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Resource-Use Efficiency in Rice Production Under Small Scale Irrigation in Bunkure Local Government Area of Kano State

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ABSTRACT: The study was conducted in Bunkure Local Government Area of Kano State to appraise the efficiency of the resources used in rice production under small scale irrigation. The specific objectives of the study were to determine resource use efficiency, describe socio-economic characteristics of irrigated rice growers and identify constraints to irrigated rice production among respondents. Data were collected using purposive simple random Sampling techniques involving three villages and sixty rice farmers. The data was analyzed using descriptive statistics and production function analysis. Data were fitted to two functional forms based on the OLS techniques. The Cobb-Douglas (power function) production function gave the best fit in terms of R^2 value and number of significant variables. The results revealed that 90.0% of the variation in dependent variable is explained by the independent variables. All the co-efficient carried positive signs. The result revealed that fertilizer, labour and land were being used inefficiently hence below optimum economic level. This was attested by the high ratios (greater than unity) of MVP/MFC of all the variables. For optimum resource allocation to fertilizer, labour and land about 85.7%, 83.3% and 69% increase in MVP is required respectively. The estimated elasticity of production summed up to 0.815 meaning decreasing return to scale. Major problems include lack of adequate fertilizer, capital and access to land. Agricultural Policies should be directed toward provision of farming input such as fertilizer and effective extension services for efficient resources utilization.

Keywords: Irrigation; Resources; Efficiency; Production

INTRODUCTION

Rice is an important traditional basic commodity contributing a significant proportion of the food requirements for the Nigerian population cultivated in almost all the agroecological zone in Nigeria (Adeola *et al.,* 2008). In recent years rice production had been on the increase but not sufficient to meet the demand of growing population and thus the need for importation of rice to make up for the short fall. By any estimate, the bulk of the food and fibre produced in Nigeria is from the rain fed agriculture, (Ingawa, 2007). Although irrigated farming accounts for only about 18% of the cultivated area in developing world, it produces about 40% of the value of agricultural output (Cai.*et al*., 2001). Irrigation therefore, holds the key for sustainable farming practice to meet our food self sufficiency and security needs. However in spite of the giant stride in irrigation development in Nigeria, its performance leaves a lot to be desired. This finds expression in lack of effective harnessing of this key variable with a view to stepping down, to the barest minimum, the devastating effects of drought prevalent in the northern part of Nigeria (Gani and Omonona, 2009).

In order to achieve optimum production level, resources must be available and whatever quantities of available resources must be used efficiently. Successful result oriented farm planning and policies require the knowledge of productivities of farm resources to know the resources whose quantity or rate of use should be increased or decreased, (Alimi, 2000). As a result of these, attention is presently being focused on small-scale irrigation systems for small scale farmers who constitute the bulk of the farming populace in Nigeria. (Abdussalam *et al.*, 2007). There is therefore a call for an appraisal of efficiency of the resources under small scale irrigation schemes. The main objective of the study is to determine the resources' utilization by small scale farmers in rice production under irrigation. The specific objectives are to:

1. Describe the socio-economic characteristics of the respondents.
2. Analyse the efficiency of the resources used in rice production.
3. Determine the problems encountered by farmers in rice production.

METHODOLOGY

The study was conducted in Bunkure Local Government Area of Kano State in north-western Nigeria, located in the semiarid zone, around latitudes $10^0 33'$ N to 12º03' N and longitudes $7^0 34'$ E to 8º32' E. The climate of the state is mainly the Sudanese type of the tropical wet-dry season which is characterized by 5-6 months of rainfall (from May to October) and 6-7 months of dry season with the mean annual rainfall of 792 mm (Olofin, 1985). Three villages where intensive irrigation is practiced were purposely selected. In each village twenty irrigated rice farmers were randomly selected from the list of the farmers producing at the irrigation site to come up with the total respondents of sixty farmers. Data were collected using structured interview questionnaire. Information was analysed using descriptive statistics and multiple regression analysis.

Model specification: Regression model was used to examine input-output relationship and the implicit form of the model is given by:

$$Y=f(X1, X2, X3, X4; e) \ldots\ldots\ldots (1)$$

Cobb-Douglas and Quadratic forms of production were fitted to the data. The Cobb-Douglas function gave the best fit and was chosen as the lead equation on the basis of the number of significant variables, magnitude of the R^2 and the signs of coefficients. The explicit form of the lead equation is given as:

$$\text{Log } Y = \text{Log } a + b_1 \text{Log } X_1 + b_2 \log X_2 + b_3 \text{Log } X_3 + b_4 \text{Log } X_4 + e \ldots\ldots\ldots (2)$$

Where:
Y = output (kg)
X_1 = seeds (kg)
X_2 = fertilizer (kg)
X_3 = labour (man-days)
X_4 = land (ha)
e = random error

$$r = \frac{MVP}{MFC} \ldots\ldots\ldots (3)$$

Where:

r = Efficiency ratio
MVP = marginal value product of a variable input.
MFC = Marginal factor cost (Price per unit input)

Marginal value products (MVP) were estimated using the regression coefficient of each input and the price of the output as expressed in equation (4). The resources are said to be efficiently used if its MVP is equal to its acquisition unit price. The MVP is calculated as;

$$MVP = bi \frac{\overline{Y}}{\overline{X}} \ldots\ldots\ldots (4)$$

Where bi = regression co-efficient of the variables
Y and X = values of log Y and log X when they assume their means.

The prevailing market price of inputs was used as the marginal factor cost (MFC) since the farmers were assumed to be operating under purely competitive inputs markets. On the basis of the economic theory, a firm maximizes profits with respect to resource use when the ratio of the marginal return to opportunity cost is one. The values were interpreted thus;

a) If $r < 1$, it means the resource in question was over utilized hence decreasing the quantity used of that resource increases profit.

b) If $r > 1$, it shows that the resource was being underutilized and increasing the rate of use will raise profit level.

c) If $r = 1$ it means resource was being efficiently utilized.

Marginal Value Product (MVP) Adjustment: The relative percentage change in MVP of each resource required so as to obtain optimal resource allocation that is r = 1 or MVP = MFC, was estimated using equation below:

$$D = \left(1 - \frac{MFC}{MVP}\right) \times 100 \ldots\ldots\ldots\ldots (5)$$

Where:

D = absolute value of percentage change in MVP of each resource.

RESULT AND DISCUSSION

Socio-economic Characteristics of the Respondents: Table 1 shows the distribution of the respondents according to their socio-economic characteristics which include age, size of household and educational status. Most of the farmers (76.67%) are middle aged between 30-49 which pre-supposed that many of them are in their active years. This agrees with the findings of Adeola, *et al.,* (2008) that rice producing farmers are in their active farming years and is likely to enhance their production. The results also show that about 91.66% of the respondents have six and above dependents in their household. This has direct implication on labour supply to the farm. The result also indicates that 58.33% Quranic educations, 13.33% attended adult literacy class, while 11.67% primary educations, and 16.67% secondary education.

Table 1: Distribution of respondents by socio-economic characteristics

Characteristic	*Frequency*	*Percentage*
Age (year)		
<30	5	8.33
30-39	15	25.0
40-49	31	51.67
50-59	7	17.0
60 and above	2	33.0
Size of household		
1	5	8.33
6-10	29	48.33
>10	26	43.33
Educational status		
No formal education	-	-
Koranic education	35	58.33
Adult literacy class	8	13.33
Primary education	7	13.33
Secondryeducation	10	17.0

Input-output Relationship: The result of Cobb-Douglas production function shows that, the values of the multiple determinations (R^2) is 0.909. This implies that 90.9% of the total variation in the dependent variable is explained by variation in the independent variables included in the model. The regression co-efficient of all the variables are positive, indicating that a unit increase in any of the variable holding others constant will lead to a unit increase in the gross output. The elasticity of production (e p) of all the variables summed up to 0.815 meaning decreasing return to scale, implying that, if these resources are increase by 1%, the output would increases by less than 1%. A study by Gani and Omonona (2009) on resource use efficiency among Small-Scale Irrigated Maize Producers in Northern Taraba State of Nigeria reveals the technical efficiency of farmers to be 0.731. Another study by Amaza and Olayemi (1999), have shown mean technical efficiency of 0.69.

Table 2: Regression co-efficient and t-values of Cobb-Doouglas production function

Variable	Regression co-effinencent	t-value
Seed (X1)	0.215	1.885 ns
Fertilizer(X2)	0.059	2.490*
Labour (X3)	0.251	2.372**
Land (X4)	0.505	5.271*

R2 =0.909; *significant at 1% level; **=significant at 5% level; Ns= not significant

Resource-Use Efficiency: The estimated coefficients of the relevant independent variables were used to compute the marginal value products (MVP) and their corresponding marginal factor costs (MFC). The ratio of the MVP to MFC was used to determine the resources efficiency as shown in equation (3).

Table 3 reveals that comparism of ratio of MVP to MPC shows resulting ratios to be greater than unity for all the variables. This implies that a unit increase in each input would increases the value of output, indicating that all the inputs are underutilized. This finding agrees with Shehu (2007) who carried out a comparative economic analysis of small-holder rain-fed and irrigated rice production in selected Local Government Areas of Adamawa State. The result revealed that for rain-fed rice husbandry, land, seeds, hired labour, fertilizer and herbicides were underutilized. For the irrigated system of rice production land and seeds were optimally utilized while labour, fertilizer and herbicides were under-utilized. This might be due to inadequate inputs supply by Government and financial constraints on the part of the farmers to purchase such inputs at market. Also lack of incentives to farmers for the use of improved technologies, most of them still use crude methods of production which contributes to using inputs below economic level and hence, low productivity (Rahman, *et al,* 2007).

Table 3: Marginal value product and unit factor cost

Input	Production elasticity	MVP	MVP	MVP/MFC
Fertilizer(X2)	0.059	7.00	1.00	7.00
Labour(X3)	0.251	30.00	5.00	6.00
Land (X4)	0.505	26.00	8.00	3.25
Estimate of return	To scale =0.815			

Table 4 shows the percentage adjustment in marginal value products for optimum utilization of inputs. Optimum utilization of inputs requires that marginal value product be equal to inputs unit price, that is marginal factor cost (MVP = MFC). 85.7% adjustment is required for optimum utilization in fertilizer, 83.3% required for labour and 69% for land. The result indicates that a lot need to be done to bridge the gap of optimum use of the resources in the area. This requires the efforts of farmers, marketers, and government agencies in charge with the agricultural sectors.

Table 4: Marginal value product (MVP) adjustment

Variable input	Percentage adjustment required (%)
Fertilizer	85.7
Labour	83.3
Land	69.0

Production Constraints: Most of the farmers (85%) indicated that fertilizer was the major constraint to irrigation farming. (70%) consider finance as the major problem, while (30%) indicated access to land as the main problem.

Table 5: Farmers production constraints

Constraints	Frequency	%
Fertilizer	51	85
Finance	42	70
Access to land	18	30
Other constraints	9	15

*Multilple responses

To alleviate the problem problems or constraints ,there is the need for concerted efforts by farmers to form cooperative societies with the view have organised input purchase and markets groups not individuals. This would greatly assist in reducing the gap of under resource utilization

Conclusion: Production resources in the study area were found not to be efficiently utilized hence not to optimum economic advantage. It, therefore, follows that increased food production will be negatively affected. This has far reaching implication for food production. These findings will serve as a bench-mark for a grass root agricultural planning in the area. It is expected that rice growers, government agricultural agencies and related bodies such as agricultural companies will effectively harness these findings amidst advances in agricultural technology in particular and sustainable agricultural development in general. It is recommended that inputs such as fertilizer and improved seed should be made available to the farmers by Government. Effective extension services should also be extended for proper and effective resources-utilization.

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