Ex-ante adoption of Sawah rice production technology in Kwara State Nigeria.

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Abstract: This paper examines the ex-ante adoption of Sawah rice production technology in Kwara State Nigeria. A simple random sampling technique was used to select 32 farmers out of those participated in the on-farm demonstration to examine the influence of innovation attributes, farmers' socio-demographic characteristics, farm characteristics and geographical, institutional, social and economic context on the cultivation of rice along the floodplains. Descriptive statistics were used to analyze farmers personal and farm characteristics while logistic regression was used to isolate the significant determinants of sawah technology adoption. The result shows that 81.3% of the farmers were male with the mean age of 37.1years. The mean year of schooling is 1.03 years. The mean years of farming experience is 15.2 years.. The mean distance from the village to the farm is 1.93 km while the mean distance to the market is 1.98 km. Significant determinants of adoption of Sawah rice production technology in Kwara State are: practicability of the technology ($t = 3.36$, $p < 0.05$); labour requirement ($t = 2.11$, $p < 0.05$); extension support/training ($t = 3.55$, $p < 0.05$); age ($t = 2.44$, $p < 0.05$); education ($t = -2.22$, $p < 0.05$); farming experience ($t = 4.12$, $p < 0.05$); gender ($t = 2.11$, $p < 0.05$). Other factors are knowledge of rice cultivation ($t = -4.11$, $p < 0.05$); returns to investment ($t = 3.23$, $p < 0.05$); access to credit and loans ($t = -4.31$, $p < 0.05$); use of family labour ($t = 2.51$, $p < 0.05$); availability of seeds/planting materials ($t = 3.35$, $p < 0.05$); cultivate rice on lowland ($t = -4.52$, $p < 0.05$). Other significant variables are existing farmers groups ($t = 2.58$, $p < 0.05$); (t = information on rice from input dealers, $p < 0.05$); ($t = 2.72$, $p < 0.05$); information on rice from extension officers ($t = -2.33$, $p < 0.05$); information on rice mobile phones ($t = 0.77$, $p < 0.05$) and distance to market ($t = -2.66$, $p < 0.05$). The study recommend a proper consideration of these variables in order for effective adoption of the sawah rice production technology.

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Introduction

Rice occupies an important place among staples in the world such that its unavailability poses a major threat to the existing fragile food security status. In Africa rice has always been a common staple for some countries, making it the most rapidly growing food source across the continent (Africa Rice, 2011). It forms an integral part in menu of people in the countries and sub-regions of the African continent with its demand cutting across the socio-economic strata. Majority of the Nigeria population live on rice to the extent that their primary food security is entirely determined by the volume of rice produced. It will therefore not be gainsaid if it is submitted that, sustainable growth in rice production worldwide will ensure food security, maintain human health, and sustain the livelihoods of millions of small farmers. In Africa rice has been identified by several governments among other crops as a continent level strategic crop to ensuring food security and combating poverty (FARA 2009). Most African countries are endowed with favourable ecologies for rice cultivation which provides capacity for expansion of rice production. Virtually all the rice growing ecologies, the upland irrigated, inland valley swamp, deep water floating and tidal mangrove available in Africa is suitable for rice production. In Nigeria the potential and actual areas for rice production have been put at 4.6-4.9 million hectares and 1.77 million hectares respectively (Imolehin and Wada, 2000). This scenario portends rice sector development as the needed breakthrough to poverty elimination and much elusive economic growth across the African continent. Improvement in rice production will enhance the competitiveness of the African economies and reduced the valuable foreign currency exchange earnings lost its imports.

Agricultural research has been in the fore front of catalyzing agricultural innovations and the development of value chain, however the inability to consider the peculiar regional's and countries biophysical, institutional, and socio economic constraints in researches have been the problem to achieving sustainable agricultural growth. In rice production, giant biotechnological strides have been made which led to development of various breeds of rice plant with proven yield potentials capable of bringing in the needed sufficiency in rice production in the developing countries however there is still this discrepancy in the yield performance of improved varieties on research fields and farmers' fields. Apart from this disparity in production efficiency orchestrated by the ecological influence, is the new demands in terms of inputs which the already resource stressed poor farmers are unable to meet up. Gatignon and Robertson, 1985; Labby and Kinnear 1985 and Rogers 1985, have asserted that perceptions of innovation features and socioeconomic distinctiveness have been the determinants of technological innovation adoption. The decision to use a new technology is determined by the extent to which the user believes it is cost effective, either with goods or services. Moreover pro adoption supports from donor agencies and various government interventions that would have facilitated adoption have often not yielded the intended impact in encouraging adoption of technologies because they are politically motivated, not demand driven, wrongly managed or poorly implemented and supervised. These inherent constraints along the technology transfer and intervention pathways have most often eroded the production projected impacts of most agricultural innovations. This scenario necessitated the need to conduct a suitability assessment of innovations through feedbacks from intended users to expose intricate adoption inhibitors in production enhanced research based technological packages. This will not only avoid wastage of materials, human efforts and financial resources, and time involved in conducting, validating and disseminating of research findings, but also make possible an early fine tuning of improved technological packages to field realities. One of such technologies for improving rice production is Sawah

Sawah rice production technology refers to improved man-made rice-growing environment through eco-technology with leveled rice field surrounded by bund with inlet and outlet connecting irrigation and drainage. Sawah fields are the system adaptable to a lowland ecosystem but require eco-technological skills, including those for minimum changing of topographical and ecological features, such as both land leveling, bunding and irrigation/drainage systems. Wakatsuki et al. (2001) reported that the potentials of Sawah based rice farming are enormous in West Africa, and that the potential can stimulate the long awaited green revolution. This is predicated on the fact that, the agro-ecological conditions of the core region of West Africa are quite similar to those of northeastern Thailand, which is one of the rice centers in that country. Ten to twenty million ha of Sawah can produce additional food for more than 300 million people in future. The Sawah based rice farming can overcome soil fertility problems through the enhancement of the geological fertilization process, conserving water resources, and the high performance multi-functionality of the Sawah type wetlands.. Fashola et al. (2006) noted that, the Sawah system offers the best option for overcoming rice production constraints in Nigeria because of the utilization of the inland valleys which are reported to be high in fertility and enhances water management for rice production through pudding and the inlet and outlet canals for irrigation and drainage.

In Nigeria, Sawah based rice production started after preliminary basic research work on the suitability of inland valleys by Japanese researchers. A 1.5 ha field at Ejeti village was cultivated in 2001. In 2002 three farmers participated in Sawah Package program and farmers increased to 14 and 18 in 2003 and 2004 respectively. In 2010, the participating farmers have not only increased to 1500, but the programme has spread to other states in Nigeria. The technology was introduced to farmers in Edu local government of kwara state in 2012 by the Nigeria sawah team with demonstration plots set on farmers' field by members of the team and the contacted lowland rice farmers. The rice yield from these demonstration plots ranges between 4-4.5tha. The profuse tillerring as a result of the power tiller well puddled soil, coupled with the reduction in weed invasion and pest infestation of rice field as a result of the flooded rice basins, not only contributed to increase in yield but reduced the cost of production and the fatigue associated with manual weeding. Although sawah rice production of rice technology performs better than the farmers traditional practice, and have overwhelming convincing evidences of better performance there is need to determine willingness to adopt this system of rice production among rice farmers so as to forestall partial or an abandoned adoption.

Materials and Methods

The study was carried out in Edu Local Government Area of Kwara State, where sawah eco-technology has just been introduced. The Local Government is known for projects on rice production either by government or private organization. Notable among them is the large scale government irrigation scheme Lade and OLAM a Non- governmental rice irrigation scheme. The communities used for the pilot project where demonstration plots for sawah system of rice production were set up are Duku Lade, Patigi; these communities were purposively selected because of the prevalence of lowland rice in the areas due to the flood plain offered by river Niger that transverse the length of these villages The population of study is all participating farmers in the pilot project.

A simple random sampling technique was used to select 32 farmers in village to examine the influence of innovation attributes, farmers' socio-demographic characteristics, farm characteristics and geographical, institutional, social and economic context on the cultivation of rice along the floodplains of River Niger. Data were described with mean, standard deviation, and Logit estimates. The farmer's decision process is modeled using the random utility framework. From the utility theoretic standpoint, a farmer is willing to adopt a new technology if the farmer's utility with the new technology minus its cost is at least as great as the old technology that is if adoption responses are central to the analysis of new technologies.

The logistic model was applied due to the fact that it has advantage over the others in the analysis of dichotomous outcome variable in that it is extremely flexible and easily used model from mathematical point of view and results in a meaningful interpretation. The parameter estimates of the model were asymptotically consistent and efficient. The standardised coefficients correspond to the beta-coefficients in the ordinary least squares regression models. The binary logistic model does not make the assumption of linearity between dependent and independent variables and does not assume homoskedasticity (CIMMYT, 1993 Hosmer and Lemeshew (1989)). Another advantage of using the logit model is that it does not require normally distributed variables and above all, the logit model is relatively easy to compute and interpret. Hence, the logistic model is selected for this study. The probability that a farmer will adopt rice cultivation practices in flood plains along River Niger was postulated as a function of some innovation attributes, policy and market attributes, farmers socio-demographic characteristics, farm characteristics and geographical, institutional, social and economic context factors. Therefore, the cumulative logistic probability model is econometrically specified as follows:

Thirty two farmers were selected using the large sample technique.

$$(1 - Pi) = \frac{1}{1+e^{z}} \quad (2)$$

Therefore

$$\frac{Pi}{1-Pi} = \frac{1+e^{zi}}{1+e^{-z}} = e^{zi} \quad (3)$$

The natural log of equation 3 will be

$$Zi = \ln\left(\frac{Pi}{1-Pi}\right) = \gamma + \lambda_1 X_1 + \lambda_2 X_2 + \lambda_3 X_3 + \cdots \ldots \ldots \ldots \ldots \ldots \lambda_n X_n \quad (4)$$

If the disturbance term (U_i) is taken into consideration, the logit model becomes:

$$Z_i = \gamma + \sum_{i=1}^{m} \lambda_1 X_1 + U_i \quad (5)$$

Equation (3) was estimated by maximum likelihood method. This procedure does not require assumptions of normality or homoskedasticity of errors in predictor variables. This analysis was carried using STATA version11.0

Results

The results of the study are organized into two tables as Table 1 shows the personal characteristic of respondents and Table 2 presents the Logistic Binary Estimates of factors that will influence the adoption of sawah rice production technology.

Table 1. Personal Characteristic of Respondents

Personal characteristics	Description
Gender	Male 81.3%
Age (mean)	37.1years
Education (mean years of schooling)	1.03 years
Farming experience (mean)	15.2years
Distance to rice farm (mean km)	1.93km
Distance to market (mean km)	1.98km

Table 2: Logistic Binary Estimates

Variables	**Definition**	**Units**	**Estimate**	**t-statistics**
Innovation attributes				
Practicable	Practicability of the cultivation technique	0 - 1	0.37*	3.36
Adaptable	Adaptability of the cultivation technique	0 – 1	0.12	0.47
High Income	Net income	0 – 1	-0.11	-1.46
Low Technical Efficiency	Difficulty index	0 – 1	-0.036	-0.23

High Yield	Average yield	0 – 1	0.22	1.08
Labour Requirement	Net labour requirement	0 – 1	0.20*	2.11
Drought Resistant	Resistance to low water availability	0 – 1	-0.007	-0.005
Non-lodging	Non –lodging variety	0 – 1	0.10	1.50
Flood Resistance	Flood resistant variety	0 - 1	-0.045	-1.06
Policy and market attributes				
Government promotion of rice production	1 if farmer anticipate t government promotion of rice	0 – 1	-0.03	-0.102
Market accessibility	1 if farmer anticipate that there is market accessibility	0 – 1	0.114	1.58
Effective demand for rice (local rice)	1 if farmer anticipate that there is effective demand for rice	0 – 1	-0.98	-4.74
Effective pricing	1 if farmer anticipate that there is effective pricing	0 – 1	0.05	0.03
Extension support/training	1 if farmer anticipate that there is extension support	0 - 1	2.46*	3.55
Farmers socio-demographic characteristics				
Age	Age of farmers	Years	0.92*	2.44
Education	Years of schooling	Years	-0.77*	-2.22
Farming experience	Years of farming	Years	1.12*	4.12
Gender	1 if farmer is male	0 – 1	1.28*	2.11
Start adoption early	1 if farmer prefer to adopt the technique instantly	0 – 1	0.045	0.03
Start adoption after some people	1 if farmer prefer to adopt the technique	0 – 1	-0.005	-0.22
Start adoption after every other person	1 if farmer see technology adopted before trying it	0 – 1	0.05	0.66
Have knowledge of rice cultivation	1 if farmer has knowledge of rice cultivation	0 – 1	-0.54*	-4.11
Cultivate rice for income diversification	1 if farmer prefer to diversify production	0 – 1	-0.044	-0.54
Farm Characteristics				
Anticipate returns to investment	1 if farmer anticipate returns to investment	0 – 1	1.97*	3.23
Cash flow limitation is often	1 if farmer is often limited by cash flow	0 – 1	0.003	0.12
Cash flow limitation is permanent	1 if farmer is permanently limited by cash flow	0 – 1	-0.14	-0.55
Cash flow limitation is seldom	1 if farmer is seldom limited by cash flow	0 – 1	0.010	.0.70
Access to credit and loans	1 if farmer has access to credit	0 – 1	-2.33*	-4.31
Family labour will be used	1 if farmer will use family labour	0 – 1	2.66*	2.51
Land accessibility for rice production	1 if farmer is has access to land	0 – 1	-0.16	-1.24
High risk of fire	1 if farmer anticipate high risk of fire	0 – 1	-0.003	-1.20
High risk of human swamp diseases	1 if farmer anticipate high risk of human swamp diseases	0 – 1	-0.19	-0.93
High risk of rice pest and diseases	1 if farmer anticipate high risk of rice pest and diseases	0 – 1	-0.003	-1.00
Availability of herbicide	1 if farmer has access to herbicide	0 – 1	0.02	0.10
Availability of fertilizer	1 if farmer has access to fertilizer	0 – 1	-0.003	-0.02
Availability of seeds/planting materials	1 if farmer has access to seeds/planting materials	0 – 1	0.027*	3.35
Distance to rice farm	Average kilometers	Km	0.25*	2.22
Other crops compete for land	1 if farmer anticipate competition for land	0 – 1	0.101	0.33
Other crops compete for labour	1 if farmer anticipate competition for labour	0 – 1	0.040	0.15
Cultivate rice on lowland	1 if farmer cultivate rice on lowland	0 – 1	-0.75*	-4.52

Cultivate rice on midland	1 if farmer cultivate rice on midland		-0.014	-0.54
Cultivate rice on upland	1 if farmer cultivate rice on upland	0 – 1	0.101	1.22
Geographical, institutional, social and economic context				
Existing farmers groups	1 if farmer belong existing group	0 – 1	2.45*	2.58
Information on rice from radio	1 if farmer obtains information from radio	0 – 1	-0.101	-0.55
Information on rice from input dealers	1 if farmer obtains information from input dealers	0 – 1	0.62*	2.72
Information on rice from extension officers	1 if farmer obtains information from extension officers	0 – 1	-0.305*	-2.33
Information on rice mobile phones	1 if farmer obtains information from mobile phones	0 – 1	0.106*	0.77
Information on rice from friends/ neighbors	1 if farmer obtains information from friends/ neighbors	0 – 1	-0.12	-1.24
Distance to market	Average kilometer	Km	-0.528*	-2.66
Availability of storage facilities	1 if farmer has storage facilities	0 - 1	-0.030	-0.10

Discussion

From Table 1, it is indicated that 81.3% of the farmers were male with the mean age of 37.1years. The mean years of schooling are 1.03 years which translated into low literacy level. This low level of education achievement implies that a lot of education would be required in extending modern farm techniques to the farmers. However the mean years of farming experience is 15.2 years. This long year of farming experience mean that the farmers are not novice on the field but have better understanding of crop management which is a very good platform for technology adoption. This stance is corroborated by Gbengeh and Akuibilo (2013) that farming experience increases the uptake of all technologies. The mean distance from the village to the farm is 1.93 km while the mean distance to the market is 1.98 km..

Table 2 presents the results of the Logistic estimates, based on maximizing the log-likelihood. The table highlights both significant and non-significant adoption determinants are present in each category of variables. Significant determinants of adoption of Sawah rice production technology in Kwara State are: practicability of the technology (t = 3.36, p <0.05); labour requirement (t = 2.11, p <0.05); extension support/training (t = 3.55, p <0.05); age (t = 2.44, p <0.05); education (t = -2.22, p <0.05); farming experience (t = 4.12, p <0.05); gender (t = 2.11, p <0.05). Saka, Okoruwa, Lawal and Ajijola (2005) noted that in Nigeria farm size, frequency of extension contact and the yield rating of the improved rice varieties is the significant factors influencing both the decision of farmers to adopt the improved rice varieties and intensity of use. Other factors are knowledge of rice cultivation (t = -4.11, p <0.05); returns to investment (t = 3.23, p <0.05); access to credit and loans (t = -4.31, p <0.05); use of family labour (t = 2.51, p <0.05); availability of seeds/planting materials (t = 3.35, p <0.05); cultivate rice on lowland (t = -4.52, p <0.05). Awotide, Diagne and Omonona (2012) reported that number of years of residence in the village, access to media, access to mobile phone, vocational training, livestock, access to seed and income from other crop production significantly increased the probability of adoption. Beke (2012) reported that in terms of the farmer characteristics, the statistically significant variables are age and ethnic group while for farm specific characteristics, significant variables are the amount of fertilizer used and the use of irrigated system. Other significant variables are existing farmers groups (t = 2.58, p <0.05); (t = information on rice from input dealers, p <0.05); (t = 2.72, p <0.05); information on rice from extension officers (t = -2.33, p <0.05); information on rice mobile phones (t = 0.77, p <0.05) and distance to market (t = -2.66, p <0.05). For economic and institutional variables, contacts with extension organizations, transport costs and credit constraints are all significant determinants of the use intensity of improved rice varieties. Also, improving access to credit and reducing transportation costs encourage the adoption of modern rice varieties. Singha and Baruah (2011) reported that in India education, extension contact, annual income innovation proneness and attitude towards farm diversification of farmers had significant contributions to their extent of adoption of paddy cultivation practices under all farming systems.

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