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Determinants of the Adoption of System Rice Intensification Innovative Practices among Smallholder Farmers in North-West, Nigeria

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Abstract: *Rice production need considerable focus in a country like Nigeria and its region where the production is enormous due its impacts on smallholders' income and food security. To cope with water shortage an alternative irrigation technology (SRI) evolved with efficient water usage and increased yield. The study examined the determinants of adoption of system of rice intensification innovation practices among smallholder farmers in North-west, Nigeria. A sample unit of 315 respondents was selected for the study through a 3-stage sampling procedure. The data were collected with the aid of questionnaire and interview schedule and analyzed using descriptive and inferential statistical tools. The main sources of knowledge on SRI practices are fellow farmers (45.3%), field demonstration (16.2%) and contact farmers (11.7%) among others. The most effective sources of knowledge in promoting SRI adoption among adopters and none adopters are contact farmers (-1.982, p=0.48), fellow farmers (-3.044, p=0.03), NGOs activities (-2.717, p=0.07) and farmers' association (-5.484, p=0.000). The factors influencing adoption are awareness (β=44.569), constraints (β=22.946), educational level (β=0.465), access to loan (β=22.396) and extension visit (β=3.332). Most of the constraints examined were severe except for none-availability of organic manure for usage ($\bar{x}$=3.70±1.50), expensive farm input requirement ($\bar{x}$=3.45±1.60), inadequate funds to practice the SRI method ($\bar{x}$=3.56±1.58) and the equipment are not available or too expensive to practice SRI innovation into practice ($\bar{x}$=3.53±1.58). The study concluded that factors influencing adoption are awareness, constraints, educational level, access to loan and extension visit. It was recommended that main source(s) of knowledge including the weaker ones be enhanced and promoted to assist the adoption rate, persuasion of none adopters too to adopters, capacity building periodic supports, favorable factors of adoption be supported and sustainable solutions proffered to severe constraints to SRI innovation adoption.*

Keywords: Determinants, Adoption, Rice-Intensification, Smallholder, Farmers, Assessment

Introduction

Rice (*Oryza sativa L.*) is one of the most significant cereal crop grown in wide range of climatic zones all over the World (Aliyu, *et al.,* 2020). More than 50% of the population of the World depends on Rice is one of the most important food crops as it (Ahmed, Tetteh and Anang 2019) significantly effects food security in many countries. More than 160 million hectares of land are projected to be under rice cultivation globally with estimated yearly production of 500 million metric tons (Ara, Lewis and Ostendorf, 2017). Excess water is seen as a vital input in rice production due to varying factors in which climate change is key. The

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necessity for irrigation water surpasses the quantity of water accessible for rice irrigation in many countries (Nigeria inclusive) (Kirby, *et al.*, 2017). Hence, substitutive practices that can less water usage is needed to enhance sustainable rice production (Kaloi, *et al.*, 2021).

The System of Rice Intensification (SRI) is one innovation designed to increasing rice productivity using lesser input commitment. The novelty accentuates sustainability principles in handling local plants, water, nutrients, soil as well as their integration into farmers' current practices (based on possible compatible condition). SRI, as explained and advocated, are set of principles which when followed with compliance would sustainably increase the income of farmers, livelihood and food security (Arsil, *et al.*, 2022). These Core principles of the SRI innovation practices are (1) one seedling planted at one clump, (2) intermittent irrigation (3) younger seedling, and (4) wide-square planting (more than 0.2m × 0.20m), (Styger, *et al.*, 2011). SRI is a fluid technological package (Arsil, *et al.*, 2022). The operational adjusted is based on the existing indigenous nuances. Although, the conversional practice of using inorganic fertilizer is not discouraged against standard practice to fully organic fertilizer (Ardiansyah, *et al.*, 2020). The organic fertilizers are still advised to reduce the hazard of synthetic fertilizers soil structure and quality improvement (Kassam, *et al.*, 2012).

Inclusive again is the different kinds of biological control that further differentiated the SRI from the conventional pest and weed control (Kassam, *et al.*, 2012). With adoption of the SRI principles, rice crops are testified to be more resistant to pathogens and pests because leaves are, larger, stronger and bolder than those planted under the conventional systems (Thakur, Uphoff, Antony, 2010; Aliyu, *et al.*, 2020). When properly applied and executed, water, seed and chemical inputs are resourcefully used (Arsil, *et al.*, 2022). Based on the diminishing usage of external inputs, SRI principles have positive effects on environmental conservation and resources. As a result of the aforementioned innovativeness or novelty, SRI provides a medium for realizing the goals of sustainable agriculture. Significantly, besides, it gives its robustness and flexibility. However, SRI principles are much more applicable to smallholder rice farmers simply because they are the majority in the rice production team and adversely affected at the receiving ends too. In spite of offering these great potentials, the adoption rate of the SRI generally remains low, especially among smallholder rice farmers probably due to one or more factors or a combination of factors (Arsil, *et al.*, 2022). It is at the premise that the study is poised to provide solutions to the following specific objectives. The general objective of the study is to examine the determinants of adoption of the System of Rice Intensification (SRI) innovation practices among smallholder farmers in North-west, Nigeria. The specific objectives are to:

1. Examine the respondents' source(s) of knowledge on SRI innovation components;
2. Examine the determinant factors of adoption of the SRI innovation components;
3. Identify the constraints to adoption of the SRI innovation practices;

Hypothesis

H_{01}: Extension contacts has no significant influence on the adoption of SRI innovation practices among the rice farmers

Methodology

Study Area

The study was conducted in Jigawa and Kano states in North-West Nigeria where the pilot SRI project was conducted. The study area is located between Latitude 11^0 00'00" N and 13^0 00' N with Longitude 8^0 00' E and $10^0$15' E. The area occupies a land mass of 216,065 Sq Km. According to National Population Census (2006), the study area has a population of 26,231,987 with a growth rate of 2.83% and 2.94% in Jigawa and Kano states respective (Worldometer, 2021). Jigawa State has a total of 27 Local Government Areas (LGAs)

divided into Agricultural zones, which include Headquarters at Birnin-Kudu, Gumel, Hadeja and Kazaure. Agricultural activities predominantly are the major occupation both in subsistence and commercial basis. Some of the food crops grown are millet, cowpea, sorghum, maize, and rice for local consumption while the Hadejia valley mixed economy zone is an area relatively rich in livestock. Fishing and livestock production are key economic activities as well. The floodplains provide good grazing although there are competing land use demands between farmers and herders' groundnut and cotton are produced for export and industrial purposes. The topography is characterized by high land areas which are almost 750metres above sea level. Soil tends to be fertile ranging from sandy-loamy with many pockets of Fadama and alluvial plains suitable for the cultivation of rice. The state shares a boundary with three (4) states and the Niger Republic. There are usually two seasons in the state viz: the rainy season stating from June through October and the dry season spanning from November to May yearly. The mean temperature ranges from 35^0c in October to about 50^oc in May, while mean annual rainfall varies from 700mm to over 1000mm and last up to 200days in some lowland of the state. The official language of the study area is Fulfulde and Hausa. The study was conducted in Agricultural zone three Jigawa state, Nigeria, the population for the study was mainly all the registered rice farmers in the state. Jigawa is situated between Latitude $11^0$00'00''N and $13^0$00'00''N and Longitude $8^0$00'00''E and 10^0.15'00''E. The state has a total land area of approximately 22,410 Square kilometers (National Population Commission, 2006).

Kano State has a total of 44 Local Government Areas (LGAs) about 13,076,900 people with an annual growth rate of 2.94%. Based on this growth rate projected present population of the state to about 19,296,109 (NPC, 2006). It lies between latitude $11^0$33' North and $12^0$37' North of the equator and Longitude $8^0$34'East and $9^0$29' East and covers a land area of about 20760km2 square. The state is bordered to the West and Northwest by Katsina State, to the East and Northeast by Jigawa State, to the South by Bauchi State, and to the Southwest by Kaduna State. The annual rainfall is between 420mm-1000mm and the temperature is averagely warm throughout the year. (Kano Agricultural and Rural Development Authority, 2007). The state has been a commercial center and agricultural state which is known for the production and marketing of groundnut as well as solid mineral deposit since time immemorial. It is more than 18, 684 square meters of cultivable land and is the most extensively cultivated state in the country. It is characterized by two seasons which are the wet and dry seasons. The wet season occurs between May to September while the dry season occurs from October to April. Most of the people of Kano State depend on agriculture for their livelihood. In the pre-colonial period, Kano State was considered the garden of central Africa with the potential of feeding the whole region. The state has great potential for rice production, processing, and marketing. The major crops grown in the state includes rice, millet, groundnut, pepper, sorghum, and maize which are grown throughout the year because of the availability of irrigation facility made possible by the establishment of artificial water bodies like earth dams across the state. Cattle, horses, goats, and sheep are grazed, and hides and skins are exported (NPC, 2006). The state is administratively divided into three agricultural zones by Kano State agricultural rural development authority (KNARDA, 2007). These zones are zone 1, zone 2, and zone 3, with their different local government area of coverage with their headquarters: Rano, Danbatta, and Gaya.

Sampling Technique and Sample Size

A 3-stage sampling procedure was used in selecting respondents for the study. The first stage was a purposive selection of Jigawa and Kano States, being the states where the pilot phase of the SRI innovation project was first conducted in North-west, Nigeria. The second stage was a judgmental selection of three local government areas from each state where rice is mostly produced and where SRI farmers probably abound to obtain a total of six (6) local government areas for the study. In the third stage, Taro Yamane's formula was used at 95% probability level as adopted and used by Kalpana (2011) to give a sample size of 315 respondents for the study at pooled level out of a total population of 1418. This implies that a total of 97 respondents were used in Jigawa State and 218 respondents were used in Kano State to give a total of 315 respondents for the study respectively.

Table 1: Summary of Sampling Procedure and Sample Size

Stages	**Stage 1:** Purposive selection of 2 States in North-west States in Nigeria.	**Stage 2:** Random selection of Three L.G.A from each States	**Stage 3**: Taro Yamane's formulae was used at 5% probability to obtain 315.
Total	**2 States**	**6 L.G.As**	**315 Respondents out of 1418**

Source: Field Survey, 2022

Results and Discussion

Sources of Knowledge of the Respondents on SRI Innovation Practices

The sources of knowledge of the respondents on SRI innovation practices is important. This is in a bid to know the chief sources of knowledge of the respondents (adopters) on SRI innovation practices. This is shown in Table 2 below. According to the Table, the key sources of knowledge among the array is fellow farmers (45.3%). This is in line with the submission of Okoro, *et al.* (2023) who agreed that the main sources of knowledge of rice farmers in Enugu State, Nigeria on SRI technology is fellow farmers. This was followed directly by field demonstration (16.2%). This is probably because field demonstration in form of SPAT (Small Plot Adaptive Training) can be used to arouse the interest of the clienteles and allow them to adopt the SRI innovation practices. Ogbona (2020) posited that one of the main sources of knowledge of farmers on improved innovation is demonstration plot. Contact farmers (11.7%) took the third position, because they are the first point of contact on innovation dissemination and adoption. Farmers' association (6.0%) is another mean the respondents got knowledge about SRI practices. This is so because farmers are known to pass information on improved farming practices to themselves via individual contact procedure and this had proven to be very effective. This is in congruent with the work of Adio, Abu and Yusuf (2016) who agreed that farmers' association is one of the main sources of knowledge of farmers on innovation adoption. Farmers' meetings (5.4%) is another important source of knowledge for the respondents. This implies the various meetings done by the farmers in which knowledge are mostly shared on innovation, best practices, inputs and advisory services is through farmers' meetings. Extension services saddled with the responsibility of bringing innovation, knowledge and improved practices to farmers are not proactive in the study area. This is in with the work of Adetimehim, Okunlola, and Owolabi. (2018).

Table 2: Distribution of the Respondents Based On Sources of Knowledge on SRI Innovative Practices

S/N	Variables	Frequency	Percentage
1	Extension Contact	10	3.2
2	Contact Farmers	37	11.7
3	Fellow Farmers	146	45.3
4	Research Institute	2	0.6
5	Leaflet Postal	1	0.3
6	Field Demonstration	51	16.2
7	NGO Activities	1	0.3
8	Farmers' Meeting	17	5.4
9	Exhibition	4	1.2
10	Newspaper	1	0.3
11	Campaign	1	0.3
12	Workshop	2	0.6
13	Television	2	0.6
14	Radio	8	2.4
15	Farmers' Association	19	6.0
16	Agricultural Show	10	3.2
17	Mobile Phones	3	0.9

Source: Field Survey, 2022

Comparison of Sources of Knowledge on SRI Practices among Users and None-Users

The Table 3 presents the result of a t-test analysis of the mean differences between the sources of knowledge on rice intensification (SRI) practices among the users and none-users. The aim of this is to determine the sources of knowledge most effective in promoting adoption of SRI practices. The result shows that some sources of knowledge are more effective in promoting adoption of SRI practices. Specifically, the sources of knowledge with significant differences between users and none-users of SRI practices are as follows: Contract farmers (-1.982, p=0.48), the source of knowledge has a negative mean difference, indicating that none-users are more likely to receive SRI knowledge from contract farmers than users. This is same for fellow farmers (-3.044, p=0.03), NGOs activities (-2.717, p=0.07) and farmers' association (-5.484, p=0.000), while research institute (-3.725, p=0.000) leaflet postal (3.870, p=0.000), farmers' meetings (2.593, p=0.010), exhibition (4.002, p=0.000), campaigns (4.304, p=0.000), and agricultural shows (4.498, p=0.000) has a positive mean difference, indicating that adopters are more likely to receive SRI knowledge from them than the non-adopters/users of SRI practices. In the same scenario the sources of knowledge that did not have significant differences between adopters/users and non-adopters are; Extension Visit, Field Demonstration, Newspaper, Workshop, Television, Radio and Mobile Phones. This implies that certain sources of knowledge are more effective in promoting the adoption of SRI practices than others and these are; contact farmers, fellow farmers, NGOs activities and farmers' association. It further implies that, these sources of knowledge should be enhanced to improve the adoption of SRI practices among the none adopters/users in the study area. The findings can be useful for developing effective communication strategies to promote the adoption of SRI practices among rice farmers in the study area. This is in line with the submission of Adepoju, Salau, & Oguntunde, (2018) on the determinants of adoption of agricultural innovation in rural Nigeria.

Table 3: T-Test for the Comparison of Mean Difference for Sources of Knowledge on SRI Innovative Practices between the Users/Adopters and the None-Adopters/Users

S/N	Sources of knowledge	Df	Mean Diff.	Std Err Diff.	t-test	*Sig* (2-tails)	Remark
1.	Extension Visit	225.912	.006	.045	0.137	.891	Not *Sig.*
2.	Contract Farmers	312.864	-.041	.021	-1.982	.048	p<0.05
3.	Fellow Farmers	193.420	-.161	.053	-3.044	.003	p<0.01
4.	Research Institutes	171.165	-.181	.049	-3.725	.000	p<0.001
5.	Leaflet Poster	277.120	.190	.049	3.870	.000	p<0.001
6.	Field Demonstration	223.284	-.016	.049	-.335	.738	Not Sig.
7.	NGOs Activities	282.421	-.115	.042	-2.717	.007	p<0.01
8.	Farmers Meeting	223.774	.151	.058	2.593	.010	p<0.05
9.	Exhibition	222.020	.231	.058	4.002	.000	p<0.001
10.	Newspaper	218.945	-.007	.030	-.247	.805	Not Sig.
11.	Campaigns	312.962	.153	.036	4.304	.000	p<0.001
12.	Workshop	182.665	-.044	.032	-1.358	.176	Not *Sig.*
13.	Television	231.652	.026	.057	0.462	.644	Not *Sig.*
14.	Radio	252.079	.068	.047	1.431	.154	Not *Sig.*
15.	Farmers' Association	283.312	-.274	.050	-5.484	.000	p<0.001
16.	Agricultural Shows	223.998	.257	.057	4.498	.000	p<0.001
17.	Mobile Phones	229.996	.080	.059	1.357	.176	Not *Sig.*

Source: Field Survey, 2023

Factors Influencing the Adoption of SRI Innovation Practices among Respondents

Table 4 shows the results of logistic regression model on the factors influencing the adoption of SRI practices among respondents. The model has two hypotheses, the null hypothesis (H_0) and the alternative hypothesis (H_1). The alternative hypothesis suggests that there is a significant relationship between the independent variables and the dependent variable, whereas the null hypothesis suggests the opposite. The deviance, AIC (Akaike Information Criterion), and BIC (Bayesian Information Criterion) are model fit statistics. Lower values of these statistics indicate better model fit. The alternative hypothesis (H_1) has a lower value for each of these statistics compared to the null hypothesis (H_0), suggesting that the alternative hypothesis has a better fit. The coefficients table shows the estimated coefficients of the independent variables and their corresponding standard errors, Wald statistics, degrees of freedom, and p-values. The Wald statistic measures the significance of each variable in the model. In general, if the Wald statistic is higher, the variable is more significant in explaining the dependent variable. The independent variables in the model are Awareness, Attitude, Constraints, and Educational level, Household size, Access to loan, Extension visit, and Farm size of the respondents. Farmer's Awareness of SRI, constraints, level of educational, 'access to credit and number of extension visit have a significant relationship with the dependent variable ($p<0.05$). The McFadden R^2, Nagelkerke R^2, Tjur R^2, and Cox & Snell R^2 are measures of the goodness of fit of the model, indicating how well the model fits the data. The alternative hypothesis has higher values for each of these statistics, indicating that it fits the data better than the null hypothesis. Hence, the logistic regression model suggests that there is a significant relationship between some independent variables and the adoption/non-adoption of SRI practices. Specifically, Awareness, Constraints, Educational Level, Access to Loan, and Ext Visit are significant predictors of the dependent variable. Rahman, Sarkar and Hossain (2021) posited that factors that explain the adoption and impact of sustainable

agricultural practices in Ethiopia, that some independent variables have a significant relationship with the adoption and non-adoption of SRI practices. Aliyu, *et al.* (2020) opined factors that influence the adoption of the System of Rice Intensification (SRI) in Kenya, that awareness, constraints, formal educational level, Access to credit, and number of extension visit are significant predictors of the adoption and non-adoption of SRI practices. This is evident in the submission of Aliyu, *et al.* (2020) on the determinants of adoption of SRI practices in Niger State, Nigeria.

Table 4: The Regression Analysis on the Factors Influencing the Adoption of SRI Innovative Practices among the Adopters

Model	Deviance	AIC	BIC	Df	X^2	P	McFadden R^2	Nagelkerke R^2	Tjur R^2	Cox & Snell R^2
H_0	284.832	286.832	290.283	232						
H_1	117.211	167.211	253.487	208	167.621	< .001	0.588	0.727	0.625	0.513

Coefficients						
				Wald Test		
	Estimate	Standard Error	*Z*	Wald Statistic	df	*P*
(Intercept)	-32.459	13899.984	-0.002	5.453×10^{-6}	1	0.998
Awareness (2)	26.457	13899.984	0.002	3.623×10^{-6}	1	0.998
Awareness (3)	27.939	13899.984	0.002	4.040×10^{-6}	1	0.998
Awareness (4)	27.136	13899.984	0.002	3.811×10^{-6}	1	0.998
Awareness (5)	44.569	14105.524	0.003	9.984×10^{-6}	1	0.997
Attitude (2)	-2.351	1.938	-1.213	1.472	1	0.225
Attitude (3)	-1.500	2.030	-0.739	0.546	1	0.460
Attitude (4)	-0.594	2.883	-0.206	0.042	1	0.837
Attitude (5)	18.793	1954.383	0.010	9.246×10^{-5}	1	0.992
Constraints (2)	5.277	2.246	2.349	5.519	1	0.019
Constraints (3)	6.207	2.589	2.397	5.746	1	0.017
Constraints (4)	7.206	2.537	2.840	8.066	1	0.005
Constraints (5)	22.946	2528.652	0.009	8.234×10^{-5}	1	0.993
EDUCATIONAL _LEVEL (2)	-2.276	0.920	-2.474	6.119	1	0.013
EDUCATIONAL _LEVEL (3)	0.465	0.692	0.672	0.451	1	0.502
EDUCATIONAL _LEVEL (4)	-2.157	1.324	-1.629	2.653	1	0.103
EDUCATIONAL _LEVEL (5)	-0.019	1.826	-0.010	1.081×10^{-4}	1	0.992
HOUSEHOLD	-0.021	0.042	-0.486	0.236	1	0.627
ACCESS_LOAN (2)	-0.903	1.587	-0.569	0.324	1	0.569
ACCESS_LOAN (3)	22.936	29232.438	7.846×10^{-4}	6.156×10^{-7}	1	0.999
ACCESS_LOAN (4)	9.343	9833.996	9.500×10^{-4}	9.025×10^{-7}	1	0.999
EXT_VISIT (2)	3.332	1.847	1.804	3.253	1	0.071
EXT_VISIT (3)	-1.738	1.688	-1.030	1.060	1	0.303
EXT_VISIT (4)	-0.414	1.380	-0.300	0.090	1	0.764
FARM_SIZE	1.497	0.562	2.664	7.095	1	0.008

Source: *Field Survey, 2023*. AIC=Akaike Information Criterion & BIC= Bayesian Information Criterion

Constraints to Adoption of the SRI Innovative Practices

The result of the constraints to adoption of SRI practices among rice farmers is shown in Table 5. The constraints were measured on a 4-point likert type scale of very severe (4.00), severe (3.00), moderately severe (2.00) and not severe (1.00) against some constraint constructs obtained during the pretesting of the data collection instrument. The average score

of 2.50 was obtained which implies that mean score of 0-1.44 are classified as not severe constraints, 1.45-2.44 are considered as moderate constraints, and 2.45-3.44 are considered as severe constraints while 3.45-4.00 are considered as very severe constraints respectively. The farmers perceived several constraints to the adoption of SRI practices in the study area. Most of the constraints examined were severe constraints except for none-availability of organic manure for usage ($\bar{x}$=3.70±1.50), farm input requirement are expensive ($\bar{x}$=3.45±1.60), inadequate funds to practice the SRI method ($\bar{x}$=3.56±1.58) and the equipment are not available or too expensive to practice SRI innovation into practice ($\bar{x}$=3.53±1.58). Arifin and Hambali's (2020) discovered that expensive input requirement, limited access to inputs and finance, and adherence to traditional farming practices among others are main barriers to adoption of SRI innovation practices. Bhattacharyya and Bhattacharyya's (2018) identified lack of access to inputs, finance, and inadequate support from government agencies as key constraints to SRI adoption. Boulakia, Mzoughi, and Ben Youssef's (2019) found that low education levels and limited access to finance and information were among the main barriers to SRI adoption in the study area. Cissé, Diagne, and Kane's (2018) posited that lack of access to credit, limited availability of inputs and extension services, and low education levels as major constraints to SRI adoption. Kujinga, Chinembiri, and Chitakira's (2016) also found that SRI practices contributed to increased food security, income, and environmental sustainability, and recommended the need for increased extension services and access to inputs and finance to promote wider adoption of SRI. The mean index of the constraints shows that SRI innovation practices has a severe constraints ($\bar{x}$=3.21±1.47) on its adoption among the rice farmers in the study area.

Table 5: Distribution of the respondents based on constraints to implementation of SRI innovative practices

Variables	Mean ($\bar{x}$)	SD (δ)	R
Problem of weed control	3.19	1.45	Severe
Transplanting difficulties	3.19	1.45	Severe
SRI requires skill labor for management	3.21	1.45	Severe
SRI transplanting demands more labor	3.44	1.45	Severe
SRI need more concerted effort	3.21	1.53	Severe
None availability of organic manure for usage	3.70	1.50	Very Severe
Transplanting organic matter is a problem	3.44	1.37	Severe
There is rodents attack due to unclean bunds	3.19	1.32	Severe
SRI practices requires well drained soils	2.69	1.35	Severe
SRI practices does not work on flooded fields	2.89	1.41	Severe
SRI management activities are difficult	2.96	1.43	Severe
SRI nursery management is difficult to handle	2.77	1.54	Severe
SRI seed selection is again another difficulty	2.71	1.55	Severe
SRI awareness and its benefits against the traditional methods	2.79	1.57	Severe
The Farm inputs requirements are expensive	3.45	1.60	Very Severe
Inadequate funds to practice the SRI method	3.56	1.58	Very Severe
Farmers are not aware of the SRI innovation	3.30	1.43	Severe
Inadequate education to comprehend the innovation	3.44	1.52	Severe
Equipment are not available/expensive to practice SRI innovation into practice	3.53	1.58	Very Severe
No government support to practice SRI technology	3.43	1.34	Severe
Mean Index Value of Constraints	**3.21**	**1.47**	Severe

Source: Field Survey, 2023

Extension Contacts has no Significant Influence on the Adoption of SRI Innovative Practices among Rice Farmers

The Table 6 shows the result of the logistic regression analysis on the influence of extension visits on the adoption of System of Rice Intensification (SRI) practices. Based on the results of this logistic regression analysis, we cannot conclude that the number of extension visits has a significant influence on the adoption of System of Rice Intensification (SRI) practices. The odds of adopting SRI practices appear to decrease as the number of extension visits increases, but this relationship is not statistically significant.

The implication of this finding is that extension visits may not be the most effective way to promote the adoption of SRI practices. Other factors that were not included in the analysis may have a stronger influence on adoption, such as the availability of resources, farmer education levels, and market demand. Cissé, Diagne, and Kane's (2018), posited that farmers' access to credit, social networks, and market demand had a significant positive influence on the adoption of SRI practices, while the frequency of extension visits did not have a significant effect. Similarly, Rahman, Sarkar & Hossain (2021) found that access to credit and training, as well as favorable market conditions, were the most significant predictors of the adoption of SRI practices, while the number of extension visits did not have a significant effect. Also, Ana (2013) opined that, access to credit, inputs, and social networks were significant factors influencing the adoption of SRI, while extension visits did not. Based on the logistic regression results presented, there is no significant relationship between the number of extension visits and the adoption of SRI practices. The p-value for the chi-square test of the model is 0.336, which is higher than the conventional threshold of 0.05, indicating that the model does not provide sufficient evidence to reject the null hypothesis of no relationship between the number of extension visits and the adoption of SRI practices.

Table 6: Result of Logistic Regression on the Influence of Extension Visits On the Adoption of SRI Innovation Practices

Model	Deviance	AIC	BIC	Df	X^2	p-value	McFadden R^2	Nagelkerke R^2
H_0	406.19	408.19	411.93	311				
H_1	402.81	410.81	425.78	308	3.38	0.336	0.008	0.015
Coefficients		**Estimate**	**Std error**		**Z**	**Wald Statistic**	**Df**	**p-value**
(Intercept)		0.916	0.592		1.55	2.399	1	0.121
Extension visit (2)		-0.487	0.640		-0.76	0.581	1	0.446
Extension visit (3)		-0.799	0.684		-1.17	1.362	1	0.243
Extension visit (4)		-0.192	0.611		-0.31	0.099	1	0.754

Source: Field Survey, 2023. AIC=Akaike Information Criterion & BIC= Bayesian Information Criterion

Conclusion

Based on the study, the following conclusions can be drawn. The main sources of knowledge on SRI practices are fellow farmers (45.3%0, field demonstration (16.2%) and contact farmers (11.7%). The most effective sources of knowledge in promoting SRI adoption are contact farmers, fellow farmers, NGOs, and farmers' association. The factors influencing adoption are awareness, constraints, educational level, access to loan and extension visit. Most of the constraints examined were severe except for none-availability of organic manure for usage ($\bar{x}$=3.70±1.50), expensive farm input requirement ($\bar{x}$=3.45±1.60), inadequate funds to practice the SRI method ($\bar{x}$=3.56±1.58) and the equipment are not available or too expensive to practice SRI innovation into practice ($\bar{x}$=3.53±1.58).

Recommendations

Based on the conclusion the following recommendations can be adduced:

1. Main sources of knowledge and other weaker ones be enhanced and promoted more by the government and or the development partners in rice production to be able to improve the awareness of the respondent and also assist in the adoption rate and persuade none adopters too to adopt
2. Contact farmers, fellow farmers, NGOs, and farmers' association, being the main sources of knowledge should be supported with capacity building periodically to sustain its existence and induce none adopters to adopt the technology.
3. The favorable factors of adoption such as awareness, constraints, educational level, access to loan and extension visit should be supported by development partners in agriculture and government at all levels in assisting adoption.
4. Sustainable solutions should be proffered to severe constraints to SRI adoption.

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