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Full Length Research Article

Farmers' Adoption of System of Rice Intensification in Chanchaga Local Government Area of Niger State, Nigeria

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ABSTRACT

The study evaluated the adoption of System of rice intensification (SRI) among rice farmers in Chanchaga Local Government Area of Niger State, Nigeria. A 3-stage sampling technique was used to collect data for the study through a structured questionnaire and interview schedule administered to 200 rice farmers. The results indicated that the majority of the farmers were males (83.0%) and married (68.5%) with no formal education (50.5%). Mean age was 44.1 years, household size was 8.8 persons, farming experience of 16 years, average monthly income was N590,000.00 and average farm size was 1.7 ha. The most adopted SRI production practice was fertilizer and herbicide application (100.0%), planting depth (91.5%) manual land cultivation and planting method (91.0%). The respondents were at different stages of adoption with accelerating growth, rotary weeding and use of organic fertilizer having positive adoption index of 0.972, 0.970 and 0.601, respectively. Level of adoption of SRI technologies was low (34.5%) with a positive perception. Major constraints to SRI technologies were high labor ($\bar{x}$=3.27), non-awareness of SRI technologies ($\bar{x}$=3.14) inadequate understanding of SRI ($\bar{x}$=2.89). The profitability of SRI in rice cultivation was higher compared to the conventional method. Therefore, the provision of more training and demonstration programmes and input subsidy should be encouraged to boost adoption of SRI for improved rice production.

Keywords: Rice Intensification, Farming activities, Training, Chanchaga, System, Niger State.

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important cereal crops all over the world and it is grown in a wide range of climatic zones. Rice is the staple food for nearly half of the world's population, most of who live in developing countries. The crop occupies one-third of the world's total area planted to cereals and also provides 35 to 60% of the calories consumed by 2.7 billion people worldwide (Tayefe, *et al.,* 2014). Rice consumption has risen tremendously at about 10% per annum and is the most consumed staple food by Nigeria's over 174 million people across states and geo-political zones (Terwase and Madu, 2014). However, there is lopsidedness in the level of production of rice in Nigeria as compared to its consumption pattern (Omofonmwan and Kadiri, 2017). System of rice intensification (SRI) is a methodology for increasing the productivity of irrigated rice by changing the management of plants, soil, water, nutrients and transplanting young seedlings at a wider spacing (Fernandes and Uphoff, 2002).

The literature on agriculture has highlighted two major driving factors behind successful agricultural technology adoption in developing countries. These are: (1) the availability and affordability of new agricultural technologies and (2) farmers' expectations of long-term profitability promised by the new technology (Foster and Rosenzweig, 1995). These factors can be further categorized into three groups namely: economic factors, social factors and institutional factors. The economic factors included farm size, cost of adoption, access to credit, expected benefits from the adoption and the off-farm income generation activities. The social factors included the age of farmers, the level of education and gender. The

institutional factors included access to extension services (Chi and Yamada, 2002).

Niger state in Nigeria emerged and remains a major contributor to agricultural productivity in the country. Despite being a major hub with vast acreages and the third-largest rice producing state of the nation, it is faced with several sectorial challenges impeding rice farming. Yet very little has been done over the years to assess the trends in local rice production to gauge yield potentials and develop new models for improved decision-making capability (Merem *et al.,* 2017). SRI practice in many tropical and subtropical countries have shown the significance of SRI methods with respect to increasing grain yield. The main objective of this study was to assess farmers' adoption of SRI and identify the constraints to the adoption of SRI in Chanchaga Local Government Area of Niger State, Nigeria. Specifically, the study aimed to: (i) describe the socio-economic characteristics of rice farmers in the study area and (ii) assess the rate, level of adoption and constraints of SRI by farmers in the study area.

MATERIALS AND METHODS

Study Area

The study was carried out in Chanchaga Local Government Area (LGA) of Niger State. Niger State is located within the Guinea Savannah ecological zone of Nigeria. Some of the crops grown in Niger State include yam, cotton, maize, sorghum, millet, soybean, cowpea, rice and groundnut. The State has 25 LGAs with three Agricultural Zones (Sheshi and Usman, 2018).

Sampling techniques and data collection

A multi-stage (3-stage) sampling technique was employed in the study. The first stage was the purposive selection of a LGA in Niger State with a large population of farmers involved in rice production. The second stage involved a random selection of 8 out of the 11 wards in the LGA while the third stage involved a random selection of 25 respondents from each ward to give a sample size of 200 respondents. Primary data were obtained from information obtained by the structured questionnaires and secondary data accessed through government publications, websites, books, journal articles, internal records and past publications.

Statistical Analysis

Descriptive statistics such as frequency counts, percentages, mean, standard deviation and Likert type scale were used in analyzing the data. The constraints to the adoption of SRI were analyzed using a four-point Likert type scale with 2.5 as mean ($\bar{x}$) decision rule. Cumulative values of above $\bar{x}$ =2.5 imply major constraint while below implies not a constraint. This was scaled as strongly agreed = 4, agreed = 3, disagreed = 2 and strongly disagreed = 1. Rate of adoption was determined by the total number of adopters over the sample size expressed as a percentage as well as the mean value. The respondents' adoption stages of SRI techniques were examined against compliance with recommended practices. According to Rogers' (2003) classification, there are five stages in the adoption of innovation by clientele in any social system. These stages are awareness (A=1.00), interest (I=2.00), evaluation (E=3.00), trial (T=4.00) and adoption (AD=5.00). Therefore, in investigating the adoption of SRI a mean average was determined as follows: 5+4+3+2+1/5=3. It implies that variables with positive adoption are those with adoption index, $\bar{x}/n$ of ≥ 0.6.

RESULTS AND DISCUSSION

Socioeconomic Characteristics of Respondents

Table 1 shows some socioeconomic attributes of the respondents. The results revealed that majority of the farmers were males (81.5%) probably because of the tedious work of managing rice farms from land/field preparation to processing. This result is in agreement with the findings of Carr (2008) that implied male domination of farming activities. On the contrary, it was posited by AFDB (2000) and FAO (2011) that the combined time burden of household chores and farm work may have been too rigorous for women and affirmed that gender

disparity weakens women's rights to land and their position in accessing financial resources where collaterals are needed. Majority of respondents were within the age range of 30-50years (73.5%) and clientele's mean age is 44.1 years. The finding suggests respondents were in their productive years, which could be instrumental to the adoption of improved technology as suggested by Sheik *et al.* (2003). A larger proportion was married (68.5%) with a mean household size of 9 persons (75.0%). According to Akinbile (2007), marriage confers responsibility on respondents to cater for their households through the various livelihood activities they are engaged. The large household size in the study will provide adequate labour for farming activities as a household with a large size tended to attach greater importance to food security than those with small size. These findings have implication for the adoption level of technologies in the study area as reported by Folorunso and Okoroji (2015) and Ejechi *et al.,* (2016).

The result showed slightly above average (50.5%) of respondents have no formal education while only about 1/3 (28.0%) had only primary education which implied that the respondents were not educated. Agwu and Anyanwu (1996) reported that an increase in education of farmers positively influences the adoption of improved practices. A higher percentage of the respondents (38.5%) had the farming experience of 11 - 20 years. Farming experience according to Hassan and Nhemachena (2008) increases the probability of uptake of adoption measures. The farm size of 93.5% of respondents is less than 3 ha with mean of 1.7 ha, an indication that small-scale family managed farm units are mostly in use by farmers in the study area; which may in turn limit investment in technology adoption and output level.

The average annual income of respondents is less than or equal to one million (97.0%) as well as their degree of cosmopoliteness indicating that respondents hardly travel out of their immediate environment. Farmers' cosmopoliteness according to Olowu *et al.* (1990) is a significant determinant of the adoption of new technologies. Islam *et al.* (2007) further asserted that farmers with higher expenditure had better economic and social status in the community.

On assess to SRI training on rice production, the majority (67.0%) claimed that they had passed through the training among the clientele. This implies that a significant proportion (2/3) of the respondents were aware and trained on the SRI technologies. This finding is in agreement with Bassey (2016) that reported SRI adoption rate of 50% by rice farmers in south-south Nigeria.

Management Practices Adopted by Rice Farmers

Table 2 shows the management practices adopted by rice farmers in the study area. The Table shows that all the respondents practiced fertilizer and herbicides application (100.0%), a greater proportion (91.5%) of the farmers put into practice planting depth while the use of manual land cultivation and planting method is also in vogue (91.0%). A significant percentage (88.0%) adopted plant spacing too. However, on the contrary only, few of the respondents do engage in the following management practices; tractor land ploughing

Table 1: Distribution of the respondents based on the socio-economic characteristics

VARIABLES	FREQUENCY	PERCENTAGE	$\bar{x}$±SD
Age (Years)			
≤ 30	1	0.8	44.1±6.6
30 - 40 years	79	39.5	
41 - 50 years	68	34.0	
≥ 51	53	26.5	
Sex			
Female	37	18.5	
Male	163	81.5	
Marital Status			
Single	53	26.5	
Married	137	68.5	
Separated	0	0.0	
Divorced	0	0.0	
Widowed	10	5.0	
Household Size (No of persons)			
≤ 5	56	28.0	8.8±3.0
6-10	94	47.0	
11-15	19	9.5	
16-20	18	9.0	
≥ 21	13	6.5	
Educational Qualification			
No formal education	101	50.5	
Primary Education	56	28.0	
Secondary Education	33	16.5	
Tertiary Education	10	5.0	
Farming Experience (Years)			
≤ 10	58	29.0	16±4.4
11 - 20 years	77	38.5	
21 - 30 years	60	30.0	
≥ 31	5	2.5	
Farm Size (Ha)			
≤ 3	187	93.5	1.7±1.3
4-6	13	6.5	
≥ 7	0	0.0	
Average Annual Income (Naira/million)			
≤ 1	194	97.0	0.59million
2-4	5	2.5	
≥ 5	1	0.5	
Assess to SRI Training			
Yes	134	67.0	
No	66	33.0	
Degree of Cosmopolitness			
Yes / No	36	18.0	

(9.0%), seed selection before planting/after processing (7.0%) and pesticide application (6.5%) while none of the respondents engages in irrigation and storage of rice harvest using modern storage equipment (0.0%). This finding is in agreement with Akintayo *et al.* (2010) that reported rice farmers in Niger state employed sub-optimal recommended management practices; seed rate, fertilizers and agrochemicals for weed control. This could be responsible for the low yields obtained by rice farmers in the zone as also agreed by Coulibaly *et al.* (2020).

Respondents' Adoption Stages of System Rice Intensification

It can be seen from Table 3 judging from the mean value ($\bar{x}$) and the adoption index ($\bar{x}$/n) that, the respondents were at the awareness stage of adoption for early transplanting ($\bar{x}$=1.210; $\bar{x}$/n=0.242) and spacing of plant wider apart in a square pattern ($\bar{x}$=1.180; $\bar{x}$/n=0.236). In addition, adoption was at interest stage for both planting of one seedling per hole on the field ($\bar{x}$=1.760; $\bar{x}$/n=0.352) and intermittent watering to increase wet and dry soil condition apart from continuous flooding ($\bar{x}$=2.085; $\bar{x}$/n=0.417). Increased uses of organic fertilizer to enhance soil fertility ($\bar{x}$=3.005; $\bar{x}$/n=0.601) was at the evaluation stage of adoption while accelerating growth under good soil, water and nutrient condition and proper handling ($\bar{x}$=3.960; $\bar{x}$/n=0.792) was at the trial stage of adoption of innovation. Only rotary weeding to control weeds and promote soil aeration ($\bar{x}$=4.850; $\bar{x}$/n=0.970) was at full adoption stage of the innovation of system rice intensification. Based on adoption index only three variables (increased use of organic fertilizer, rotary weeding and accelerated growth under good soil, water and nutrient respectively were positive, while the remaining four (early transplanting of seedlings, planting of one seedling per hole, spacing of plants wider apart and intermittent water application) were not. This implies that these four variables under the system of rice intensification were not adopted since they have lower adoption index values (i.e. $\bar{x}$/n less than 0.6). Similar findings were also reported by Nath and Das (2017) and Agarwal and Kumar (2017).

Table 2: Distribution of the Respondents based on Management Practices Adopted

S/N	RICE MANAGEMENT PRACTICE	FREQUENCY	PERCENTAGE	RANK
1	Tractor Land ploughing	18	9.0	5th
2	Manual land ploughing and planting	182	91	3rd
3	Seed selection	14	7.0	6th
4	Planting Depth	183	91.5	2nd
5	Plant Spacing	176	88.0	4th
6	Herbicide Application	200	100.0	1st
8	Pesticide Application	13	6.5	7th
10	Fertilizer Application	200	100.0	1st
11	Irrigation	0	0.0	8th
12	Use of modern storage equipment	0	0.0	8th

Table 3: Distribution of the Respondents Based on the Stages Involved in the Adoption Process of System of Rice Intensification

VARIABLES	A	I	E	T	AD	$\bar{x}$	$\bar{x}$/n	D
Early Transplanting of Seedlings to open field	181	7	5	3	4	1.210	0.242	A
Planting of one seedling per hole on field	63	129	1	7	0	1.760	0.352	I
Spacing of plants wider apart and in a square pattern	184	3	7	5	1	1.180	0.236	A
Increased use of organic fertilizer to enhance soil fertility	4	1	191	3	2	3.005	0.601	E
Intermittent water application to increase wet and dry soil conditions instead of continuous flooding	2	189	2	4	3	2.085	0.417	I
Rotary weeding to control weeds and promote soil aeration	3	2	2	8	185	4.850	0.970	AD
Accelerating growth under good soil, water and nutrient conditions and proper handling procedure	2	1	0	197	0	3.960	0.792	T

Key: Mean= $\bar{x}$ Adoption Index= $\sum\bar{x}$ and D=Decision. Awareness (A), Interest (I), Evaluation (E), Trial (T) and Adoption (AD).

Categorization of Level of Adoption of System Rice Intensification (SRI)

Table 4 indicates the level of adoption of System Rice Intensification by rice farmers in Chanchaga community of Niger State, Nigeria. The Table shows that 34.5% of the respondents have adopted the System of Rice Intensification method, while the majority (65.5%) of the respondents did not adopt the system. Bassey (2016) found the adoption rate of SRI of 50% among respondents in Abi LGA of Cross-Rivers State, Nigeria.

Perception of Cost and Reasons for Adopting SRI

The perceived benefits and cost of adopting SRI are highlighted in Table 5. Majority (64.0%) of the respondents spent an amount less than ₦10,000 per hectare on labor for adopting SRI while the remaining 32.0% of the respondents incurred input cost of ₦10,000 and above ₦20,000, respectively. On input cost, majority (78.0%) of the respondents spent less than ₦10,000 while 22.0% spent more than ₦20,001, which is another factor that determines their adoption of SRI. Based on the perceived benefits of adopting SRI by the respondents, it shows that there is increase in income as expressed by majority of the respondents (80.0%). It also saves time and labor required in the entire production (70.0%) as well as increased yield of the rice (66.0%).

Table 4: Distribution of the respondents based level of adoption of system of rice intensification

Variable	Frequency	Percentage
Adoption of SRI		
Yes	69	34.5
No	131	65.5
Total	200	100

Table 5: Perceived benefits and costs for adopting SRI

VARIABLES	FREQUENCY	PERCENTAGE (%)
Labor Cost on 1 ha		
Less than ₦10,000	128	64.0
₦10,000 - 20,000	44	22.0
₦20,001 and above	28	14.0
Input Cost (₦)		
Less than ₦10,000	156	78.0
₦10,000 - 20,000	36	18.0
₦20,001 and above	2	8.0
Factors Determining Adoption		
Increased income	160	80.0
Saves time and labor	140	70.0
Increased crop yield	132	66.0
It gives maximum plant population	16	8.0

The respondents disagreed on the fact that it gives a high plant population (8.0%) once the normal seed rate is used. Similar findings were reported by Krishnan and Tarnaka (2008).

Respondents' Constraints to the Adoption of SRI

The constraints of the respondents to the adoption of a system of rice intensification are shown in Table 6. The results indicate that high labor cost ranked first with mean score of $\bar{x}$= 3.27, this was followed by non-awareness of SRI with a mean score of $\bar{x}$=3.14, while inadequate understanding of SRI technologies ($\bar{x}$=2.89) took the third place. Non-availability of funds ($\bar{x}$=2.84) was the fourth-ranked constraint. Non-availability of extension agents ($\bar{x}$=1.75) and non-availability of input materials ($\bar{x}$=1.00) were not seen as constraints to the respondents in the study area since cumulative average values were below the decision rule mean of ($\bar{x}$) =2.50. This supported the work of Johnson and Vijayaragavan (2011).

CONCLUSION

It can be concluded that although most of the respondents practiced SRI technologies such as fertilizer and herbicide application, however, early planting of seedlings per hole, the spacing of plants and intermittent watering was not adopted by most respondents in the study area. This indicated a low level of SRI technology acceptance, although there was a positive perception of the SRI technologies among the respondents. The constraints of the respondents to the adoption of SRI technologies were high cost, non-awareness and inadequate understanding of SRI technologies. It is therefore, recommended that there should be the provision of more training demonstration programmes and input subsidy to boost the awareness level of the respondents for more adoption of the SRI technologies.

Table 6: Distribution of the Respondents based on Constraints to Adoption of SRI

PROBLEMS	SA (4)	A (3)	DA (2)	SDA (1)	CUM	$\bar{x}$	R
Non-awareness of SRI	84 (344)	63 (189)	44 (88)	7 (7)	628	3.14	2nd
Non-availability of extension agents	6 (24)	28 (84)	76 (152)	90 (90)	350	1.75	5th
Non-availability of input materials	93 (372)	68 (204)	29 (58)	10 (10)	200	1.00	6th
Inadequate Understanding of SRI	75 (300)	58 (174)	38 (76)	29 (29)	579	2.89	3rd
High labor cost	98 (392)	70 (210)	20 (40)	12 (12)	654	3.27	1st
Non availability of funds	60 (240)	72 (216)	47 (94)	21 (21)	571	2.84	4st

The figures in parentheses are the sum of frequency and the scale Key: CUM = Cumulative, CA = Cumulative average and R=Ranking.

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