An Assessment of Factors Influencing Adaptation of Special Rice Project Technology Package by Farmers under the Rice Value Chain in Niger State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author UM designed the study, wrote the protocol and supervised the work. Authors RSO and ISU carried out all research work and performed the statistical analysis. Author MAN managed the analyses of the study. Author SJ wrote the first draft of the manuscript and managed the literature searches and edited the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

The study was designed to identify "An Assessment Factors Influencing the Adaptation of Staple crop Special Rice Project (SRP) Technology among farmers in Niger State. The objectives of the study was to determine the level of awareness of the Staple Crop SRP technology, levels of adoption and adaptation of the technology, the socio-economic characteristics and the technology attributes that influenced adaptation of technologies, impact of adaptation on the yield of rice, and to identify the reasons why farmers adapted the recommended SRP technology package. The data

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that was used in this study was obtained by a field survey which was conducted on 100 rice farmers in each of the three agricultural zones of the State through the use of questionnaires in the study area. The analytical tools that were used in this study are distribution frequencies, percentages, mean, t-test, correlation and multiple regression models. The result and findings of this research shows that 8 percent of the farmers were aware of 3 and below of the technologies, 18 percent were aware of 4 to 6 of the technologies, 74 percent were aware of 7 to 8 of the improved technologies and more than half (63 farmers) were aware of all the 8 improved technologies, It was also found that 40 percent of the SRP participants adopted 5 out of the 8 technologies while 94 percent of the participants adopted 8 of the recommended practices. This indicates high level of adoption of the SRP technology package by participants.

1. INTRODUCTION

Rice (*Oryza sativa*) is a cash crop and a income source for rice farmers in Nigeria. There are two sub-species of rice namely Indica and Japonica. The Japonica sub-species is typically shorter grain rice and is grown in sub tropical and temperate region. It becomes sticky and moist when cooked [1]. On the other hand, Indica rice sub-species is a long grain mainly grown in tropical region and when cooked, it usually becomes fluffy and dry with easily separated kernels. Rice is the fourth major cereal crop in Nigeria after Sorghum, Millet and Maize in terms of output and cultivated land in a large area. According to annual report of the Federal Ministry of Agriculture and Rural Development [2], the land area put to sorghum, millet, maize, and rice is 5.5 million hectares, 3.3 million hectares, 3.2 million hectares and 1.82 million hectares respectively. Rice is cultivated under diverse ecological conditions which include upland, lowland, mangrove and floating/deep water and these cut across the 36 States of Nigeria including FCT [2].

Rice production in Nigeria is dominated by small holder farmers with individuals' holdings of 0.5 to 1.5 hectares (ha) on the average. Nigeria's annual demand for rice is estimated at 5.0 million tones [3], while production level is 3.0 million tones resulting in 2.0 million tones deficit. Consequently, the country resorted to rice importation to bridge the gap. [4], the rice import bill was US $655 million (N75.60 billion at US $1 = N120) and US $756 billion (N96.01 billion) at US $1 = N 127) in 2011 and 2012, respectively [5]. From the foregoing, it is obvious that a lot of the country's hard earned foreign exchange is expended on rice importation.
Rice is the most popular cereal grain consumed in a variety of ways – jollof, white rice with stew and paste form with soup. A combination of factors triggered the increase in rice consumption. The rising demand is partly the result of population growth, and also increase in income level [6]. Rapid urbanization and the associated changes in family occupational structures also contributed to the shift in consumer preferences away from traditional staples towards rice. As more people migrate into the urban areas, the opportunity cost of their time increases and the demand for convenient foods such as rice also increases. Other commercial uses of rice include broken rice in the brewing business to make beer, rice flour in the manufacturing of some baby foods, a thickener in some canned foods and dusting of loaves of bread before they go into the oven in commercial bakeries. Rice hull is used as roughage in animal feed [1].

To reduce the drain in the foreign exchange earnings, rice importation was banned in Nigeria in 1985, in pursuit of a goal to make Nigeria self-sufficient in rice production in the shortest possible time. The Special Rice Project (SRP) was initiated in 1997 to increase land under rice cultivation and paddy yield improvement. The purpose of the study was to examine the Assessment of factors influencing adaptation of SRP technology package under the rice value chain by small holder rice farmers in three Agricultural zones of Niger State. The specific objectives were to:

i. Determine the level of awareness of the SRP technology package by farmers;
ii. Determine the levels of adoption and adaptation of the SRP technology by farmers;
iii. Determine the socio-economic and technology attributes that influence adaptation of the SRP technology and

1.1 Problem Statement

In Nigeria, the small holder farmers constitute the bulk of the major producers of food and cash crops. However, the population increase as well as rural-urban migration continually put pressure on food demand and there is a gap in the demand and supply ratio [6]. The SRP is one of the development interventions to backup the Federal Government of Nigeria's (FGN) agricultural development derives. The project is jointly implemented by National Cereals Research Institute (NCRI), Badeggi and West African Development Association (WARDA), and the technology package is disseminated by the Agricultural Development Projects (ADPs). The project which was expected to bring about self-sufficiency in local production of rice has the following objectives [2]:

i.   Development of major lowland irrigated and swamp rice producing areas of the country;
ii. Provision of subsidy on production inputs such as improved seeds, fertilizer and agro-chemicals;
iii. Provision of tractors and implements to facilitate land preparation;
iv. Extension delivery, expected to be strengthened through training workshops, extension bulletins and farm broadcast to rice farmers, and
v.   Dissemination of the SRP recommended packages to the farmers.

The Niger. State Agricultural Mechanization Development Authority (NAMDA) began the dissemination of eight major SRP recommended package to rice farmers in 1998. The eight (8) major components of the "technology package" include [7]:

i.   The use of improved seed varieties;
ii. Land preparation (leveling and building as necessary);
iii. Row planting of 2-3 seeds/hill;
iv. Plant spacing of 20 cm x 20 cm (inter row and intra row);
v.   Fertilizing 120 kg N, 40 kg P_2O_5 and 80 kg K_2O split at 1-2 weeks and 6-7 weeks after sowing;
vi. Water control (proper leveling and good water level of 3.0-5.0 cm above soil surface);
vii. Plant protection – application of seeds dresser, insecticide and fungicide.

It was expected that the participating farmers would apply completely the technology package to obtain the optimum expected yield of 4.0 tons per hectare. However, when adaptation was partial or incomplete, farmers expected yield of lowland rice was put at 0.9-3.0 tons per hectare [8]. Research findings make it clear that complete adaptation of technology differ considerably in yield from those partially adopted or adapted. It is also common knowledge that Small scale farmers in their wisdom and understanding tend to adapt dissemination technologies to their needs and circumstances rather than wholesomely adopt recommended packages [9].

2. METHODOLOGY

2.1 The Study Area

The study was conducted in three agricultural zones of Niger State. Niger State shares common boundaries with North with *Zamfara* State, to the north east with *kebbi* state and north east and Federal Capital Territory (FCT) bordered the state to North East and South East. The state also shares a common international boundary with the republic of Benin along *Newbussa*, *Aguara* and *Wushishi* local government Areas. The state is located in the north central savannah of the vegetation zones between latitudes 8° and 11°N and longitudes 3°E and 7°E of the prime meridian.[10].

The State is the largest in Nigeria with a total land mass representing about 9.3 percent of the total land mass of the country. The population of the state was 3,950,429 in 2006[11]. The bureau of statistics has maintained an approximate population growth rate of 2.5% geometrically. Based on that, the projected population in 2012 was estimated to be 4,883,036. The state occupies on area of about 58,676.2 square kilometers [11]. The state is made up to 25 LGAs namely Agaie, Agwara, Bida, Borgu, Bosso chanchaga, Edati, Gurara, Katch, Kontagora, Lapai, Lavun, Magama, Mariga, Mashegu, Mokwa, Munya, Paikoro, Rafi, Shiroro, Suleja, Tafa, and Wushishi local government Areas.

Niger state is divided in to three Agricultural zones namely I, II and III for better Administration of agricultural activities each of these Agricultural zones has their headquarters at *Bida*, *Kuta* and Kontagora respectively. The Climate and Ecological conditions of the state is favored with mean annual rain fall of 782-1250 mm and

temperature is about 27.7° F" by "27.7° C". [12]. The state has abundant wild vegetation of Shea trees and dominated by small scale farmers. The major crops cultivated are millet, rice, maize, guinea corn, beans, cassava, groundnuts and sweet potatoes. Majority of the famers keep livestock like poultry, goat and sheep. Other engaged in crafts such as sculptures, weaving and blacksmith [12]. About 85% of the population of the state are farmers, while 15% are involved in other vocation such as white collar jobs, businesses, crafts and arts [12].

2.2 Method of Data collection and Sampling Procedure

A multi-stage sampling procedure was employed in the selection of the respondents. The first stage was purposive selection of Agric cultural zones I, II and III of the State Agricultural Mechanization and Development Authority (AMADA). This was followed by random selection of three Local Government Areas from each of the Agricultural zones. The third stage was random selection of eight (8) extension cells from each of the extension blocks. A total population sample size of 300 small scale rice farmers was randomly selected across the three Agricultural zones of the State.

2.3 The Software and Analytical Techniques used are

SPSS (Special package for science students) [6] and analytical technique such as descriptive statistics, frequency counts, means, t-test and percentages was used to report the findings of objectives 1, 2, and 3 t-test is useful for comparing differences between means and ascertaining significant relationship between variables. The calculated t-value is compared with appropriate table value at the chosen level of significance (this is the critical value in table value). For this study, this was done at 0.05 level. The model is expressed as follows:

$$\frac{X_1 - X_2}{\sqrt{\dfrac{S_1^2}{n_1} + \dfrac{S_2^2}{n_2}}}$$

X_1 = Mean value of the yield and income of SRP participants, respectively.

X_2 = Mean value of the yield and income of non-participants, respectively.

S_1 = Standard deviation of SRP participants.

S_2 = Standard deviation of SRP non-participants.

n_1 = Sample size of the participant.

n_2 = Sample size of non-participant

2.4 Variables used in this Study, Along with their Possible Impacts on Productivity Enhancement

The Variables used such as age of farmers, household size, level of education, farming experience, farm size, access to credit, extension contact, perceived cost of technology, perceived labour requirement of technology, has a positive association with the adaptation of the SRP technology and impact on the productivity enhancement of the respondent. The younger the age of the farmer the more the farmer adopt such technology likewise the household size; the larger the size of the household in adopting SRP technology the more impact of the productivity enhancement of the respondents and the more in reduction of the labour cost on the respondents, the more the extension agents creates an awareness on the SRP technology the more the farmers involve in adopting such technology and the more productive the farmer are in maximizing their potentials.

To determine the influence of socio-economic characteristics and technology attributes on adaptation of the SRP technology (objectives 3), correlation and multiple regression analyses was used. The chosen significant level is at 0.05 level.

The multiple regression model is implicitly specified as follows:

$$Y= f (b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + b_9x_9 + b_{10}x_{10} + b_{11}x_{11}, e)$$

Where:

Y = Adaptation of SRP technology.
F = Constant
b_1-b_{11} = Regression co-efficient.
X_1 = Age of farmer (years).
X_3 = Level of education (years spent in formal education)
X_4 = Farm size (hectares)
X_5 = Farming experience (years)
X_6 = Farm credit (amount in naira)
X_7 = Extension contact (frequency of visits)
X_8 = Perceived cost of technology
X_9 = Perceived labour requirements

X_{10} = Perceived benefits of technology
X_{11} = Perceived complexity of technology
e = Stochastic error term

3. RESULTS AND DISCUSSION

3.1 Level of Awareness of the SRP Technology Package by Farmers

It was found that 8 percent of the farmers were aware of 3 and below of the technologies, 18 percent were aware of 4 to 6 of the technologies, 74 percent were aware of 7 to 8 of the improved technologies and more than half (63farmers) were aware of all the 8 improved technologies (Table 1).

Similarly, it was found that 79 percent of the non-participants were aware of 3 and below of the technologies, 20 percent were aware of 4 to 6 of the technologies while 1 percent were aware of 7 to 8 of the improved technologies. Expectedly, the data indicate that there was much higher awareness of the improved rice technologies among the project/participating famers compared to non-participating farmers. The creation of awareness on the SRP technology was effected mainly through the VEAs efforts. The extension efforts where Training Plots (MTPs) and Small Plots Adoption Techniques (SPATs) on proven technology.

Table 1. Level of awareness of the 8 SRP technologies by farmers

Number of Technologies Aware of	Percentage of SRP participants	Percentage of non-participants
1	0	34
2	2	29
3	6	16
4	3	14
5	5	4
6	10	2
7	11	1
8	63	0
Total	100	100

The findings on awareness agreed with that of [13], who affirmed that the primary function of awareness stage is to initiate the sequence of later stages that lead to eventual adoption of rejection of an innovation. Hence, the higher awareness level of the SRP participants give them an age over the non-participants in the adoption.

3.2 Level of Adoption and Adaptation of the SRP Technologies

Affirmed the importance of access to information, contact with extension services and market orientation of rice production as major determinants of technology adoption at the farmers' level. In this study, farmers who fully adopted 5 out of the 8 technologies were considered as high adopters. Similarly, farmers who fully adapted 5 out of the 8 technologies were considered as high adapters [14].

It was found that 40 percent of the SRP participants adopted 5 out of the 8 technologies while 94 percent of the participants adopted 8 of the recommended practices (Table 2). This indicates high level of adoption of the SRP technology package by participants. Among the non-participants of the SRP technology, 60 percent of the farmers adapted 5 out of the8 recommended practices while 16 farmers adapted 7 to 8 of the practices. This portrays high level adaptation of the SRP technology by the non-participants.

Table 2. Levels of Adoption and Adaptation of the 8 SRP technologies

Number of Technologies	Percentage Adoption of participants	Percentage of non-participants
5	40	60
6	76	24
7	90	10
8	94	6

3.3 Rice Farmer Source of Extension Information in the Study Area

Respondent's source of extension information include: benefit obtained from extension agents, relevance of extension information and constraints faced.

3.4 Respondents Source of Extension Information

According to Adewuyi (2004) which revealed that low source to extension information reduces the level of involvement in any improved agricultural practice. Table 3: shows that 49% of the respondents had source to extension information through friends, relative and neighbours which may not be enough for the acceptance and adoption of improved Agricultural Productivity.

187

3.5 Respondents Benefit from Extension Information

There are various benefits that could be derive from extension contact i.e. extension agent visiting the fadama farmers among the benefits are knowledge, skills, input and information. Table 4: shows that 72% of respondents benefited knowledge from the extension information this implies that the extension agent visit to the rice farmer impacted some knowledge in respect to the adoption of special rice package technology by the farmers.

Table 3. Distribution of respondents source of extension information

Source to extension information	Frequency	Percentage
Radio	36	30.00
Television	25	20.83
Friends, Relatives and Neighbours	39	49.17
Others	0	0

Table 4. Distribution of respondents based on benefit obtained from extension information

Variables	Frequency	Percentage
Knowledge	64	72.00
Skills	13	10.83
Inputs	2	1.1
Information	8	5.24
Agricultural materials	13	10.83

3.6 Frequency of Extension Information in Making Decisions Concerning the Adoption of Special Rice Package Technology by the Farmer

Extension agent plays an important role in helping the farmer decides which of the technologys to adopt and the advantages of adopting the technology. Table 5: shows that 89% of respondents said that they received extension information quarterly which will affect the level of there adoption.

3.7 Constraints Faced by the Extension Agents in Adopting Irrigation Technologies

Discontinue of the adopted technology means putting an end to the adoption or use of the adopted technology this may be due to one or more reasons, in the study area the reasons for discontinue include poor knowledge of the technology, high cost of maintenance, high labour, flexibility of the technology among others.

Table 5. Distribution of respondent's frequency to extension information.

Extension information	Frequency	Percentage
Weekly	6	6.1
Fortnightly	3	1.7
Monthly	5	2.8
Quarterly	86	89.4

Table 6 shows that 78% of the respondents discontinue adoption because of the cost of rice technologies equipment this implies that the cost of rice technology is a major factor in adopting or discontinuing of any technology.

Table 6. Distribution of respondents based on Constraints faced by the extension agents in adopting irrigation technologies

Variables	Frequency	Percentage
Poor knowledge of technology	2	3.34
Cost of maintenance	22	18.33
Labour	0	0
Capital intensive	76	78 33

3.8 Socio-economic Characteristics and Technology Attributes That; Influence Adaptation of SRP Technologies

The study posited positive association between age of farmers, household size, level of education, farming experience, farm size, access to credit, extension contact, perceived cost of technology, perceived labour requirement of technology, perceived benefits of technology, perceived complexity of technology and adaptation of the SRP technology (Table 3).

In Table 7 The correlation coefficient (r =0.33) showed only perceived complexity of technology to be positive and statistically significant in relation to adaptation of the SRP technology at 0.01 level. The SRP technology is complex (mechanized land preparation, leveling, bunding, row planting, close spacing and spot method of fertilization). This indicates that the more complex the SRP technology, the more the farmers seek for alternative to the technology.

Table 7. Product-moment correlation (r) matrix showing the relationship between some selected socio-economic variables and technology attributes and SRP technology adaptation

Variables	(X_1)	(X_2)	(X_3)	(X_4)	(X_5)	(X_6)	(X_7)	(X_8)	(X_9)	(X_{10})	(X_{11})	(X_{12})
Age of farmer(X_1)	1.00											
Household size(X_2)	.65	1.00										
Level of education(X_3)	.49	.62	1.00									
Farm size(X_4)	.23	.29	.00	1.00								
Farming Experience(X_5)	.08	-.19	-.25	-.18	1.00							
Access to credit(X_6)	-.06	-.04	.10	-.12	.18	1.00						
Extension contact (X_7)	.20	.18	.23	-.03	-.06	-.07	1.00					
Perceived cost of tech. (X_8)	-.26	-.25	-.13	-.18	-.10	.00	-.33	1.00				
Perceived labour req. (X_9)	.14	.19	.22	-.05	-.06	.06	.72	-.48	1.00			
Perceived benefit of tech.(X_{10})	.02	.13	.14	-.05	-.12	.01	.64	-.44	.86	1.00		
Perceived complexity of tech.(X_{11})	.05	.11	.17	-.23	-.16	-.07	.11	.12	.07	.10	1.00	
Adaptation of SRP tech(X_{12})	.03	.07	.09	-.14	-.07	-.04	.05	.17	.11	.19	33*	1.00

*coefficient statistically significant at 1% level

Table 8. multiple regression results of selected socio-economic characteristics and technology attributes and adaptation of SRP technology

Independence variable	Coefficient	Standard Error	T-values	Level of significant of T-value
Age of farmer(X_1)	-2.090	.040	-52.25	NS
Household size(X_2)	.152	.095	1.600	NS
Level of education(X_3)	-.2.653	.061	-43.491	NS
Farm size(X_4)	-.1.137	.062	-18.338	NS
Farming Experience(X_5)	-7.718	.047	-164.212	NS
Farm credit(X_6)	-5.103	.061	-83.655	NS
Extension contact (X_7)	.1.749	.074·	23.635	NS
Perceived cost of tech. (X_8)	.319	.077	4.142	**
Perceived labour req. (X_9)	.234	.093	2.516	*
Perceived benefit of tech.(X_{10})	.116	.064	1.812	NS
Perceived complexity of tech.(X_{11})	.2.901E-02	.044	665	NS

Constant = 7.68

$R2 = 0.553$; Adjusted R-2 = 0. 480; F- Ratio = 7.538;** Coefficient statistically significant at 1% level ;* Coefficient statistically significant at 5% level; NS = Not significant

Therefore, the complexity of the SRP technology appear to necessitate concerted extension effort. This finding is in the hypothesized direction. In Table 8 above shows that the correlation coefficients for the perceived cost of the technology (r =0.17), the perceived labour requirements of the technology (r =0.11) and the perceived benefits of the technology (r=0.19) were not statistically significant at 0.05 level. The coefficients for age of farmers (r = 0.03), household size (r = 0.07), level of education (r = 0.09), extension contact (r = 0.05), farm size (r = -0.14), farming experience (r = -0.07) and access to credit (r = -0.04) were not statistically significant at 0.05 level. The table below shows the relationship between some selected socio-economic variables and technology attributes and SRP technology adaptation:

The double-log functional form of multiple regressions was used as it gave the best fit to the data collected based on statistical criteria such as high R^2 value and significance of coefficient. The result of the double-log produced two statically significant variables, and a coefficient of multiple determinations (R^2) of 0.553 which implies that about 53% of the respondents in adaptation of the SRP technology is associated with the technology attributes as a constraints (Table 4).

4. CONCLUSION AND RECOMMENDATIONS

The was designed to achieve three specific research objectives all aim at Factors Influencing Adaptation of Special Rice Project Technology Package By Farmers Under The Rice Value Chain in Niger State. Results indicated high level of awareness among the participants compared to non-participants which was low, the level of adoption and adaptation of each of these 8 SRP technologies among participants were high and low respectively. Results of the correlation analysis shows a positive and statistical significant relationship between the perceived complexity of the technology and the adaptation of the SRP technology package (r = 0.33). The major reasons why farmers adapted the SRP technology were the technology attributes, the socio-economic variables were not statistically having influence on the farmers adaptation in study area. The study showed that the yield of the participants were higher than those of non-participants. Generally the. study concluded that both participants and non-participants should be given opportunity by the extension agents in creating awareness on SRP technology to them through constant visit to their domain. Based on these findings it was recommendations that, since the level of awareness of the SRP technology were higher compared to non-participants, efforts should be made by the Village Extension Agents (VEAs) (through visit, radio, and television programmes) to create more awareness of the improved farm practices to non-participants so also since the result shows that the level of adoption of SRP technology by non-participants were low due to variations at the farm conditions, pressure of the labour and time. It is also found in the study that rice technologies equipments are capital intensive, Therefore the

study recommends that the rice technology equipments should be subsidies to the rice farmer at affordable prices by the Government and non Governmental Organization so as to facilitate high level of adoption of special rice package technology by the rice farmers in the study area.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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