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Profitability of Usage of Sawah Rice Technology Among Small Scale Farmers in Kebbi State, Nigeria

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ABSTRACT

Background and Objective: Currently, Nigeria is not self-sufficient in rice production, but has the potential to produce more for domestic consumption and even export, for the states to be self-reliant in rice production farmers need to find a way to improve on the average yield per hectare. Therefore, the profitability of usage of Sawah rice technology in Kebbi State Nigeria was investigated. **Materials and Methods:** Well-structured questionnaire was used to obtain cross-sectional data from small scale rice farmers that utilize Sawah rice technology in Kebbi State, Nigeria in the 2021 cropping season using multistage sampling procedures. A list of rice farmers was obtained and a total of three hundred respondents were sampled. The data collected were analyzed using descriptive statistics, gross margin analysis and the logit model. **Results:** It revealed that the usage of Sawah technology was widespread among rice farmers, the total returns of ₦487,381.60/ha were generated through the usage of Sawah rice technology, the logistic regression model revealed that age (t = 3.26; p = 0.001), no. of plots of land in separate places (t = 2.03; p = 0.0042), farming experience (t = 1.76; p = 0.079) and membership of farmers association (t = 1.66; p = 0.096) were variables that significantly influenced the usage of Sawah rice technologies among rice farmers in Kebbi State. **Conclusion:** It was concluded that the technology is profitable in the study area and there is a need to address the problem of limited land access due to the nature of the land tenure system to facilitate large-scale production to take advantage of the economy of scale.

KEYWORDS

Sawah technology, rice farmers, agriculture production, conventional technology, puddled rice

INTRODUCTION

Nigeria is blessed with varied climatic zones, vast land resources and the potentials for the production, processing, marketing and export of various agricultural commodities[1]. Rice (*Oryza sativa*) is a crucial staple in Nigeria and is enjoyed worldwide by people from all social and economic backgrounds. The government's efforts to increase food security and reduce food imports in order to feed the population

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rely heavily on the production of rice, which is significant to Nigerian agriculture[2]. One of Nigeria's states that produce rice is Kebbi State[3]. The state is well-known for its irrigation- and low-rain-fell lowland rice farming. The amount of milled rice in Nigeria went from 2,818 million metric ton in 2010 to 5,000 million metric ton in 2021, demonstrating the considerable increase in rice output in the country[4]. The amount of land used for rice farming has also dramatically increased[5]. Although domestic rice output appears to be rising, Nigerian producers have never been able to keep up with the nation's rising rice consumption. According to Kamai *et al*.[6] the consumption of rice in Nigeria is rising quickly as a result of a number of important variables, such as shifting consumer preferences for rice, population increase, rising income levels and quick urbanization. Data on hand indicate that in 2021, the nation's output of essential foods improved slightly. According to data from the US Department of Agriculture, Nigeria's rice production increased from 4.89 million metric tonnes in 2020 to 5.0 million metric ton in 2021[7].

According to Alarima *et al*.[7] Sawah is a man-made, improved rice-growing environment with demarcated, bundled, leveled and puddle fields for water control. Sawah is soil-based eco-technology. In a simpler form, the term Sawah refers to levelled, bundled and puddled rice field with a water inlet and outlet to control water and manage soil fertility, which may be connecting irrigation and drainage facilities including Sawah to Sawah irrigation and drainage.

The term Sawah originated from Malayo Indonesian, in the absence of water control, fertilizers cannot be used efficiently. Consequently, the high-yielding varieties performed poorly and soil fertility cannot be sustained. The potential of Sawah-based rice farming is enormous in Sub-Sahara Africa (SSA), especially in West Africa. Ten to twenty million hectares of Sawah can produce additional food for more than 300 million people in the future[7]. Through the improvement of the multi-functionality of wetlands of the Sawah type and geological fertilization processes in watersheds, Sawah-based rice cultivation may overcome both low soil fertility and limited water resources[7].

Rice is grown virtually in all the agroecological zones of Nigeria. The country is endowed ecologically to produce enough rice to satisfy domestic demand and has the potential to export to other countries considering its vast agricultural land and suitable climatic conditions; however, in spite of this advantage, the efficiency of production and productivity of rice is very low because of lower utilization of improved agricultural technologies[8]. Rice production involves both pre-harvest and post-harvest tasks, including land selection, clearing, nursery, rice field preparation, planting and transplanting, weeding, manuring and fertilizer application, scaring away birds and rodents, harvesting, threshing, parboiling, drying, winnowing, packaging and marketing[2]. Each of these stages in the production of rice is significant and necessitates the intelligent deployment of farm resources that come from well-informed farm choices. For the states to be self-reliant in rice production farmers need to find a way to improve the average yield per hectare. Therefore, the profitability of usage of Sawah rice technology in Kebbi State Nigeria was investigated.

MATERIALS AND METHODS

Study area: The study was conducted in Nigeria's Kebbi State. Birnin Kebbi serves as the capital of Kebbi State, which is situated in Northwestern Nigeria. In 1991, the State was formed from a portion of Sokoto State. Sokoto State, Niger State, Zamfara State, Dosso Region in the Republic of Niger and the country of Benin border Kebbi State. It covers 36,800 km^2 in total. The State combines elements of the Sahel savannah and the Sudan. The Niger River cuts through the southern region, which is typically rocky, from the Benin Republic to the state's Ngaski LGA. The majority of the population in Kebbi State is Hausa, with minor populations of Fulani, Lelna, Bussawa, Dukawa, Dakarkar, Kambari, Gungawa and Kamuku ethnic groups. The majority of Kebbi's residents are Muslims.

Study duration: This study was carried out over a period of three months, from May to August, 2021.

Sampling procedure and sample size: A list of rice farmers under the intervention of Sawah technology was collected from the Fadama headquarters in Birnin Kebbi and used as the sampling frame sample random sampling was employed and the 165 rice farmers using Sawah technology were selected.

A two-stage sampling technique was used for the selection procedure of rice farmers who are not using Sawah rice technology. The first stage was to generate a list of rice farmers who are not under the intervention of Sawah technology. This was achieved with the assistance of Fadama staff delegated by the coordinator of Fadama in Birnin Kebbi. Two hundred and seventy farmers were encountered during the survey. The second stage was the selection of 50% of the farmers not under the intervention of Sawah Technology. Hence, 135 rice farmers that are not using Sawah rice technology were selected making a total number of 300 rice farmers selected for the study.

Data collection: Data were collected on the socioeconomic characteristics of the rice farmers some of which include; age, marital status, years of education, size of households, expenditure, cost of inputs used for rice cultivation, farm size, years of farming experience, sex of the respondents, membership of farmer's association and access to the credit facility.

Method of statistical analysis: Descriptive statistics used for this study include mean, standard deviation, percentages and frequencies. They were used to describe household and farm characteristics information of the respondents selected for the survey, while inferential statistical methods such as logistic regression analysis were used and tested at a 5% significance level.

Logistic regression model[9]: The logistic regression model was used to determine factors influencing the usage of Sawah rice technology among rice farmers in Kebbi State.
The model is given as:

$$\text{Logit } (E[Y]) = \text{Logit } (P) - XT\beta \quad (1)$$

Where,

Logit (E [Y]} = Binary response/dependent variable which represents 1 if the farmers use Sawah technology and 0 if not
Logit (P) = Natural log of the odds
XT = Explanatory/independent variables

The independent variables are:

β = Regression co-efficient
X_1 = Farm size (ha)
X_2 = Quantity of rice seed (kg)
X_3 = Quantity of fertilizer used (kg)
X_4 = Herbicides (L)
X_5 = Labour (man days)
X_6 = Marital status (married = 1; not married = 2)
X_7 = Household size (number)
X_8 = Age of farmers (years)
X_9 = Cooperative membership (yes = 1, no = 0)
X_{10} = Amount of credit used for rice production (naira)

The dependent variable is a dichotomous variable depicting the users of Sawah rice technology. It takes the value of 1 if the rice farmers use Sawah technology and 0 if not.

Gross margin analysis: Gross margin analysis was used to estimate the costs and returns to rice production by the farmers. This formula was used by Ukpabuku and Ohen[9]. The formula specification is stated thus:

$$GM = TR\text{-}TVC \quad (2)$$

Where:
GM = Gross margin
TR = Total revenue
TVC = Total variable cost

RESULTS AND DISCUSSION

Costs and returns analysis: This section discusses the costs and returns analysis. It is subdivided into three sub-headings: Cost analysis, estimate of the returns associated with rice production and gross margin analysis.

Cost analysis: Table 1 reveals the estimate of the cost of production by users and non-users of Sawah technology. The average cost spent on fertilizer by users was ₦20,895,770 while that of non-users was discovered to be ₦24,084,550 as shown in the Table 1. This finding agreed with the findings of Oladele and Wakatsuki[10] who reported that using the sawah technique, the problem of shortage of fertilizers can be overcome. Moreover, users spent an average of ₦7,159,700 on herbicide while non-users on the other hand spent an average of ₦5,606,100 on the herbicide. For labour supply, users spent an average of ₦12,201,516.56 while non-users spent an average of ₦11,204,325. For the rent on land, users spent an average of ₦4,867,200 while non-users spent an average of ₦3,072,000. The total variable cost (TVC) of ₦45,124,186.56 and ₦43,966,975 were reported by users and non-users, respectively.

Distribution of the estimate of returns associated with rice production
For users of Sawah technology:

- Total returns = ₦337,720,880
- Total returns/ha = ₦337,720,880/693= ₦487381.60/ha

For non-users of Sawah technology:

- Total returns = ₦162,440,800
- Total returns/ha = ₦162,440,800/635 = ₦255,812.28/ha

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

- TVC (for users) = ₦45,124,186.56
- TVC/ha = ₦45,124,186.56/693 = ₦65,114.27
- Gross margin = ₦255,812.28-₦65,114.27 = ₦190, 698.01

Table 1: Estimate of cost of rice production

	Users	Non-users
Items	Value (₦)	Value (₦)
Cost of purchasing fertilizer	20,895,770	24,084,550
Cost of purchasing herbicide	7,159,700	5,606,100
Cost of labour	12,201,516.56	11,204,325
Rent on land	4,867,200	3,072,000
Total variable cost (TVC)	45,124,186.56	43,966,975

Field survey, 2021

$$\text{Operation ratio} = \frac{\text{TVC}}{\text{TR}} = \frac{₦45,124,186.56}{₦162,440,800} = 0.28$$

Non users:

- TR = ₦162,440,800
- Total revenue/ha = ₦162,440,800/635 = ₦255,812.28

$$\text{Gross margin} = \text{TR-TVC}$$

- TVC = ₦43,966,975
- TVC/ha = ₦43,966,975/635 = ₦69,239.33
- Gross margin = ₦255, 812.28-₦69,239.33 = ₦186,572.95

$$\text{RI} = \frac{\text{TVC}}{\text{TR}} = \frac{₦69,239.33}{₦255,812.28} = 0.26$$

The finding revealed that for every unit investment into rice production using Sawah technology, there are returns of 0.28 and 0.26 by users and non-users respectively which therefore implies that Sawah rice technology production in the study area was a profitable agribusiness. This therefore has a positive implication on the income and Sawah rice farmers' livelihood and reduces their poverty level. This will also increase the gross domestic product (GDP) and add to the economy stability and income.

Determinants of usage of Sawah rice technology: The logistic regression model was used to determine factors influencing the use of Sawah rice technology among rice farmers in Kebbi State as presented in Table 2. The dependent variable is a dichotomous variable depicting the users of Sawah rice technology in the study areas take the value of 1 if the rice farmers are willing to use the technology and 0 if not. The independent variables are the socio-economic factors. The hypothesized independent variables are farm size (hectares), educational status of the farmers (dummy), sex (dummy), marital status (dummy), household size (adult equivalent), age (years), no of plots of land in separate places (actual number), extension services (number of visits), farming experience (years), access to credit (Naira) and membership of farmer's association (dummy). It was revealed that the age (t = 3.26; p = 0.001), no. of plots of land in separate places (t = 2.03; p = 0.042), farming experience (t =1.76; p = 0.079) and membership of farmer's association (t =1.66; p = 0.096) were variables that significantly influenced the use of Sawah rice technologies among rice farmers in Kebbi State. Age and membership of farmer's association with coefficients (odd ratio) of 1.096161 and 1.849993, respectively positively influenced the use of Sawah rice

Table 2: Result of logistic regression model showing factors influencing the use of Sawah rice technology among rice farmers

Variable	Coefficient	Standard error	t-value	p-value
Constant	0.0686285	0.1052421	-1.75	0.081
Farm size	0.9842621	0.0875327	-0.18	0.858
Educational status of the farmers	1.042596	0.0350937	1.24	0.215
Sex	1.69041	0.7760401	1.14	0.253
Marital status	0.4769349	0.4702562	-0.75	0.453
Household size	0.9714538	0.0223177	-1.26	0.207
Age	1.096161	0.0308628	3.26***	0.001
No of plots of land in separate places	0.7573714	0.1037202	-2.03**	0.042
Extension services (number of visits)	1.085621	0.1061652	0.84	0.401
Farming experience	0.9605664	0.0220102	-1.76*	0.079
Access to credit	0.999999	9.29e-07	-1.13	0.260
Membership of farmers association	1.849993	0.6836641	1.66*	0.096

*Significant at 0.05, **Significant at 0.01, ***Significant at 0.001, Log likelihood = -192.4177, Prob >chi^2 = 0.0032, Pseudo R^2 = 0.0679 and Field survey, 2021

technology and statistically significant 1 and 10%, respectively. This means that when age and membership of farmer's association increased by 100%, holding all other variable inputs constant, the likelihood of using Sawah rice technology would increase by about 11.0 and 18.5%. However, no plots of land in separate places and farming experience with coefficients of -0.7573714 and -0.9605664 inversely influenced the use of Sawah rice technology and statistically significant 5 and 10%. This means that when number of plots of land in separate places and farming experience increased by 100%, holding all other variable inputs constant, the likelihood of using Sawah rice technology would decrease by about 7.5 and 9.6%.

Similarly, a study by Barungi *et al*.[11] found that experience of farming; land quality and extension contacts play important factors in affecting the speed of soil erosion-control technology in Malawi. In the same vein, Oyewo *et al*.[12] found that extension contact, the experience of farming, membership in social organization, access to credit; primary education attendance and land per capita are significant factors in affecting the speed of technology adoption of land and water management employed by maize farmers in Ghana. Agreeably, Sharma *et al*.[13] found years of farming, farming as a full-time job, profitability and mixed farm to assess the speed of pest management technology adoption employed by farmers.

CONCLUSION AND RECOMMENDATIONS

The usage of Sawah technology is very widespread among rice farmers, especially for enhancement potential and boosting production levels. The finding revealed that Sawah rice technology is profitable in the study area with a gross margin of ₦422,267.33. The logistic regression model revealed that age, no. of plots of land in separate places, farming experience and membership in farmer's associations were variables that significantly influenced the usage of Sawah rice technologies among rice farmers in the state. Based on the findings, the following recommendation is necessary; Sawah rice technology has been known to significantly improve rice production levels and there is a need to review the Sawah technological package to remove various bottlenecks to make it accessible to the rice farmers. Membership in social organizations should be encouraged since it is a major determinant of rice output to avail better opportunities to access adequate information on sources of credit facilities and other production assets to boost rice production and farmers' income.

SIGNIFICANCE STATEMENT

Despite the apparent increase in domestic rice production, local production in Nigeria has never met the growing demand and consumption of rice in the country. The significance of this study lies in its potential to illuminate the economic implications of adopting Sawah rice technology among small-scale farmers in Kebbi State, Nigeria. By examining the profitability of this innovative approach, the study aims to provide valuable insights that can inform policy decisions, empower farmers with sustainable farming methods and contribute to the overall enhancement of agricultural productivity and livelihoods in the region.

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