation do not take place in isolation. The decision to use more or less of an input can be influenced by its price, availability and the farmer's capacity to obtain it. Consequently, understanding resource use efficiency requires attention to both the production relationship and the wider conditions under which farmers make production decisions.

The theoretical basis for this paper is therefore the microeconomic theory of production. The theory provides a framework for understanding how farmers combine different inputs to produce output and how the allocation of those inputs affects production efficiency. The paper draws from the concepts of technical efficiency, allocative efficiency, production frontier and marginal productivity to explain the resource use situation among upland rice farmers.

The paper therefore provides a theoretical examination of resource use efficiency and agricultural productivity in upland rice production. It focuses on the concepts underlying efficient resource allocation, the relationship between production inputs and output, and the constraints that may prevent farmers from achieving optimal resource use. The analysis is based on the dissertation and the relevant literature reviewed within it.

2.0 Objectives of the Paper

The paper has two objectives:

1. To clarify the concepts of resource use efficiency and agricultural productivity in relation to upland rice production.
2. To examine theoretically and empirically how production inputs, resource allocation and production constraints influence resource use efficiency among upland rice farmers.

3.0 Conceptual Clarifications

3.1 Resource Use Efficiency

Resource use efficiency is the central concept of this paper. The concept is based on the microeconomic theory of the enterprise and the idea that production requires the combination of different resources. A farmer is concerned not simply with obtaining output but with obtaining the best possible output from the resources available.

The dissertation identifies the production frontier as an important part of understanding efficiency. The production frontier represents the lowest quantity of inputs required to produce a particular level of output when production is carried out efficiently. A farm that operates on the frontier is considered efficient, while one operating below the frontier is considered inefficient.

Farrell (1957) distinguished between technical and allocative efficiency. Technical efficiency refers to the ability of a farm to produce the maximum possible output from a given quantity of inputs. In practical terms, a technically efficient farmer can increase output without increasing the quantity of inputs used. The farmer can also produce the same quantity of output with fewer inputs.

Allocative efficiency is concerned with the choice and combination of inputs. A farmer may be technically efficient but still use resources in proportions that do not maximize profit. Allocative efficiency therefore requires consideration of the prices of inputs and the value of the additional output generated by each input.

The dissertation explains that maximum resource productivity involves obtaining the highest possible output from the fewest inputs. Optimal resource productivity concerns how well resources are employed during the production process. This shows the close relationship between productivity and efficiency.

In agricultural production, resource use efficiency can be examined through the marginal value product and marginal factor cost. The marginal value product indicates the additional value of output resulting from an additional unit of input. The marginal factor cost represents the cost of acquiring an additional

unit of the input. When the marginal value product is equal to the marginal factor cost, the resource is considered efficiently allocated.

The relationship can be expressed as:

MVP/MFC = 1

When the ratio is equal to one, the resource is efficiently utilized. A ratio below one indicates over-utilization, while a ratio above one indicates under-utilization. This approach was used in the dissertation to assess the efficiency of farm size, seed, fertilizer, agrochemicals and labour.

Resource use efficiency therefore goes beyond simply asking whether a farmer uses an input. It asks whether the quantity of the input used is economically justified in relation to the additional output it produces.

3.2 Agricultural Productivity

Productivity is another important concept in understanding resource use efficiency. Udoh and Falake (2016) described productivity as a measure of the efficiency with which resources are used in agricultural activities. Agricultural productivity can generally be considered as the relationship between total farm output and the inputs used to produce that output.

The dissertation also explains productivity through marginal physical product. Marginal physical product refers to the increase in total output resulting from an increase in the use of a particular input, while other factors remain constant. It therefore provides a basis for understanding the contribution of individual inputs to agricultural output.

Agricultural productivity can be considered in relation to labour, land, capital, water and management. For example, labour productivity can be considered by relating total output to labour input. Land productivity can be considered by relating output to the quantity of land used. Similar approaches can be applied to other production resources.

The importance of productivity lies in the fact that improvements in productivity can contribute to broader economic development. Oni et al. (2012) argued that productivity research should seek ways of increasing output per unit of input and achieving better allocation of resources between firms, within firms and between sectors.

For upland rice production, productivity is therefore closely related to the amount of rice obtained from land, labour, fertilizer, seed and other inputs. Where the same quantity of resources can produce more rice, productivity has improved. Where resources are used without corresponding increases in output, efficiency becomes a concern.

3.3 Technical Efficiency

Technical efficiency refers to the ability of a farm to obtain maximum output from a specified set of inputs. Farrell (1957) provided the basis for this understanding. A technically efficient farm operates on the production frontier.

The concept is important because farmers may have access to similar resources but obtain different levels of output. The difference may be associated with how the resources are organized and managed.

A farm can improve its technical efficiency by increasing output while keeping the quantity of inputs constant. It can also improve efficiency by maintaining the same level of output while reducing the quantity of inputs used. The closer the farm moves toward the production frontier, the greater its technical efficiency.

The dissertation notes that technical efficiency reflects the technological side of production, while economic efficiency also considers prices and other value factors. A technically efficient farmer is therefore not necessarily economically efficient. Economic efficiency requires both technical efficiency and appropriate allocation of resources.

3.4 Allocative Efficiency

Allocative efficiency focuses on whether the farmer selects the most appropriate combination of production inputs. It takes the prices of inputs and the value of output into account.

For example, if the cost of fertilizer is lower than the value of the additional rice produced through its use, there may be a reason for the farmer to increase fertilizer application. If the cost of an input is higher than the value of the additional output it produces, the farmer may be using too much of that resource.

The MVP/MFC approach provides a practical basis for determining allocative efficiency. A ratio of one indicates the point of optimum allocation. A ratio below one indicates that the resource is being used beyond the economically desirable level. A ratio above one indicates that the resource is being used below the economically desirable level.

3.5 Production Inputs

Production inputs are the resources used in the production of rice. The dissertation identified fertilizer, labour, agrochemicals, farm size and seed as the major explanatory variables in its production function.

Fertilizer is used to improve soil fertility and increase crop yields. The dissertation expected fertilizer to have a positive relationship with rice output.

Labour is an important agricultural resource, particularly in activities such as land preparation, planting, weeding and harvesting. Labour was also expected to have a positive relationship with output.

Agrochemicals include herbicides and pesticides. They are used to control weeds, pests and diseases. Although the dissertation expected agrochemicals to contribute to production, the estimated coefficient in the final Cobb-Douglas model was not statistically significant.

Farm size refers to the area of land cultivated for rice production. The dissertation expected larger farm size to be associated with greater output.

Seed is the foundation of crop production. The quantity and quality of seed can influence crop establishment and final output.

3.6 Profitability

Profitability refers to the relationship between revenue and production costs. The dissertation considered costs and returns as the basis for assessing the profitability of rice production.

Gross margin is calculated by subtracting total variable cost from total revenue:

GM = TR − TVC

The dissertation found that upland rice production generated a gross margin of ₦868,516.31 per hectare and a gross margin ratio of 74%. This finding establishes that the production activity was profitable even though the resources employed were not all efficiently utilized.

Profitability and resource use efficiency are therefore related but different concepts. A farmer can operate a profitable farm while still using some resources inefficiently. This distinction is important in understanding the findings of the study.

4.0 MATERIALS AND METHODS

4.1 Research Design

This paper adopted a qualitative research approach based on secondary content analysis. The purpose was not to generate new field data but to examine and interpret information already contained in the dissertation titled *Resource-Use Efficiency among Upland Rice Farmers in Federal Capital Territory, Nigeria*.

The documentary material consisted of the background to the study, conceptual review, theoretical discussions, empirical review, methodology, findings, discussion, conclusion and recommendations contained in the dissertation. The empirical studies cited and discussed in the dissertation were also considered as part of the documentary material.

4.2 Source of Data

The major source of information was the attached dissertation. The dissertation examined upland rice production in the Federal Capital Territory and generated information from Gwagwalada, Kwali and Abaji Area Councils.

The original study used primary data collected from 212 upland rice farmers during the 2023 cropping season. For the present paper, those findings are treated as documentary evidence rather than as newly collected primary data.

The dissertation also reviewed studies on rice production and resource use efficiency in Nigeria, Ghana, Nepal, India and other locations. These studies were used in this paper to explain the development of the resource use efficiency argument.

4.3 Method of Content Analysis

The content analysis focused on four areas. The first was the conceptual discussion of efficiency and productivity. The second was the theoretical explanation of production and resource allocation. The third was the empirical evidence concerning production inputs and resource use efficiency. The fourth was the constraints affecting the ability of farmers to use resources efficiently.

The material was read in relation to the two objectives of the paper. Relevant arguments, findings and explanations were organized under the conceptual, theoretical and empirical sections. Particular attention was given to the relationship between inputs and output, the MVP/MFC approach, production efficiency and the constraints identified among upland rice farmers.

The approach is qualitative because the purpose of the paper is to interpret and organize existing textual evidence. No new questionnaire, interview or field observation was undertaken.

4.4 Study Context

The original study was conducted in the Federal Capital Territory, Nigeria. The territory covers about 8,000 square kilometres and is centrally located in Nigeria. The dissertation identified Gwagwalada, Kwali and Abaji as the major rice producing areas selected for the study.

The Federal Capital Territory has conditions suitable for agricultural production. Crops grown in the territory include maize, millet, rice, cowpea, groundnut and eggplant. The study therefore situated upland rice production within a broader agricultural environment.

5.0 Theoretical Framework

5.1 Microeconomic Theory of Production

The main theoretical framework adopted for this paper is the microeconomic theory of production. This framework is appropriate because the central concern of the paper is how farmers combine production resources to obtain output.

The theory of production considers the relationship between inputs and outputs. In agricultural production, inputs include land, labour, seed, fertilizer and agrochemicals. Output is the quantity of agricultural product obtained from these inputs.

The basic production relationship can be represented as:

$$\mathbf{Q = f(X_1, X_2, X_3, X_4, X_5, e)}$$

Where Q represents output, X represents the various inputs and e represents the error term.

The producer is assumed to combine available inputs in order to produce output. The farmer therefore has to decide the quantity of land, labour, seed, fertilizer and agrochemicals that should be used. The decision is influenced by the expected contribution of each input to production and the cost of acquiring it.

The theory is particularly relevant to resource use efficiency because efficiency requires the farmer to select an appropriate combination of inputs. A farmer who uses a large quantity of an input without obtaining sufficient additional output is not allocating the resource efficiently.

5.2 Production Frontier and Efficiency

The production frontier provides a basis for understanding technical efficiency. A farm that operates on the frontier is able to produce the maximum possible output from its available resources. A farm below the frontier is technically inefficient.

The dissertation uses this idea to distinguish efficient and inefficient production. Technical efficiency can be improved by increasing output with the same level of inputs or by maintaining output while reducing input use.

The production frontier therefore provides a benchmark against which actual production can be considered. It also explains why two farmers with similar resources may obtain different levels of output.

5.3 Allocative Efficiency under the Production Theory

Production theory also provides a basis for understanding allocative efficiency. A farmer must not only determine how much output can be obtained from a particular input but must also consider the economic value of that input.

The MVP/MFC ratio provides the link between production theory and resource allocation. When MVP equals MFC, the farmer has reached the point where the value of the additional output is equal to the cost of the additional input.

Where MVP/MFC is less than one, the input is over-utilized. The additional output obtained from the input is not sufficient to justify its cost. Where MVP/MFC is greater than one, the input is under-utilized because additional use of the input could generate more value than its cost.

This theoretical position directly explains the resource use findings of the original study.

5.4 Cobb-Douglas Production Function

The Cobb-Douglas production function was the preferred functional form in the dissertation because it produced the highest R^2 and significant variables compared with the other estimated forms.

The estimated Cobb-Douglas model included farm size, seed, fertilizer, agrochemicals and labour. The model produced an R^2 of 0.85 and an F-statistic of 229.38.

The coefficients showed that farm size, seed, fertilizer and labour had positive effects on upland rice production, while agrochemicals were not statistically significant.

The return to scale was 1.098. This indicates increasing returns to scale. In other words, a proportional increase in the specified inputs was associated with a more than proportional increase in output. The dissertation interpreted this result as indicating that upland rice production was at stage two of the production process.

The Cobb-Douglas model therefore supports the microeconomic production theory by showing how changes in production inputs are associated with changes in rice output.

6.0 LITERATURE REVIEW

6.1 Resource Use Efficiency in Agricultural Production

The literature contained in the dissertation shows that resource use efficiency has been examined in different agricultural settings. Farrell (1957) provided an important foundation by explaining production efficiency in terms of the relationship between actual production and the production frontier.

Coelli (1995) further contributed to the measurement of production efficiency and frontier models. The dissertation also draws on the work of Cooper, Seiford and Zhu (2004), which discusses data envelopment analysis as an approach to efficiency measurement.

In the agricultural context, Udoh and Falake (2016) considered resource use efficiency and productivity among farmers in Nigeria. Their approach supports the view that productivity can be examined by relating output to the resources used in production.

Obayelu et al. (2017) examined technical efficiency and the effects associated with the adoption of NERICA among farmers in Nigeria. Their study reinforces the importance of efficiency in improving agricultural production.

Studies on specific crops also demonstrate that inefficiency can occur even where farmers are actively engaged in production. Khalid, Kaka and Tukur (2018), for example, examined resource use efficiency in cassava production in Kebbi State. The study is used in the dissertation as a basis for comparing the utilization of agrochemicals and other production resources.

The literature therefore shows that resource use efficiency is not limited to rice production. It is a wider agricultural concern that affects the ability of farmers to obtain the best possible return from available resources.

6.2 Resource Use Efficiency in Rice Production

Several studies reviewed in the dissertation specifically examined rice production.

Nwinya, Obienusi and Onuoha (2014) conducted a comparative economic analysis of upland and lowland rice production in Izzi Local Government Area of Ebonyi State. Their study involved 112 rice farmers, with 56 farmers from upland production and 56 from lowland production. The study provided evidence on the economic performance of different rice production systems.

Bamiro and Aloro (2013) examined technical efficiency in swamp and upland rice production in Osun State. Their study used data from 96 swamp rice farmers and 94 upland rice farmers. The results showed a

major difference in technical efficiency between the two production systems. The mean technical efficiency was reported as 99% for swamp rice farmers and 56% for upland rice farmers.

Sani, Yakubu and Bello (2016) examined resource use efficiency among rice producers in Kano State. Their findings are important to the present discussion because the dissertation compares its fertilizer and seed results with those reported in Kano State.

Fred, Enoch and Philip (2012) examined resource use efficiency in rice production under the Kpong Irrigation Project in Ghana. The study considered the relationship between rice production and the use of production resources.

Muhammad-Lawal et al. (2013) examined the economics and resource use efficiency of rice production in Ogun State, Nigeria. Their study contributes to the evidence that resource allocation remains an important issue in rice production.

Dominic et al. (2019) studied technical and resource use efficiency among smallholder rice farmers in Northern Ghana. Their study used 126 smallholder rice farmers and applied the marginal value product and marginal factor cost approach. Stochastic frontier analysis was also used to examine factors influencing rice output and technical efficiency.

The study found that farm size, weedicide application and fertilizer use positively affected rice output, although some inputs were overused. The mean technical efficiency was 75%. Age, extension, household size, years of schooling and credit were identified as factors affecting technical inefficiency.

The findings from these studies indicate that resource use efficiency varies across production systems and locations. They also show that access to inputs alone does not guarantee efficient use of those inputs.

6.3 Production Inputs and Rice Output

The literature contained in the dissertation gives particular attention to farm size, seed, fertilizer, labour and agrochemicals.

Farm size is an important determinant of agricultural output because land provides the physical space for crop production. Nwinya et al. (2014) identified farm size as one of the factors influencing rice production in Ebonyi State. The dissertation similarly found that farm size had a positive and significant effect on upland rice output in the Federal Capital Territory.

Seed is another important production input. The dissertation found that seed had a positive coefficient and was statistically significant at the 10% level. A 1% increase in seed input was associated with a 7.2% increase in upland rice production.

Fertilizer had one of the strongest effects on rice production. The coefficient was 0.361 and was statistically significant at the 1% level. A 1% increase in fertilizer input was associated with a 36.1% increase in upland rice production on average.

Labour also had a positive and significant effect. The coefficient was 0.324 and was significant at the 1% level. A 1% increase in labour input was associated with a 32.4% increase in output.

Agrochemicals had a coefficient of 0.003 and were not statistically significant in the Cobb-Douglas model. This does not mean that agrochemicals have no agricultural value. It means that their contribution was not statistically established within the estimated model used in the dissertation.

6.4 Evidence on Resource Allocation

The resource use efficiency estimates from the dissertation provide a clear picture of resource allocation among the upland rice farmers.

Farm size had an MVP/MFC ratio of 0.03. This was interpreted as over-utilization. The dissertation suggested that the farmers could maximize profit by increasing farm size.

Seed had an MVP/MFC ratio of 0.13. This also indicated over-utilization. The dissertation associated this result with the possibility that farmers were applying seed above the required or standard rate.

Agrochemicals had an MVP/MFC ratio of 0.01. This indicated over-utilization.

Labour had an MVP/MFC ratio of 0.03, also indicating over-utilization.

Fertilizer produced a different result. Its MVP/MFC ratio was 2.07, which was greater than one and therefore indicated under-utilization. The dissertation associated this result with the availability and affordability of fertilizer. The farmers may not have had the right quantity or quality of fertilizer at the time it was required.

The findings show that resource use efficiency is not determined by the productive importance of an input alone. Fertilizer, for example, had a strong positive effect on output but was still under-utilized. This means that an input can be important to production while remaining insufficiently used.

6.5 Constraints and Resource Use Efficiency

The dissertation identified several constraints affecting upland rice production. Bureaucracy in accessing credit ranked first with a mean score of 3.92. Inadequate funds ranked second with a mean score of 3.89. High cost of labour ranked third with a mean score of 3.78.

Pests and diseases ranked fourth with a mean of 3.68. High cost of inputs ranked fifth with a mean of 3.55. High transportation cost ranked sixth with a mean of 3.25. Lack of access to land ranked seventh with a mean of 3.10. Poor access to extension agents ranked eighth with a mean of 2.53.

These constraints are important because resource use decisions do not occur in isolation. A farmer may know that fertilizer can increase output but may not be able to obtain enough fertilizer because of its cost or availability. Similarly, a farmer may wish to expand production but face difficulties in obtaining credit or land.

The dissertation found that only eight farmers, representing 3.77%, had access to credit, while 204 farmers, representing 96.23%, did not. This provides an important context for understanding the resource use efficiency results.

The literature reviewed in the dissertation also identifies capital shortages, pest and disease problems, lack of quality seeds, inadequate inputs and poor management as challenges affecting upland rice productivity.

7.0 DISCUSSION

The theoretical and empirical evidence presented in the dissertation establishes that resource use efficiency is an important component of agricultural production. The central argument of production theory is that output depends on the combination of production inputs. The farmer therefore needs to consider both the productive contribution and the cost of each input.

The findings from upland rice production in the Federal Capital Territory support this argument. The Cobb-Douglas model produced an R^2 of 0.85, showing that the specified production inputs jointly accounted for a substantial proportion of the variation in rice output. Farm size, seed, fertilizer and labour were positively related to output. This supports the theoretical expectation that production inputs contribute to agricultural output.

The strong effect of fertilizer is particularly important. Fertilizer had a coefficient of 0.361 and was significant at the 1% level. Yet the resource use efficiency ratio for fertilizer was 2.07, indicating under-utilization. This appears to present a clear difference between production contribution and resource allocation. Fertilizer contributes significantly to production, but farmers were not using it at the economically optimal level.

The result can be understood in relation to the constraints identified in the study. Inadequate funds and high input costs were major constraints. These conditions can limit farmers' ability to obtain fertilizer in the required quantity and at the required time. The under-utilization of fertilizer is therefore not simply a matter of farmers choosing to use less. It may also reflect the economic conditions within which production decisions are made.

Farm size provides another important example. Farm size had a positive and significant coefficient of 0.338 and a resource use efficiency ratio of 0.03. The low ratio indicated over-utilization under the decision rule used in the dissertation. At the same time, the study suggested that farmers could maximize profit by increasing farm size.

This finding illustrates the difference between production contribution and allocative efficiency. Farm size may contribute positively to output, but the existing level and manner of land use may not be economically optimal. The farmer may need access to additional land or a different production arrangement in order to improve resource allocation.

The result for seed also requires attention. Seed had a positive coefficient of 0.072 and was significant at the 10% level. However, the MVP/MFC ratio was 0.13, indicating over-utilization. This suggests that the farmers were obtaining additional output from seed, but the value of the additional output was lower than

the cost associated with the quantity being used. The dissertation linked this result to possible application of seed above the required rate.

Labour was positively related to output, with a coefficient of 0.324. Yet its efficiency ratio was only 0.03. Labour was therefore considered over-utilized. This result is important because rice production involves several labour-intensive activities. The dissertation notes that land preparation, planting, weeding, harvesting and processing all require labour. High labour cost was also ranked as the third most important constraint.

The result suggests that labour is necessary for rice production but may not always be used economically. Group farming and cooperative arrangements proposed in the dissertation could help address this problem by reducing the cost of labour through collective activities.

Agrochemicals were also over-utilized, with a ratio of 0.01. Unlike the other major inputs, however, their coefficient in the Cobb-Douglas model was not significant. This indicates that their economic use requires careful consideration. The result does not support simply increasing agrochemical application. Instead, the concern should be the appropriate quantity and timing of use.

The return to scale of 1.098 also provides important theoretical evidence. The value greater than one indicates increasing returns to scale. This means that an increase in all specified inputs would produce a more than proportional increase in output. The dissertation therefore concluded that upland rice production was at stage two of the production process.

The theoretical implication is that the production system has room for expansion. However, expansion should not simply mean increasing all inputs without considering their individual efficiency ratios. Fertilizer was under-utilized, while farm size, seed, agrochemicals and labour were over-utilized. Therefore, the appropriate strategy is selective improvement in resource allocation.

The findings also show the importance of institutional and economic conditions. Resource use decisions are influenced by access to credit, input prices, labour costs, extension services and land. The very low proportion of farmers with access to credit is particularly significant. When farmers cannot obtain funds when they are needed, they may be unable to purchase the appropriate quantity of production inputs.

The theoretical framework therefore needs to be understood within the actual conditions of agricultural production. The farmer operates within a market and institutional environment. Production theory explains the relationship between inputs and outputs, while the empirical findings show that prices, credit, input availability and other constraints affect the farmer's ability to reach the optimal point.

The literature reviewed also supports this position. Studies from Nigeria, Ghana, Nepal and India show different patterns of technical and resource use efficiency. These differences indicate that efficiency is influenced by production conditions and cannot be understood only in terms of the physical relationship between inputs and outputs.

The evidence from the Federal Capital Territory also reinforces the need to distinguish profitability from efficiency. The gross margin of ₦868,516.31 and gross margin ratio of 74% indicate that upland rice production was profitable. However, profitability did not mean that all resources were efficiently utilized. This distinction is important for agricultural policy because increasing profitability and improving resource allocation may require different interventions.

The theoretical lesson from the study is therefore straightforward. Efficient agricultural production requires the appropriate combination of resources. Farmers need enough inputs to achieve productive output, but they also need to avoid excessive use of resources whose additional contribution is lower than their cost. At the same time, inputs that have strong productive effects but are under-utilized should receive greater attention.

8.0 CONCLUSION

This paper examined resource use efficiency and agricultural production from the perspective of upland rice farming in Nigeria. The discussion was based entirely on the conceptual, theoretical and empirical materials contained in the dissertation on resource use efficiency among upland rice farmers in the Federal Capital Territory.

The paper established that resource use efficiency is rooted in the microeconomic theory of production. The theory emphasizes the relationship between inputs and output and the need for producers to select an appropriate combination of resources. Technical efficiency concerns the ability to obtain maximum output from available inputs, while allocative efficiency concerns the appropriate combination of inputs in relation to their costs and productive value.

The evidence from upland rice production supports the relevance of this theoretical position. Farm size, seed, fertilizer and labour contributed positively to rice output, while fertilizer had particularly strong influence. However, the resource use efficiency analysis showed that farm size, seed, agrochemicals and labour were over-utilized, while fertilizer was under-utilized.

The findings also show that resource allocation is affected by conditions surrounding agricultural production. Bureaucracy in accessing credit, inadequate funds, high labour costs, pests and diseases, high input costs, transportation costs, land access and limited extension access were identified as important constraints.

The study therefore demonstrates that improving agricultural production requires more than encouraging farmers to increase the use of inputs. Attention must also be given to the manner in which resources are allocated. The goal should be to increase output while ensuring that the cost of additional inputs is justified by the value of additional output.

9.0 Recommendations

Based on the theoretical and empirical evidence contained in the dissertation, the following recommendations are made.

First, government and financial institutions should simplify the processes involved in obtaining agricultural loans and credit. Bureaucracy in accessing credit was identified as the most important constraint faced by the farmers. Easier access to finance can enable farmers to obtain production inputs when they are required.

Second, farmers should be encouraged to form cooperative groups and associations. Cooperative arrangements can help farmers organize group farming activities and reduce the high cost of labour. They can also improve the ability of farmers to obtain inputs collectively.

Third, agricultural inputs should be purchased through farmer based associations where possible. Bulk purchasing can improve access to appropriate and quality inputs at more affordable rates.

Fourth, particular attention should be given to fertilizer availability. The resource use efficiency analysis showed that fertilizer was under-utilized despite its significant positive effect on rice output. Policies that improve the availability and affordability of fertilizer can therefore contribute to better production.

Fifth, farmers should receive practical training on the appropriate application of seed, agrochemicals and other inputs. The results showed that these resources were over-utilized. Agricultural extension agents should therefore be mobilized to train farmers on efficient resource allocation and farm management practices.

Sixth, agricultural policies should recognize that profitability does not necessarily mean efficient resource use. Programmes designed to improve rice production should therefore include measures for improving the efficiency of production resources.

Finally, policies for upland rice development in the Federal Capital Territory should address credit, input costs, labour, pests and diseases, transportation, land access and extension services together. These constraints are interconnected and can affect the farmer's ability to make efficient production decisions.

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