



DETERMINANTS OF ADOPTION OF SYSTEM OF RICE INTENSIFICATION (SRI) PRACTICES AMONG MALE RICE FARMERS IN KANO STATE, NIGERIA

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ABSTRACT

The study analysed gender adoption of SRI practices in Kano State, Nigeria. Multi - stage sampling procedure was used in selecting 286 respondents. Data were collected using structured questionnaire and analysed using both descriptive and inferential statistics. The results revealed that middle-aged, married, and moderately educated male farmers dominate rice farming in the study area. Majority (76.9%) of the respondents were aged 40-49 years, married and had household sizes of 5-8 persons. Nearly half (48.2%) had small-scale farms of ≤ 1.5 hectares, with majority (86.7%) being cooperative members. Education was moderately high, with 32.5% having secondary education, enhancing their ability to adopt System of Rice Intensification (SRI) practices. Majority (87.76%) accessed agricultural information through radio, while 66.78% utilized the internet, showing growing digital reliance. The results of logistic regression revealed that sex ($P < 0.01$), education level ($P < 0.01$), cooperative membership ($P < 0.05$), marital status ($P < 0.05$), and organic fertilizer ($P < 0.10$) were the factors that significantly influenced the adoption of SRI. The major constraints to adoption of SRI include socio-economic pressures (household size, education), economic barriers (low profitability, limited inputs), environmental challenges (flooding, pests), technical issues (labour-intensive practices), and institutional factors (inadequate training, poor market access) with percentage variance of 3.72%, 3.43%, 2.98%, 2.46% and 2.41% respectively. The study concludes that sex, level of education, membership of association and occupation were the determinants of adoption of SRI among male farmers in the study area. The study recommended that adult education programs, training on SRI practices, policies for organic fertilizer subsidies, enhanced pest control measures, and improved financial access through cooperatives.

Keywords: SRI Practices, Adoption, Rice, Technology.

INTRODUCTION

Rice (*Oryza sativa*) is an important global economic and staple food crop providing nutrition and calories for more than half of the world's population (Assaye *et al.*, 2023). It is one of the major cereals in developing nations such as Nigeria. It provides employment and income for more than 80% of the inhabitants as a result of the activities that take place along its value – chains, input supply to consumption (Atere *et al.*, 2022). About 6 million hectares of land are available for rice production, only 3.2 million hectares were used for rice production, producing about 3.7 million tons of rice per year. Familusi and Oranu (2021)



reported that the aggregate demand for rice in Nigeria is projected at 20 million tons and the aggregate rice supply is projected at 9million tons by 2030. This shows that the supply for rice in Nigeria will not be sufficient to meet the demand of rice in the country by 2030.

Modern improved rice technologies are the technologies that enhance rice production (Rehman *et al.*, 2016). New rice farm management technologies include all kinds of improved techniques and practices which affect the growth of rice output (Rehman *et al.*, 2016). The majority of smallholder farmers in developing countries rely on traditional methods of production and this has lowered the level of productivity. Mhoja *et al.* (2021) define adoption as the integration of new technology into existing practice and is usually proceeded by a period of 'trying' and some degree of adaptation.

Adoption of improved agricultural technologies has been associated with higher earnings and lower poverty, improved nutritional status, lower staple food prices, increased employment opportunities as well as earnings for landless laborer (Mhoja *et al.*, 2021). Attempts have been made to improve rice production so as to meet the demands of the growing population. One of such besides the Green Revolution is the introduction of the system of the rice intensification (SRI) practices. SRI represent a cultivation practice that increases rice yield by 50-100% using less water, compost manure, any rice variety and at low cost of production through six principles namely: transplanting seedlings at younger age of 8-12 days: planting only single seedling per hole; wider spacing 25cm x 25cm to 30cm by 30cm in a square pattern; increased use of organic manure; alternate wetting and drying method than flooding the field and use of rotary weeder for weed control (Abu, 2018).

SRI harmonizes the elements of soil, water, light and plant. It allowed the plants to achieve their fullest potential. Conventional broadcasting of rice on the farm consumes 100Kg/ha while planting required 30-60Kg seeds per hectare. However, in SRI only 4-10Kg of seeds is required per hectare (Toungos, 2018). SRI was found to benefit farmers more in terms of more income with less input, given higher yield with lower investment and beneficial to farming households. The limited available studies on new and more controversial technologies, such as SRI practices, denotes the need for greater understanding of these new technologies, and stress the key role of extension agents or rural advisors in bringing this information to both men and women farmers and facilitating their adoption (Ragasa, 2012). Men and women farmers have different responsibilities in agricultural production system including rice farming. These differences in gender roles are not always obvious, but they must be recognized if rice production is to be increased, especially among small-scale farmers. In Nigeria, both male and female adopters play crucial roles in rice production technologies (Matilda *et al.*, 2020). Males in rice production technologies adoption often take on various key roles.

Additionally, male farmers often make decisions regarding the adoption of new technologies including selecting appropriate varieties and managing the overall farm operations (Monica *et al.*, 2016). Therefore, it is imperative to examine how gender influences technology adoption by rice farmers in the study area. Despite the importance of technology adoption to improve yield and productivity of cereal farmers in Kano State, there were little or no literatures on gender analysis on the adoption of SRI practices among male rice farmers in the State. It is against this background that the study examined the determinants of adoption of system of rice intensification practices in Kano State, Nigeria. The specific objectives are to;

- i. describe the socio-economic characteristics of rice farmers practicing SRI;
- ii. describe the respondents' sources of information on system of rice intensification;



- iii. determine the factors that influence the adoption of system of rice intensification practices by gender; and
- iv. describe the socio-economic, economic, environmental, social and institutional constraints in the adoption of SRI practices in the study area.

MATERIALS AND METHODS

The Study Area

This study was conducted in Kano State, Nigeria. Kano State is located in Northern Nigeria and is one of the 36 States in the country. It lies within Latitude 10.25°N and 13.53°N and Longitude 7.4°E and 10.53°E. Kano State shares border with Katsina and Jigawa States to the North West and North East respectively, Kaduna and Bauchi States to the South. The State has a projected population of 15,462,200 people (NPC, 2024). The State has a total land area of 20,760 square kilometers (Tanko and Darma, 2022). Kano State has a total of 44 Local Government Areas (LGAs). Kano State experiences a semi-arid climate with distinct wet and dry seasons. The dry season typically lasts from November to March, characterized by hot days and cool nights. During this period, harmattan winds, which are dry and dusty, blow across the region. The wet season spans from April to October, with rainfall peaking between June and September. Average annual rainfall in Kano state ranges from about 500 to 800 millimeters (Manpower, 2023).

Kano State falls within the Sudan savannah ecological zone, which is characterized by grassland interspersed with scattered trees. The predominant vegetation consists of tall grasses, shrubs, and savannah woodland. The region is known for its agricultural productivity, with crops such as millet, sorghum, maize, rice, cowpea, groundnut, pepper, onions, vegetable and rearing animals such as cattle, sheep, goat and poultry (Wikipedia, 2010). The State has a diverse population comprising various ethnic groups, with the Hausa being the majority. Other ethnic groups include Fulani, Kanuri, Igbo, Yoruba and others (Manpower, 2023). The people of Kano State engage in various occupations. Historically, agriculture has been the primary occupation, with farming and livestock rearing playing a significant role in the economy. The State is known for its thriving textile industry, which contributes to the local economy. In recent years, there has been a growing emphasis on commercial activities, trade and manufacturing, with Kano serving as a major commercial centre in Northern Nigeria (Manpower, 2023).

Sampling Procedure and Sample Size

A multi-stage sampling procedure was employed in selecting respondents for this study. Stage 1: Three (3) LGAs were purposively selected due to high concentration of farmers practicing the System of Rice Intensification (SRI). These LGAs are Gabasawa, Makoda, and Warawa. Stage 2: Two (2) wards were purposively selected from each LGA, making a total of 6 wards. The wards include Zakirai and Garun Danga in Gabasawa, Babban Ruga and Wailare in Makoda, and Token A and Token B in Warawa. Stage 3: Two (2) villages were randomly selected from each ward, resulting in 12 villages. The villages include: Gabasawa LGA: Joda and Larabawa (Zakirai ward), Karmami and Kumbo (Garun Danga ward). Makoda LGA: Satame and Galoru (Babban Ruga ward), Rimi and Wailare (Wailare ward). Warawa LGA: Laraban Gadon Sarki and Litau (Token A ward), Tsallaken Arewa and Molin (Token B ward). Stage 4: A proportionate random sampling technique was applied, using 4.6% of the sampling frame in each village to determine the sample size. The total sample frame for all 12 villages was 6,210, from which a total of 286 respondents were selected.

Table 1: Sample Size Selection Plan

L.G.A.	Wards	Villages	Sample Frame	Sample Size (4.6%)
Gabasawa	Zakirai	Joda	1,050	48
		Larabawa	749	36
	Garin Danga	Karmami	561	27
		Kumbo	639	30
Makoda	Babban Ruga	Satame	726	34
		Galoru	549	26
	Wailare	Rimi	526	25
		Wailare	359	17
Warawa	Token A	Laraban G/Sarki	361	17
		Litau	230	11
	Token B	Tsallaken Arewa	310	15
		Molin	240	11
			6,210	286

Source: Author's computation

Method of Data Collection and Analysis

Data were collected using structured questionnaire. Data collected were analysed using descriptive and inferential statistics. Descriptive statistics such as mean, frequency distribution, percentage and ranking were used to achieve objective i and ii. The inferential statistics used were logit regression and factor analysis to achieve objective iii and iv, respectively.

Logit Regression Model

The model is specified as:

$$Y = \ln \left(\frac{P}{1-P} \right) \quad \dots(2)$$

$$\ln \left(\frac{P}{1-P} \right) = b_0 + b_1 X_1 + b_2 X_2 \quad \dots(3)$$

Where;

Y = Adoption of SRI practices (adopted = 1, not adopted = 0)

P = Probability of adoption of SRI practices

ln = Natural logarithm function

b₀ = Constant

b₁ – b_n = Regression Coefficients

X₁–X_n = Explanatory variables

X₁ = Age (in years)

X₂ = Sex (Dummy, 1= male, 0 = female)

X₃ = Marital status (1=married, 2=single, 3=divorced, 4=widowed)

X₄ = Level of education (1=no formal education, 2=primary, secondary, 4=tertiary)

X₅ = Farming experience (in years)

X₆ = Farm size (in hectares)

X₇ = Cooperative membership (1=yes, 0=no)

X₈ = Access to extension (1=yes, 0=no)

X₉ = Income (in naira)

X₁₀ = Less chemical fertilizer (1=yes, 0=no)

X₁₁ = Seed (in kg)

X₁₂ = Water saving (1=yes, 0=no)



X_{13} = More yield (in kg)

X_{14} = High price of rice (in naira)

e = Error term

Factor Analysis Model

The model is specified as:

$$Y_i = \beta_{i0} + \beta_{i1} F_1 + \beta_{i2} F_2 + \beta_{i3} F_3 \quad \dots(4)$$

Where:

Y_i = Standardized Variable

β_{i0} = Constant

β_i = factor loading. They tell us the correlation coefficient between each factor and the observed variables

$f_1 - f_n$ = factor score. They are values of each observation on the factor

RESULTS AND DISCUSSION

Socioeconomic Characteristics of the Respondents

The results in Table 2 revealed that 45.4% of male respondents were within the age range of 40-49 years, indicating that middle-aged men were the major participants in rice farming activities in the study area. Male respondents within the range of 30-39 years constituted 26.9%. These groups are likely more experienced and have greater decision-making power regarding adopting new agricultural technologies like the System of Rice Intensification (SRI) practices. Additionally, 17.8% of male respondents were within 50-59 years, indicating that older male farmers also play a significant role in rice farming. Only 4.1% of the male respondents were within 60-69 years. This finding aligns with Aliyu *et al.* (2020), who reported that the majority of male rice farmers were within the age bracket of 30-50 years.

The result further revealed that the majority (76.9%) of the male respondents were married. Male respondents who were single, divorced, and widowed constituted 7%, 8.4%, and 7.7%, respectively. The dominance of married men in rice farming suggests that household responsibilities and the need to provide for family members might influence their farming decisions, including the adoption of SRI practices.

The results also revealed that 48.2% of the male respondents had household sizes of between 5-8 persons. Male respondents with household sizes of 1-4 persons constituted 23.7%, while 18.1% and 9.79% had household sizes of 9-12 and above 12 persons, respectively. This implies that male farmers in the study area have relatively large households, which may affect their economic responsibilities and could help in the supply of labor. Larger households may provide additional labor, facilitating the adoption and implementation of labor-intensive SRI practices.

The result in Table 2 further revealed that 32.5% of the male respondents had secondary education, while tertiary and primary education constituted 28.0% and 25.9%, respectively, and 13.6% had no formal education. This indicates that most male rice farmers had a moderate level of formal education. The ability to interpret agricultural information and follow farming guidelines can lead to better decision-making and higher productivity. Education levels may enable farmers to take on leadership roles within agricultural communities, promoting the adoption of innovative practices such as SRI that can enhance productivity and sustainability.

The results also revealed that the majority (66.4%) of male respondents cultivated farm sizes of less than or equal to 1.5 hectares. Additionally, 24.5% of male farmers had 1.6



to 2.5 ha, while 9.1% of the male respondents had between 2.5 to 3.5 ha. This indicated that male farmers were engaged in small-scale farming, likely for subsistence or limited commercial purposes.

The results further revealed that 39.5% of male respondents had 6-10 years of farming experience. Male respondents with 11-15 years and 16-20 years constituted 27.9% and 14.3%, respectively, while 10.1% had been farming for 21 years or more. Farming experience could enhance farmers' ability to manage farm operations effectively, adopt new agricultural technologies, and respond to environmental challenges. This agrees with Ajani and Igbokwe (2014), who stated that experienced farmers are more adept at integrating innovative practices to improve crop yield.

The results also revealed the respondents' membership in cooperatives in the study area. Most (86.7%) of the male respondents were members of cooperative societies, while 13.3% were non-members. Membership in cooperatives can enhance the collective bargaining power of farmers, improve their access to financial services, and provide a platform for sharing knowledge and best practices. This high level of participation implies that cooperatives play a vital role in supporting farmers by providing access to resources such as credit, inputs, training, and market information. According to studies by Verhofstadt and Maertens (2014), cooperative membership is associated with improved agricultural productivity and income, especially among smallholder farmers.

Table 2: Distribution of Respondents According to their Socioeconomic Characteristics (n=286)

Characteristics	Freq.	%	Mean
Age			
20-29	16	5.5	43
30-39	77	26.9	
40-49	130	45.4	
50-59	51	17.8	
60-69	12	4.19	
Marital status			
Single	20	7.0	7
Married	220	76.9	
Divorced	24	8.4	
Widow	22	7.7	
Household size			
1-4	68	23.7	7
5-8	138	48.2	
9-12	52	18.1	
>12 and Above	28	9.7	
Educational level			
No formal	39	13.6	1.1
Primary	74	25.9	
Secondary	93	32.5	
Tertiary	80	28.0	
Farm size (ha)			
≤ 1.5	190	66.4	1.1
1.6-2.5	70	24.5	
> 2.5	26	9.1	
Farming experience (years)			
< 5	23	8.0	12
6-10	113	39.5	
11-15	80	27.9	
16-20	41	14.3	
21 years and above	29	10.1	
Cooperative membership			
Yes	248	86.7	13.3
No	38	13.3	
Access to Extension contact			
Yes	255	89.2	10.8
No	31	10.8	

Source: Field Survey, 2024

Sources of information of the respondents

The results in Table 3 revealed the sources of information of the respondents on SRI practices. Majority (87.76%) of the male respondents sourced information from radio. Radio's wide reach and accessibility make it a highly effective medium for disseminating agricultural information. Majority (66.78%) of the male respondents sourced information

from internet indicating the growing role of digital platforms in accessing agricultural advice and updates. This is consistent with findings from Adetimehin *et al.* (2018) in their study utilization of agricultural information and knowledge for improved production by rice farmers in Ondo State who reported the growing reliance on the internet for agricultural information among farmers. Mobile phone was also a considerable source of information, used by 38.46% of the male respondents, which may involve receiving updates or participating in agricultural groups and forums. Television is less commonly used by male respondents, with only 26.57% relying on it for information. This could be due to limited access to television or a preference for more portable or accessible sources of information. Input suppliers and agricultural extension agents were also sources of information which accounted for 46.50% and 48.25% of the male respondents, respectively. NGOs were the least utilized source among the male respondents, with only 21.68% utilized it for information, which might reflect limited NGO outreach or engagement in the study area.

Table 3: Distribution of Respondents According to Sources of Information (n=286)

Sources of information	Frequency	Percentage	Ranking
Radio	251	87.7	1 st
Internet	191	66.7	2 nd
Agricultural extension agents	138	48.2	3 rd
Input supplier	133	46.5	4 th
Mobile phone	110	38.4	5 th
Television	76	26.5	6 th
NGOs	62	21.6	7 th

Source: Field Survey, 2024

*Multiple response

Factors Influencing the Adoption of SRI Practices

Table 4 presents the logistic regression results of factors influencing the adoption of SRI practices. The results showed that sex was positive and significant ($P < 0.01$) in influencing the adoption of SRI practices. This indicates that being male positively affects the likelihood of adopting SRI practices. This finding aligns with Nakano *et al.* (2018), who reported that men often have better access to resources and information, which increases their likelihood of adopting innovative agricultural practices. Marital status was also negative and significant ($P < 0.05$) in influencing the adoption of SRI practices. This suggests that being married might reduce the likelihood of adopting SRI practices among male respondents. The additional responsibilities and risk aversion associated with marriage might limit male farmers' willingness to try new agricultural practices. This is consistent with Ranjitha *et al.* (2016), who reported that marital obligations could reduce the time and resources available for experimenting with innovative agricultural techniques.

Level of education ($P < 0.01$) and cooperative membership ($P < 0.05$) were also significant, indicating that higher education levels positively influence the adoption of SRI practices. This implies that male respondents with higher educational attainment are more likely to adopt SRI practices. Adeoye *et al.* (2020) observed similar findings, emphasizing that educated farmers are better equipped to understand and implement complex agronomic innovations. Cooperative membership suggests that social networks and group memberships enhance access to information and resources that facilitate the adoption of SRI practices. Occupation had a negative was significant ($P < 0.1$). This indicates that certain occupations may reduce the likelihood of adopting SRI practices among male respondents. The use of less



organic fertilizer showed a positive coefficient and significant ($P < 0.1$), indicating that incorporating organic farming practices promotes SRI adoption.

Table 4: Factors Influencing the Adoption of SRI Practices among Male and Female Rice Farmers

Variable	Coefficients	P – value
Age	-0.016	0.426
Sex	0.968	0.003***
Marital status	-0.386	0.040**
Household size	0.032	0.553
Level of education	0.540	0.000***
Years of farming experience	-0.042	0.243
Farm size	-0.312	0.387
Membership of association	0.661	0.048**
Occupation	-0.509	0.051*
Extension contacts	-0.123	0.735
Income	0.000	0.563
Less organic fertilizer	1.067	0.011*
Less seed (in kg)	-0.296	0.490
Water saving	0.006	0.989
More yield (in kg)	0.505	0.164
High price of rice (in naira)	-0.127	0.721
Use of inorganic fertilizer (in kg)	0.355	0.303
Constant	1.162	0.167
-2 Log likelihood	407.101	
Chi-square	89.769	
Pseudo R Square	0.283	

Source: Field Survey, 2024

***, **, * Significant at 1%, 5%, and 10%

The results presented in Table 5 highlight the factors hindering the adoption of SRI practices among male respondents. These constraints were grouped into five components: socio-economic, economic, environmental, technical, and institutional, following a rotation pattern and naming convention similar to Obianefo *et al.* (2022).

Sampling Adequacy Tests: The Kaiser-Meyer-Olkin (KMO) test for sampling adequacy yielded a value of 0.51, which is acceptable based on the threshold provided by Abdulaziz *et al.* (2021). Additionally, Bartlett's Test of Sphericity (BTS) was significant ($P < 0.01$), confirming that the correlation matrix was not an identity matrix. Five factors with eigenvalues greater than one were extracted as key constraints, explaining 63.5% of the total variance—a respectable proportion for social science research (Arimi and Olajide, 2016). Only loadings of 0.3 and above were considered significant.

Socio-Economic Constraints (Variance: 3.72%): This factor included challenges related to household size, education level, and extension contact. Larger household sizes were associated with economic pressure that limits resource allocation for new agricultural practices, while lower education levels hinder understanding and implementation of SRI practices. Limited extension contact further exacerbates the knowledge gap. These findings align with Doss (2001), who emphasized the impact of social obligations and educational background on technology adoption.

Economic Constraints (Variance: 3.43%): This component comprised concerns about the non-availability of organic manure, low net gains, and poor output prices. These

economic barriers highlight the need for supportive policies such as fertilizer subsidies, rice export promotion, and value chain improvements to enhance the profitability and attractiveness of SRI practices.

Environmental Constraints (Variance: 2.98%): Challenges under this factor included flooding/erosion, insect pests/bird infestations, and unreliable water supply. These issues underline the importance of institutional interventions and public awareness campaigns on best agronomic practices to mitigate environmental risks. Additionally, training extension personnel to manage pest and bird infestations is crucial. These findings align with Abdulaziz *et al.* (2021), who highlighted the role of extension services in overcoming such constraints.

Technical Constraints (Variance: 2.46%): This factor involved difficulties in transplanting young seedlings, late disbursement of farm inputs, poor irrigation services, and challenges in machine operation. The labour-intensive nature of SRI practices, especially in handling and transplanting young seedlings, poses a significant barrier. Moreover, inadequate irrigation infrastructure and delayed input distribution further hinder adoption.

Institutional Constraints (Variance: 2.41%): Inadequate training/capacity building and poor marketing channels were identified as key institutional constraints. Limited technical knowledge and insufficient training on SRI practices prevent farmers from fully adopting these practices. Furthermore, poor market access limits the economic incentives for adoption. These findings are consistent with Obianefo *et al.* (2022), who emphasized the importance of capacity building and improved market access in fostering agronomic practices among rice farmers.

Table 5: Factors Militating against the Adoption of SRI Practices among Male Respondents

Constraints	Proportion	Eigenvalue	Percentage of variance
Socio-economic factors			
Household size	0.41		
Level of Education	0.39	2.36	3.72
Extension contact	0.39		
Economic factors			
Non-availability of organic manure	0.55		
Low net gain	0.51	2.18	3.43
Poor output price	0.47		
Environmental factors			
Flooding/erosion	0.41		
Unreliable water supply	0.35	1.89	2.98
Insect pest/birds	0.35		
Technical factors			
Difficulty in transplanting young seedlings	0.35		
Late arrival of disbursement of farm inputs	0.35	1.56	2.46
Poor irrigation services	0.35		
Difficulty in machine operation	0.36		
Institutional factors			
Inadequate training and capacity building	0.41	1.53	2.41
Poor marketing channel	0.32		
Kaiser-Meyer-Olkin Test	0.51		
Bartlett's Test of Sphericity	1106***		

Source: Field survey, 2024

***Means significant at 1%



CONCLUSION AND RECOMMENDATIONS

The study concluded that middle-aged, married, and moderately educated male farmers with small-scale farm sizes and significant farming experience are the dominant group in rice farming in the study area. The major factors influencing the adoption of SRI practices in the study area were sex, education level, marital status, cooperative membership, and the use of organic fertilizers. It is recommended that;

- i. There should be adult education programmes and provide training on SRI practices to improve farmers' understanding and capacity to adopt innovative technologies.
- ii. Extension agents should emphasize the economic and environmental benefits of adopting SRI practices and address farmers' specific challenges.
- iii. Implement policies to provide subsidies for organic fertilizers and farming inputs while ensuring fair pricing for rice.
- iv. Facilitating access to credit and financial support through cooperatives can further empower farmers to adopt SRI practices.
- v. There should be an introduction of pest control measures and provide technical assistance to address pest and bird infestations effectively.

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