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Determination of Resource Use Efficiency of Rice Farmers in Kaambe District of Guma Local Government Area of Benue State, Nigeria

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Abstract This study examines the resource use efficiency of rice farmers in Kaambe district of Guma Local Government Area to help improve rice production in Benue State, Nigeria. A sample size of 100 rice farmers was randomly selected from four rice farming communities of the study area. Data collected were farm size, amount of fertilizer, herbicide/pesticide, planting seeds, farm labour and capital. A regression model was used as analytical tool. The Coefficient of determination (R^2) of productivity level by rice farmers is 0.812 with improved seeds and the farm hecterage as the most significant predictors of the productivity achieved by rice farmers. The research concludes that, rice farmers were making efficient use of available resources. Productivity level of rice farmers in the area was determined by 81.2% of the farm inputs such as farm size, fertilizer, herbicide /pesticide, planting seeds, farm labour and capital. These shows that, the variables can therefore be further exploited to improve productivity level of rice farmers to boost rice production in the area.

Keywords: *resource use, rice production, efficiency, Kaambe District*

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1. Introduction

Rice is an important food crop in Nigeria and its consumption is growing, particularly among urban dwellers. Rice contributes 90% of the food requirements of the country. The importance of rice in the Nigerian economy is also seen in its contribution to agricultural GDP and employment. Therefore as Nigeria struggles to achieve accelerated growth in food production, increasing the output of rice has become an important goal. The strategic nature of rice has long drawn the attention of policy makers who view promoting domestic rice production as a means of reducing dependency on imports, lowering the pressure on foreign currency reserves, ensuring stable and low-priced sources of food for people, and generating employment and income for rice growers [1].

Efficiency of resource use, which can be defined as the ability to derive maximum output per unit of resource, is the key to effectively addressing the challenges of achieving food security. Raising productivity in agriculture will certainly lead to availability of food and reduce the real price of food. Increased food production will have to come from increased yield. Production of rice in Nigeria is mainly in the hands of small scale farmers who are still using unimproved farming techniques. Actual yields of rice differ significantly from potential yields, and this has been attributed to low resource productivity [2]. It is, therefore, necessary to examine resource use efficiency among rice farmers.

However, the ability of rice farmers in Nigeria to adopt new agricultural technologies is affected by farmer and farm characteristics. Examples of such characteristics include age and household size of rice farmers, total number of years of farming, total land area used for rice production, and farmer's managerial ability or experience in rice farming. Others are extension visits and benefit of credit facility.

To do this, there is need to assess the current level efficiency of rice farmers and to identify the factors that affect their resource use efficiency. In fact, it is unlikely that the Nigeria government's objectives of increasing food supply and income as stated in the Growth and Poverty Reduction Strategy can be fully achieved unless positive steps are taken to adequately improve farmers' efficiency [3]. The critical question to be answered is: What is the level of resource use efficiency of rice farmers in Kaambe District of Guma Local Government Area of Benue State, Nigeria?

Most of the literature investigating the impact of improved agricultural input on farmers and the associated agro-based firms focuses on strategic assessment for agriculture and economic growth in rice producing regions, the dynamics of rural livelihoods, as well as commodity and market trends [4]. Increasingly, globalized markets are critically important for determining investment

priorities for rural development. Nesbitt [5] observed that, planning and prioritizing rice research requires a deeper understanding of the people's access to use of natural resources and other forms of capital such as physical, financial and social capital, their interactions with government agencies, None Governmental Organizations, and other institutions that influence their livelihood strategies. It is critically important to understand the changes in farmers' practices that are currently taking place and drivers of such changes, including farmers' knowledge concerning their technological choice and how the components of livelihood systems and rice technologies interact. Such an understanding provides the scientific basis for improved farm input design, targets and delivery [6].

The concept of efficiency is at the core of economic theory. Its crucial role in agricultural input/output has been widely recognized by researchers and policy makers alike. It is no surprise therefore, that considerable effort has been devoted to the analysis of farm business level efficiency in the developing countries. An underlying premise behind much of this work as found in the work of Awoyemi, Amao and Ehirim, [7] is that, if farmers and agricultural processors are not making use of the existing technology, their efforts designed to improve efficiency would be more cost-effective to introducing new technology as a means of ensuring efficiency in production. In contrast to the underlying premises by many scholars, Shehu, and Mshella [8] says, since increased productivity is directly related to production efficiency, it is imperative to raise productivity of the farmers by helping them reduce technological inefficiencies. This can be achieved through investigating the nature of resource productivity and efficiency in production of the farmers.

The concept of efficiency is concerned with the relative performance of the processes used in transforming given inputs into outputs. Farrel, [9] identified three types of efficiency: technical, allocative and economic efficiency. He went further to distinguish between the three types of efficiency thus:

Technical efficiency in production is the physical ratio of product output and the factor input, the greater the ratio, the greater the magnitude of technical efficiency. To Kahrajan and Veragunsingh [10], it is the ability and willingness of an economic unit to produce the maximum possible output from a given combination of inputs and technologies regardless of demand and market prices of outputs and inputs.

Allocative efficiency is concerned with choosing optimal sets of inputs. A firm is allocatively efficient when production occurs at a point where the marginal value product is equal to the marginal factor cost. While, economic efficiency is a situation where there are both technical and allocative efficiency. The simultaneous achievement of both efficiency conditions according to Ogundari and Aladejimokun [11], occurs when price relationship are employed to denote maximum profits for the firm or when choice indicators are employed to denote the maximization of other economic objectives [12]. So, economic efficiency refers to the choice of the best combination for a particular level of output which is determined by both output and input prices.

In a bid to help farmers increase productivity, the focus is usually on whether farmers are using better and improved technologies. It is however necessary to investigate whether these farmers are even making maximum use of what is available to them in terms of inputs so that the stakeholders involved in agriculture will be convinced that the new technologies they intend to introduce to farmers will be used efficiently and cost—effectively to boost output. Farmers might use resources rationally but not at the economic optimal level. As the aim of every agribusiness firm is to maximize profit whiles minimizing cost, it is pertinent to determine the efficiency of resource-use.

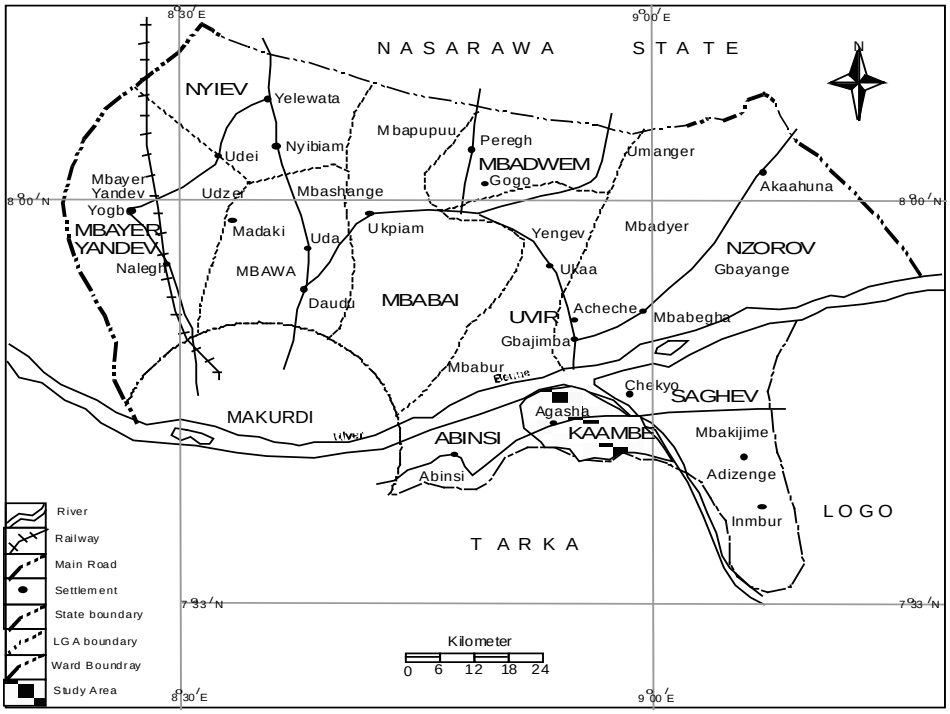

Figure 1. Map of Guma Local Government Area Showing Kaambe District (*Source: Ministry of Lands and Survey, Makurdi)*

2. Materials and Method

2.1. Study Area

Kaambe district is located between latitudes 7°38[1]N and 7°52[1]N and longitude 8°50[1]E and 9°05[1]N. The area shares boundary with Saghev ward to the east, on the north by Uvir ward, on the west by Abinsi ward all of Guma local government area of Benue State, and in the south by Tarka local government area of Benue state. The location of the area in Guma local government area is shown on Figure 1 and Figure 2.

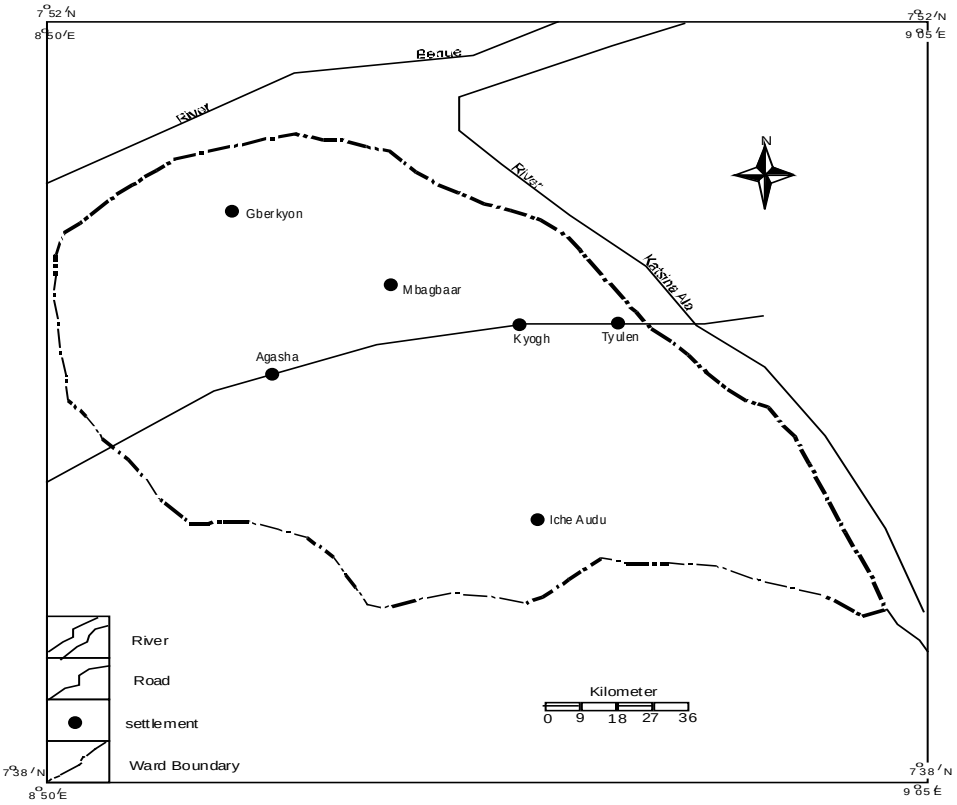

Figure 2. Map of Kaambe District Showing Rice Farming Communities *(Source: Derived from Ministry of Lands and Survey, Makurdi)*

Agriculture forms the backbone of Kaambe ward economy, engaging more than 70% of the working population in the area. Though the agricultural system was largely subsistent and depended highly on hand tillage with few people practicing mechanize farming. Although, mechanization has gradually crept in, use of farm inputs such as improved seeds, fertilizers, insecticides and herbicides is on the increase in the area [13].

Kaambe district is divided into four rice farming communities; Agasha, Tyulen, Mbagbaav and Gberkyon. A total of 100 rice farmers were randomly selected, twenty five each from the four rice farming communities of the area. Although, some the issues where not attended to by the respondents. Data collected for this study include: farm yield, amount of farm inputs such as farm size, fertilizer, planting seeds, herbicides/pesticides, labour and capital. This data were generated from both primary and secondary sources using the following instrument of data collection: questionnaire, interviews and field measurement. The data was analyzed using a regression model to determine the resource use efficiency of rice farmers in the area.

3. Results and Discussion

3.1. Characteristics of Rice Farmers in the Area

Age Distribution of Rice Farmers

Age determines to some extent how productive an individual is in carrying out agricultural activities. It plays an important role most especially in the traditional system of agriculture practiced in the third world countries.

Table 1. Age of respondent

S/No	Age	Respondent	Percentage (%)
1	15-29	09	10.23
2	30-44	42	36.96
3	45-59	28	31.81
4	60-74	06	6.82
5	75-89	03	3.41
	Total	88	100.00

Source: Author's Fieldwork, 2010

Table 1 shows that, 68.77% of the respondent were within the age category of 30 to 59 years, thus they are said to be in the productive age to be able to cope with the rigours of rice production. The mean age of respondent is 43.82 years which indicates that they were still very active. The active age of rice farmers implies that, their farm labour is productive.

3.2. Period of Rice Cultivation among Respondents

Rice a major commodity is an increasing important crop in the state and the country at large. Cultivation of

this crop decades ago attracted few farmers. Today, it has become a major food and cash crop due to the decline in maize production world over.

Table 2. Period of rice farming in the area

S/no	Years	Respondent	Percentage (%)
1	Below 5	10	11.11
2	6-10	21	23.33
3	11-20	39	43.33
4	21-30	13	14.44
5	31-40	04	4.44
6	41 and above	03	3.33
	Total	90	100.00

Source: Author's Fieldwork, 2010

Table 2 shows that majority of the rice farmers in the study area have stayed in the business of rice cultivation for between 11 to 20 years represented by 43.33% of the respondent. The mean period of rice cultivation of respondent was 15.69 years which indicates that rice cultivation in the study area is a recent phenomenon. However, with the increasing demand of rice, farmers are ready to adopt new rice farming practices in order to better their experience in rice production.

3.3. Efficiency of Resource Allocation by Rice Farmers

The concept of efficiency is at the core of economic theory. It indicates the maximum benefits derivable from optimal allocation and use of resources, in this case farm resources. The theory of production economies is concerned with optimization which implies efficiency. The important role of efficiency in increasing agricultural output has been widely recognized by researchers and policy makers alike. It is no surprise therefore, that considerable effort has been devoted to analysis of farm level efficiency in the developing countries. An underlying premise behind much of this work is that, if farmers are not making efficient use of the existing technology, efforts designed to improve productivity of farmers cannot be achieved. The efficiency of resource allocation by rice farmers in the area were determined by productivity level achieved by farmers as a result of farm inputs.

3.3.1. Determinants of Rice Farmers' Productivity in the Study Area

The productivity of rice farming in the study area is determined using a regression analytical technique. The formula is stated thus:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + e \quad (1)$$

Where: Y- Rice yield (kg)
a - constant
b_1, b_2, b_3, b_4, b_5, b_6 – plane of the variables
X_1 – Farm size (ha)
X_2 – Fertilizer (kg)
X_3 – Herbicide/pesticide (litre)
X_4 – Seeds (kg)
X_5 – Labour (man/day)
X_6 – Capital (Naira)
e – Error of estimate

Table 3. Model Summary

Model	R	R Square	Adjusted R Square
1	.901(a)	.812	.800

Source: Author's Analysis, 2010

Table 4 shows the factors that determine the productivity level achieved by rice farmers in the study area. It shows that, of the forms in which the variables used to explain the productivity level of the rice farmers were entered. A regression model that accommodates rice yield, their farm size, the quantity of herbicide/pesticide, the quantity of fertilizer, amount of labour used, planting seeds and capital. It showed that the six (6) independent variables regressed against rice yield (the dependant variable) in the study area gave a coefficient of determination (R^2) of 0.812 (Table 3). Thus the variation in productivity of rice farmers can be adequately explained (81.6%) by the identified variables (farm size, fertilizer, herbicide/pesticide, seeds, labour and capital). Thus, the six independent variables can explain 81.6% of the productivity of rice farmers. They can determine 81.6% of the variation that can be observed in the productivity level achieved by rice farmers in the study area.

Table 4. Determinants of Productivity level of rice Farmers

Model parameters		Unstandardized coefficients		Standardized Coefficients	T	Sig
		B	Std Error	Beta		
Code						
Farm Size (ha)	X_1	2.994	1.599	0.156	1.872	0.064
Fertilizer (kg)	X_3	1.159	0.530	0.196	2.188	0.031
Herbicide/pesticide (litre)	X_3	1.623	0.783	0.196	2.074	0.041
Seeds (kg)	X_4	3.181	1.278	0.249	2.489	0.015
Labour (man/day)	X_5	0.875	1.586	0.033	0.551	0.583
Capital (₦)	X_6	0.000	0.000	0.149	2.049	0.043
Constant	a	-20.531	8.619	-	-2.382	0.190

Source: Author's fieldwork, 2010

The table further shows that the seeds planted by the respondent was the highest predictor of the productivity level achieved by respondents, indicating that farmers with larger quantity of seeds were more productive. Followed by farmers with large farm size were also more productive than those that cultivated small holdings. The huge investment of farmers that cultivated large farms and quantity of planting seeds propelled them to be more productive in order to be able to recover production cost. The contribution of quantity of planting seeds and farm

size is followed by those of herbicide/pesticide, fertilizer, and labour with capital having an insignificant coefficient of determination. These variables can therefore be further exploited to improve productivity level of rice farmers to boast their economic status in the area.

There is thus need to encourage rice farmers to adopt the use of improved varieties and also open up new areas of land for rice cultivation to increase their output. Since, farm size and quantity of planting seeds have the tendency of propelling rice production in the study area. The predictor model of the study area is stated thus:

$$Y^* = -20.53 + 2.994X_1 + 1.159X_2 + 1.623X_3 + 3.181X_4 + 0.875X_5 + 0.00X_6 + e = Y \quad (2)$$

Where: Y* is predicted rice yield of the area and Y is estimated rice yield of the area.

3.3.2. Determination of Rice Yield Using Regression Model

Multiple regression analysis is a powerful technique used for predicting the unknown value of a variable from the known value of two or more variables also called the predictors. For instance the yield of rice per hectare depends upon quality of seed, farm size, fertilizer used, pesticide/herbicide and amount of labour used as shown in Table 5. Using equation 3, the following predictions were made for the communities of the study area.

Table 5. Determination of rice yield using the regression model

S/no	Community	Estimated	Predicted	SE
1	Agasha	79.36	72.26	5.10
2	Tyulen	66.40	60.91	5.49
3	Gberkyon	71.70	69.27	2.43
4	Mbagbaav	48.10	50.06	-1.96
	Total			11.06

Source: Author's fieldwork, 2010

The degree of uncertainty inherent in an estimate of rice yield regression plane expressed in units of standard deviation represents the standard error of estimates which is the error of multiple regression model in predicting actual values of rice yield in the area. The formula of standard error of estimate is stated thus:

$$\sqrt{\frac{\sum\left(Y - Y^*\right)}{N-1}} \quad (3)$$

Table 6. Standard error estimate

Community	Y	Y*	Y-Y*	$(Y-Y^*)^2$
Agasha	79.36	72.26	5.10	26.01
Tyulen	66.40	60.91	5.49	30.14
Gberkyon	71.70	69.27	2.43	5.91
Mbagbaav	48.10	50.06	- 1.96	3.84
				65.90

Source: Author's fieldwork, 2010

$$\text{Standard error of estimate} = \sqrt{\frac{\sum\left(Y - Y^*\right)}{N-1}} = \sqrt{\frac{65.90}{4-1}} = \sqrt{21.97} = 4.69$$

This implies that predicted values of rice yield of farmers in the study area with the regression model will deviate from actual value by 4.69 standard deviations.

Table 7. Analysis of variance for testing the significance of the regression model

Mode	Source of variation	Sum of Squares	df	Mean Square	F
	Regression	523275.677	6	87212.613	66.844
	Residual	121339.483	93	1304.726	
	Total	644615.160	99		

From Table 7:
Calculated F value = 66.844
Df = 6 under 93
Critical value = 2.29
Level of Significance = 0.05

At 0.05 level of confidence, the critical value of F from tables is 2.26. Since the F of 66.844 > 2.26, there is significant linear relationship between farm yield of rice farmers and the six (6) independent variables (farm size, fertilizer, herbicides, planting seeds, labour and capital).

4. Conclusion

In conclusion, rice farmers in Kaambe district of Guma local government of Benue State, Nigeria were making efficient use of available resources. Farm inputs such as farm size, fertilizer, herbicide /pesticide, planting seeds, farm labour and capital were the major predictors of productivity level achieved. These shows that, the variables can therefore be further exploited to improve productivity level of rice farmers to boost the economic status of rice farmers in the area.

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