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Resource-Use Efficiency Among Upland Rice Farmers In The Federal Capital Territory, Nigeria

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ABSTRACT

Resource-use efficiency is central to improving the productivity and profitability of rice farming, particularly among smallholder farmers who operate under limited access to production resources. This study examined resource-use efficiency among upland rice farmers in the Federal Capital Territory (FCT), Nigeria. Specifically, the study assessed the socioeconomic characteristics of the farmers, determined the costs and returns of upland rice production, estimated the effects of major production inputs on rice output, examined the efficiency of resource utilisation, and identified the major constraints affecting rice production. A quantitative cross-sectional survey design was adopted. Data were collected from 212 upland rice farmers selected through a multistage sampling procedure from Gwagwalada, Kwali and Abaji Area Councils during the 2023 cropping season. Data were analysed using descriptive statistics, gross margin analysis, multiple regression and resource-use efficiency analysis based on the marginal value product and marginal factor cost approach. The findings showed that upland rice production was profitable, with a total revenue of ₦1,176,879.60 and a gross margin of ₦868,516.31, representing a gross margin ratio of 74%. The Cobb-Douglas production function provided the best fit, with an R^2 of 0.85 and an F-statistic of 229.38. Farm size, fertilizer and labour significantly increased rice output, while seed had a positive effect at the 10% level. Resource-use efficiency estimates showed that farm size, seed, agrochemicals and labour were over-utilised, while fertilizer was under-utilised. The major constraints were bureaucracy in accessing credit, inadequate funds, high cost of labour, pest and disease incidence, and high cost of inputs. The study concludes that improving access to production finance, reducing input costs, strengthening extension services and promoting more efficient allocation of farm resources are important for enhancing the productivity and profitability of upland rice farmers in the FCT.

Keywords: resource-use efficiency, upland rice, rice farmers, production inputs, gross margin, Federal Capital Territory, Nigeria

INTRODUCTION

Rice is one of the most important food crops in Nigeria and has become an important source of income and employment for households involved in its production, processing, marketing, and distribution. The crop is cultivated under different ecological conditions, including upland and lowland systems. In Nigeria, rice has a dual role as both a food and commercial crop, and rice-producing communities derive employment and income from different activities along the production and distribution chain (Ajala & Gana, 2015; Dogara & Jumare, 2014). Despite the importance of rice to household food consumption and agricultural livelihoods, domestic production has continued to fall short of demand, resulting in reliance on imports to bridge the supply gap. The dissertation from which this article was developed identifies a substantial gap between estimated rice supply and demand in Nigeria and notes that the expansion in production has not kept pace with consumption.

Rice production in Nigeria is undertaken in both lowland and upland environments. Upland rice production is particularly important because it can be undertaken under rain-fed conditions and does not depend on irrigation infrastructure in the same way as lowland and irrigated production. The study notes that upland rice accounts for an important proportion of rice production in Nigeria, although productivity remains relatively low. The productivity challenges confronting upland rice farmers include problems associated with land preparation, planting methods, soil fertility, weeds, pests and diseases, limited access to inputs, inadequate capital, poor-quality seeds, and weak disease-management practices (Seck et al., 2012). These constraints have implications not only for the quantity of rice produced but also for the efficiency with which farmers use scarce production resources.

The problem of resource use is particularly important in the context of smallholder agriculture. Farmers operate with limited land, labour, capital and production inputs and must make decisions concerning how much of each input should be committed to production. The efficient use of these resources is therefore central to improving farm output and profitability. Resource-use efficiency refers broadly to the extent to which available resources are combined and utilized in ways that maximize output or returns. Farrell (1957) distinguished technical efficiency from allocative efficiency, while Olayide and Heady (1982) emphasized the importance of identifying the most appropriate combination of inputs for achieving a given level of output. In agricultural production, efficiency is closely associated with productivity because higher productivity requires farmers to obtain greater output from available resources.

The increasing demand for rice makes the issue more pressing. Nigeria's rice demand has increased considerably over time, partly because of population growth and changing food preferences. The study reports that rice consumption expanded while the share of traditional cereals such as sorghum and millet declined. Although domestic rice production also increased, the growth in production remained insufficient to meet the increase in consumption (Amaechina & Eboh, 2016; Cadoni & Angelucci, 2013). The dissertation further reports that average upland rice production in Nigeria was about 1.8 tonnes per hectare compared with higher yields obtained under irrigation and in some other West African countries. This productivity difference raises questions about whether the resources available to Nigerian upland rice farmers are being used efficiently.

Previous studies have examined the economics, profitability and resource use of rice production in different parts of Nigeria and elsewhere. Nwinya et al. (2014), for example, compared upland and lowland rice production in Ebonyi State and found upland rice production to be profitable. Sani et al. (2016) examined resource-use efficiency among small-scale irrigation rice farmers in Kano State and found inefficient utilization of labour, fertilizer and land. Fred et al. (2012) also reported varying degrees of underutilization and overutilization of resources among rice farmers in Ghana. Similarly, Bamiro and Aloro (2013) found considerable differences in technical efficiency between swamp and upland rice farmers in Osun State. These studies demonstrate the importance of examining resource-use efficiency according to production ecology and location.

However, the dissertation identified a relative shortage of empirical evidence specifically addressing resource-use efficiency among upland rice farmers in the Federal Capital Territory. Some previous Nigerian studies concentrated primarily on profitability or general rice production without sufficiently examining the efficiency of resources within the upland production ecology. The present study therefore examined the costs and returns of upland rice production, the efficiency with which major inputs were utilized, the factors influencing production, the return to scale and the constraints confronting upland rice farmers in the Federal Capital Territory.

The study was conducted in Gwagwalada, Kwali and Abaji Area Councils of the Federal Capital Territory. These locations were selected because of their concentration of rice farmers. Primary data covering the 2023 cropping season were collected from 212 upland rice farmers using a structured questionnaire.

Objectives

The broad objective of the study was to examine resource-use efficiency among upland rice farmers in the Federal Capital Territory, Nigeria.

The specific objectives were to:

1. evaluate the costs and returns of upland rice production in the study area;

2. determine the resource-use efficiency of upland rice farmers;
3. examine the factors influencing upland rice production;
4. evaluate the return to scale of upland rice production; and
5. identify the constraints faced by upland rice farmers in the study area.

The study also tested the null hypothesis that input variables used by rice farmers do not affect rice output in the study area.

MATERIALS AND METHODS

Study area

The study was conducted in the Federal Capital Territory (FCT), Nigeria. The FCT is located in the central part of Nigeria and covers approximately 8,000 square kilometres. It is bounded by Kaduna State to the north, Niger State to the west, Nasarawa State to the east and southeast, and Kogi State to the southwest. The territory has a predominantly savannah environment and favourable conditions for agricultural production. Crops cultivated in the FCT include maize, millet, rice, cowpea, groundnut and eggplant.

The FCT experiences distinct rainy and dry seasons. The rainy season generally extends from March to October, while the dry season occurs from October to March, with a short harmattan period associated with the northeast trade winds. The study area therefore provides ecological conditions suitable for upland rice cultivation. The dissertation reports a population estimate of 2,820,261 for the FCT in 2020 (National Bureau of Statistics, 2021).

Research design and sampling

The study adopted a quantitative cross-sectional survey design. Primary data were collected from upland rice farmers during the 2023 cropping season using a structured questionnaire. A multistage sampling procedure was employed.

At the first stage, three of the six Area Councils in the FCT, namely Gwagwalada, Kwali and Abaji, were purposively selected because they were identified as major rice-producing areas with high concentrations of rice farmers. At the second stage, three rice-producing wards were selected from each Area Council, giving nine wards. The sampling frame contained 449 rice farmers. A proportionate sampling procedure was subsequently used to obtain a sample of 212 farmers.

Data collection and instrument reliability

Data were collected through a structured questionnaire administered to upland rice farmers. Professional enumerators associated with the Agricultural Development Project (ADP) were briefed and engaged for the data collection exercise. The questionnaire was subjected to validity and reliability assessment. Reliability was examined using Cronbach's alpha, while test-retest reliability was also assessed. The reported Cronbach's alpha coefficient was 0.7413, indicating an acceptable level of internal consistency for the instrument (Taherdoost & Group, 2017).

Measurement of variables and analytical techniques

The study used descriptive and inferential quantitative techniques. Gross margin analysis was used to estimate the profitability of upland rice production. Resource-use efficiency was estimated using the marginal value product (MVP) to marginal factor cost (MFC) ratio. Multiple regression analysis was used to identify the factors influencing upland rice production and to estimate returns to scale. A four-point Likert-type scale was used to rank production constraints. The hypothesis was tested using the t-test at the 5% level of significance.

The gross margin was calculated as:

$$\mathbf{GM = TR - TVC}$$

where GM represents gross margin, TR represents total revenue and TVC represents total variable cost.

Total revenue was calculated from the quantity and price of rice produced:

$$\mathbf{TR = P \times Q}$$

where P represents the price of rice per kilogram and Q represents the quantity of rice produced.

Resource-use efficiency was evaluated using the ratio of MVP to MFC. A ratio equal to one indicates optimum resource allocation. A ratio below one indicates overutilization, while a ratio above one indicates underutilization.

Three functional forms were estimated for the production relationship: linear, semi-log and Cobb-Douglas. The Cobb-Douglas function was selected as the lead equation because it produced the highest R^2 and contained more statistically significant explanatory variables. The dependent variable was rice output, while the explanatory variables were fertilizer, labour, agrochemicals, farm size and seed.

The Cobb-Douglas model was specified in the study as:

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

where Y represents rice output; X_1 is fertilizer measured in kilograms; X_2 is labour measured in mandays; X_3 is agrochemicals measured in litres; X_4 is farm size measured in hectares; and X_5 is seed measured in kilograms.

Return to scale was determined by summing the estimated production elasticities. Constraints were measured using a four-point scale comprising Strongly Agree = 4, Agree = 3, Disagree = 2 and Strongly Disagree = 1. A mean score of 2.5 was adopted as the decision threshold. Mean scores of 2.5 or above represented significant constraints.

RESULTS AND DISCUSSION

Socioeconomic characteristics of upland rice farmers

The socioeconomic characteristics of the 212 respondents are presented in Table 1.

Table 1: *Socioeconomic Characteristics of Upland Rice Farmers (N = 212)*

Variable	Category	Frequency	Percentage (%)	Mean
Sex	Female	139	65.57	
	Male	73	34.43	
Marital status	Single/Never married	28	13.21	
	Married/Living as partner	165	77.83	
	Separated/Divorced	7	3.30	
	Widow/Widower	12	5.66	
Household size	0–5 persons	185	87.26	4
	6–10 persons	27	12.74	
Age	0–30 years	3	1.42	47
	31–40 years	59	27.83	
	41–50 years	84	39.62	
	51–60 years	53	25.00	
	61 years and above	13	6.13	
Farming experience	0–10 years	38	17.92	21
	11–20 years	83	39.15	
	21–30 years	56	26.42	
	31–40 years	35	16.51	
Education	Non-formal	65	30.66	
	Primary	31	14.62	
	Secondary	67	31.60	
	Post-secondary	49	23.11	
Farm size	0–1 hectare	123	58.02	1.42 ha
	1–2 hectares	89	41.98	
Income from rice farming				₦1,994,127.40

Income from non-rice activities				₦201,084.94
Access to credit	No	204	96.23	
	Yes	8	3.77	
Extension contact	No	64	30.19	
	Yes	148	69.81	
Cooperative membership	No	57	26.89	
	Yes	155	73.11	

Source: Computed from field data, 2023.

The results show that women constituted the majority of the upland rice farmers, accounting for 65.57%, while men accounted for 34.43%. The predominance of women in upland rice production in the study area differs from findings from Ebonyi State, where male farmers dominated upland rice production (Nwinya et al., 2014; Chidiebere-Mark et al., 2019). The result suggests that the social organization of rice production differs across locations and production systems.

Most respondents were married or living with a partner (77.83%). The mean household size was four persons, while 87.26% had household sizes of between one and five persons. The relatively small household size is relevant because labour is an important component of rice production costs. Where family labour is insufficient, farmers may have to rely on hired labour, thereby increasing production costs. The result is consistent with the observation of Ugwu et al. (2017) that household members can make important contributions to farm labour.

The mean age of respondents was 47 years, indicating that the farmers were largely within active working ages. Farming experience averaged 21 years, suggesting that the respondents had substantial practical experience in rice production. Experience can be important in farm decision-making because farmers with longer experience are more likely to have accumulated knowledge concerning input use, production timing and resource allocation.

Education was also relatively widespread among respondents. A total of 69.34% had some form of formal education, comprising primary, secondary and post-secondary education. This level of educational exposure may facilitate farmers' access to information and their ability to understand and adopt improved production technologies. Similar observations were reported by Saliu et al. (2016) among rice farmers in Kogi State.

The mean farm size was 1.42 hectares, with 58.02% cultivating less than one hectare. This indicates that most respondents operated on a small scale. Small farm holdings can restrict mechanization and may affect the manner in which other resources such as labour, fertilizer and capital are deployed. Umar et al. (2022) similarly reported the prevalence of small farm holdings among rice farmers.

The average income from rice farming was ₦1,994,127.40, compared with ₦201,084.94 from other farming activities. Rice therefore represented an important source of farm income for the respondents. Despite this income potential, access to formal credit was extremely limited. Only 3.77% reported access to credit, while 96.23% had no access. In contrast, 69.81% had contact with extension agents and 73.11% belonged to cooperative societies. These findings indicate that farmers had relatively greater access to extension and cooperative structures than to formal agricultural credit.

Costs and returns of upland rice production

The cost and return estimates demonstrate that upland rice production was profitable during the 2023 production season.

Table 2: *Cost and Return Analysis of Upland Rice Production per Hectare*

Item	Amount (₦)
Total operating cost	174,590.70
Total input cost	133,772.59
Total variable cost	308,363.29
Total revenue	1,176,879.60
Gross margin	868,516.31
Gross margin ratio	74%

Source: Computed from field data, 2023.

The total revenue from upland rice production was ₦1,176,879.60 per hectare, while total variable cost was ₦308,363.29. The resulting gross margin was ₦868,516.31. The gross margin ratio was 74%, indicating that upland rice production generated a substantial return relative to variable production costs. In practical terms, the result indicates that ₦0.74 of every naira generated from sales was available after accounting for the operating costs represented in the gross margin analysis.

The profitability result agrees with earlier findings on rice production. Nwinya et al. (2014) reported that upland rice production was profitable in Ebonyi State, while Nwahia (2020), Subedi et al. (2020), Isah et al. (2017), and Shelleng and Tabitha (2021) similarly reported positive economic returns from rice production. The present result therefore confirms that the economic potential of upland rice production exists in the FCT, even though farmers face substantial constraints and resource-use inefficiencies.

The profitability of the enterprise is particularly important because the average farm size was only 1.42 hectares. This suggests that profitability can be achieved even within relatively small-scale production systems. However, profitability should not be interpreted as evidence that all production resources are being used efficiently. The subsequent resource-use analysis demonstrates that the farmers were overutilizing several resources while underutilizing fertilizer.

Factors influencing upland rice production

Three production functions were estimated: linear, Cobb-Douglas and semi-log. The Cobb-Douglas function was selected as the lead equation because it had an R^2 of 0.85 and contained more statistically significant variables.

Table 3: *Estimated Cobb-Douglas Production Function for Upland Rice*

Variable	Coefficient	Standard Error	t-value	Significance
Farm size	0.338	0.057	5.90	***
Seed	0.072	0.043	1.68	*
Fertilizer	0.361	0.048	7.57	***
Agrochemicals	0.003	0.034	0.09	NS
Labour	0.324	0.048	6.69	***
Constant	0.119	0.193	0.61	NS
Return to scale			1.098	
R^2			0.85	
F-statistic			229.38	

Note. ***p < .01; *p < .10.

Source: Computed from field data, 2023.

The R^2 of 0.85 indicates that the five explanatory variables jointly accounted for approximately 85% of the variation in upland rice output. The result indicates a strong relationship between the specified production inputs and rice output in the study area. Farm size, seed, fertilizer and labour had positive coefficients, while agrochemical input was positive but statistically insignificant.

Farm size had a coefficient of 0.338 and was statistically significant at the 1% level. This means that a 1% increase in farm size was associated with an estimated 33.8% increase in upland rice output, holding other variables constant. The importance of farm size is consistent with Nwinya et al. (2014), who identified farm size as an important factor influencing rice production.

Seed had a positive coefficient of 0.072 and was significant at the 10% level. The result indicates that a 1% increase in seed input was associated with an estimated 7.2% increase in rice output. Access to adequate seed is therefore relevant to production performance in the study area.

Fertilizer had a coefficient of 0.361 and was significant at the 1% level. A 1% increase in fertilizer input was associated with an estimated 36.1% increase in rice output, holding other variables constant. Fertilizer was therefore one of the strongest statistically significant production factors in the model.

Labour also had a positive and statistically significant coefficient of 0.324 at the 1% level. A 1% increase in labour input was associated with an estimated 32.4% increase in output. The result is consistent with Dominic et al. (2019), who found labour to be a positive determinant of rice production among smallholder farmers in Northern Ghana.

Agrochemical input had a coefficient of 0.003 and was not statistically significant. This suggests that changes in agrochemical use did not have a statistically significant effect on rice output within the estimated model.

Return to scale

The sum of the estimated elasticities in the Cobb-Douglas model produced a return-to-scale coefficient of 1.098. A value greater than one indicates increasing returns to scale. This means that a proportional increase in all specified inputs would result in a more than proportional increase in output. The study therefore classified upland rice production as operating within the second stage of production.

The finding is important because it suggests that the farmers had scope to increase production through an expansion of production inputs, provided that such expansion is undertaken efficiently. However, the resource-use efficiency results indicate that increasing all inputs indiscriminately would not be appropriate. The key issue is not simply increasing input use but correcting the imbalance between inputs that are already overused and those that are underused.

Resource-use efficiency

Resource-use efficiency was assessed using the ratio of marginal value product to marginal factor cost.

Table 4: *Resource-Use Efficiency of Upland Rice Farmers*

Resource	MVP	MFC	MVP/MFC	Decision
Farm size	68.13	2,262.20	0.03	Over-utilized
Seed	60.68	457.86	0.13	Over-utilized
Fertilizer	1,311.40	633.34	2.07	Under-utilized
Agrochemicals	0.52	1,451.73	0.01	Over-utilized
Labour	50.29	1,500.00	0.03	Over-utilized

Source: Computed from field data, 2023.

The findings indicate that none of the five resources had an MVP/MFC ratio equal to one. Farm size recorded a ratio of 0.03, indicating overutilization. Seed had a ratio of 0.13, while agrochemicals and labour recorded ratios of 0.01 and 0.03, respectively. Fertilizer was the only resource with a ratio above one, at 2.07, indicating underutilization.

The overutilization of farm size is particularly notable given the relatively small average farm size of 1.42 hectares. Within the framework used by the study, the ratio indicates that the marginal cost associated with additional farm size was greater than the marginal value generated from the resource at the observed level of utilization. The dissertation relates this result partly to multiple cropping.

Seed was also overutilized, with an MVP/MFC ratio of 0.13. The result suggests that farmers were using seed beyond the level that would maximize returns under the prevailing prices and production conditions. Rather than increasing seed use simply to raise output, farmers need to pay attention to appropriate seed rates and quality.

Agrochemicals recorded the lowest ratio, 0.01, indicating substantial overutilization according to the decision rule adopted in the study. Labour also had a ratio of 0.03, indicating overutilization. This result is consistent with Chapke et al. (2011), who reported labour overutilization in agricultural production.

Fertilizer differed from the other inputs. Its MVP/MFC ratio of 2.07 indicates underutilization. The result suggests that the farmers could potentially increase returns by increasing fertilizer use, provided the additional fertilizer is available at the prevailing marginal factor cost and is appropriately applied. The dissertation attributes the underutilization partly to the difficulty of obtaining fertilizer in the required quantity, quality and time. This finding is consistent with Sani et al. (2016), who associated inefficient fertilizer use with high costs and difficulties in obtaining inputs when required.

The resource-use results therefore reveal an important distinction between profitability and efficiency. Although the enterprise generated a gross margin of ₦868,516.31 per hectare, the pattern of resource allocation was not optimal. Profitability alone does not guarantee that each production factor is being employed at its economically appropriate level.

Production constraints

The major constraints confronting upland rice farmers were measured using a four-point Likert scale.

Table 5: *Constraints Faced by Upland Rice Farmers*

Constraint	Mean	Standard Deviation	Rank
Bureaucracy in accessing credit	3.92	0.79	1st
Inadequate funds	3.89	0.32	2nd
High cost of labour	3.78	0.35	3rd
Pest and diseases	3.68	0.47	4th
High cost of inputs	3.55	0.49	5th
High cost of transportation	3.25	0.82	6th
Lack of access to land	3.10	0.41	7th
Poor access to extension agents	2.53	0.67	8th

Source: Computed from field data, 2023.

All the listed constraints had mean scores above the study's threshold of 2.5, indicating that each was considered significant by the respondents. Bureaucracy in accessing credit was the most prominent constraint, with a mean of 3.92. Inadequate funds ranked second with a mean of 3.89, while high labour cost ranked third with a mean of 3.78. Pest and disease problems followed with a mean of 3.68.

The dominance of credit-related constraints is consistent with the socioeconomic findings, particularly the fact that 96.23% of the farmers reported no access to credit. Limited access to finance can prevent farmers from purchasing fertilizer, seed, agrochemicals and labour at the appropriate time. It can also contribute to inefficient resource allocation because farmers may adjust input use according to immediate cash availability rather than agronomic requirements.

The finding is consistent with Ayanwale and Oluwasola (2013), who identified inadequate funds as an important constraint among upland rice farmers in Osun State. Sani et al. (2016) similarly reported inadequate capital as a major problem among rice farmers in Kano State. High labour costs and pest and disease problems further add to production costs and can reduce the returns obtainable from rice farming.

Test of hypothesis

The null hypothesis stated that input variables used by rice farmers do not affect rice output in the study area.

Table 6: *Effect of Input Variables on Rice Output*

Variable	Coefficient	t-value	Decision
Farm size	0.338***	5.90	Significant
Seed	0.072*	1.68	Not significant
Fertilizer	0.361***	7.57	Significant
Agrochemicals	0.003	0.09	Not significant
Labour	0.324***	6.69	Significant

Note. ***p < .01; *p < .10.

Source: Computed from field data, 2023.

The test shows statistically significant effects for farm size, fertilizer and labour. Seed was significant only at the 10% level in the production function, while agrochemicals were not statistically significant. Based on the stated decision rule and the significant effects of major input variables, the study rejected the null hypothesis that input variables used by rice farmers do not affect rice output.

The rejection of the hypothesis reinforces the importance of input management in upland rice production. Farm size, fertilizer and labour were not merely associated with production; their estimated effects were statistically significant within the fitted Cobb-Douglas model. The result supports the broader argument that improving rice production in the FCT requires attention to the quantity, timing and allocation of production resources rather than expansion of production without corresponding improvements in resource management.

CONCLUSION

The study established that upland rice production in the Federal Capital Territory is economically viable but characterized by considerable inefficiency in the utilization of production resources. The average upland rice farmer operated a relatively small farm of 1.42 hectares and generated an average rice-farming income of ₦1,994,127.40. The enterprise recorded a total revenue of ₦1,176,879.60 per hectare, total variable cost of ₦308,363.29 and gross margin of ₦868,516.31, producing a gross margin ratio of 74%.

The production function showed that farm size, seed, fertilizer and labour had positive effects on rice output, although the statistical strength of the effects differed. Farm size, fertilizer and labour were significant at the 1% level, while seed was significant at the 10% level. The Cobb-Douglas model explained 85% of the variation in output. The return-to-scale estimate of 1.098 indicated increasing returns to scale.

Despite the profitability of the enterprise, the farmers were not using production resources at economically optimal levels. Farm size, seed, agrochemicals and labour were overutilized, while fertilizer was underutilized. The major constraints were bureaucracy in accessing credit, inadequate funds, high labour costs, pests and diseases, high input costs, transportation costs and limited access to land and extension services.

The central implication is that increasing rice production in the FCT should not depend solely on increasing the quantity of inputs used. Greater attention should be paid to the efficient allocation, timing and management of production resources. In particular, the underutilization of fertilizer should be addressed while the excessive use of seed, agrochemicals and labour should be reduced through improved farm management practices.

RECOMMENDATIONS

Based on the empirical findings, the following recommendations are made:

1. **Simplify agricultural credit procedures.** Government agencies and financial institutions should reduce the bureaucratic procedures associated with accessing agricultural loans and credit. This is particularly important because 96.23% of the farmers reported that they had no access to credit, while bureaucracy in accessing credit was ranked as the most serious production constraint.

2. **Strengthen farmer cooperatives.** Upland rice farmers should be encouraged to organize themselves into cooperative societies and farmer-based associations. Collective organization can improve access to finance, facilitate group farming and help farmers reduce the cost of labour and other production activities.
3. **Promote collective input procurement.** Farmer groups should be supported to purchase seed, fertilizer and agrochemicals collectively. Bulk purchasing can improve farmers' access to quality inputs and may reduce the cost of inputs through economies of scale.
4. **Strengthen agricultural extension services.** Agricultural extension agents should provide practical training on appropriate input application, particularly the efficient use of seed, fertilizer, agrochemicals and labour. This is necessary because the resource-use analysis showed that four of the five resources examined were either overutilized or underutilized.
5. **Improve access to fertilizer.** Since fertilizer was underutilized, measures should be taken to improve its availability, affordability and timely distribution to upland rice farmers. Increased fertilizer use should, however, be accompanied by technical guidance to ensure appropriate application rates.
6. **Promote efficient labour management.** Farmers should adopt production practices that reduce unnecessary labour requirements, particularly in activities where labour costs are high. Cooperative labour arrangements and appropriate labour-saving technologies can help reduce production costs.
7. **Strengthen pest and disease management.** Extension services should provide farmers with practical information on integrated pest and disease management. This would help reduce inappropriate agrochemical application and address the overutilization of agrochemical inputs identified by the study.
8. **Promote upland rice production as an income and food-security activity.** Given the profitability of the enterprise, upland rice production should be supported as a means of improving household income, creating agricultural employment and contributing to food security.

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