Adoption of System of Rice Intensification (SRI) Methodology among Rice Farmers in Nasarawa State, Nigeria

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Abstract— *The research assessed farmers adoption of system of rice intensification (SRI) in Nasarawa State, Nigeria. The specific objectives of the study were to: describe the socioeconomic characteristics of SRI practitioners among rice farmers, investigated their awareness of SRI, evaluated their adherence to recommended SRI practices, explored factors influencing adoption, and identified barriers hindering adoption. A multi-stage sampling method was used to survey 300 participants. Data were collected using questionnaire and data obtained were analyzed using descriptive statistics and logit regression were employed to achieve these objectives. Results indicated that the majority of SRI practitioners were male, averaging around 45 years old, and typically lived in households with approximately (9) nine members. Findings also showed widespread awareness of nursery planting, high familiarity with manual weeding, and the use of organic fertilizers. Regarding adoption, practices such as nursery planting, transplanting young seedlings at three weeks old, and irrigation were commonly implemented. Logit regression analysis highlighted significant positive influences of gender ($P<0.01$) and education level ($P<0.01$) on SRI adoption. The primary barrier identified was the high cost of labor, which significantly deterred farmers from adopting SRI. The study concluded that the socioeconomic characteristics of farmers play a crucial role in their adoption of SRI in Nasarawa State. Recommendations included initiatives to mitigate labor costs and strengthen extension services to provide ongoing technical support and guidance on SRI practices.*

Keywords— Adoption, rice, intensification, methodology, farmers.

I. INTRODUCTION

Rice is a crucial cereal crop cultivated across diverse climatic zones worldwide, serving as the primary dietary staple for nearly half of the global population. It accounts for approximately one-third of the world's cereal cultivation and contributes significantly to caloric intake, ranging between 35% and 60% for about 2.7 billion individuals (Tayefe, Gerayzade, Amiri & Zade, 2014). In Nigeria, rice has increasingly become a vital component of the national diet and is now regarded as both a staple food and a major source of calories. Traditionally, Nigerian farmers have predominantly cultivated lowland rice due to its ecological compatibility. However, in recent years, actual production levels have fallen below potential, largely due to inefficient resource use and suboptimal practices. In response, the Nigerian government has implemented various initiatives aimed at transforming rice farming from subsistence-based operations to commercial enterprises. These include the provision of improved inputs and the establishment of Public-Private Partnership (PPP) frameworks to enhance agricultural productivity (Tayefe *et al.*, 2014).

Rice consumption in Nigeria has risen dramatically, growing at an annual rate of approximately 10%. It has become the predominant staple food among the country's population of over 200 million people (Terwase & Madu, 2014). Yet, domestic production has not kept pace with rising demand, leading to a significant gap between consumption and local supply (Omofonmwan & Kadiri, 2017). To bridge this gap, government institutions, Community-Based Organizations (CBOs), and Non-Governmental Organizations (NGOs) have intensified efforts to mobilize and train rice farmers in improved agronomic practices. One such innovation is the System of Rice Intensification (SRI), which has been promoted and demonstrated across the country as a viable strategy for enhancing rice productivity and achieving self-sufficiency.

SRI is an agronomic methodology aimed at improving the productivity of irrigated rice through optimized management of soil, water, nutrients, and plant spacing. The method involves transplanting young seedlings at wider intervals and practicing alternate wetting and drying (AWD), rather than continuous flooding, to stimulate better root growth and plant vigor (Fernandes & Uphoff, 2015). This approach was originally developed in Madagascar in the 1980s by Father Henri de Laulanié, with the objective of establishing sustainable farming systems that enhance productivity while minimizing input costs and conserving water resources (Zotoglo, 2017). Compared to traditional practices, SRI has proven to be more resource-efficient and environmentally sustainable. For example, while conventional broadcasting methods require 100 kg of seeds per hectare and direct planting requires 30–60 kg, SRI only uses 4–10 kg of seeds per hectare, substantially reducing input costs and labor demands (Randriamiharisoa, Barison & Uphoff, 2016).

In Nigeria, various public and community-based initiatives have supported the dissemination and demonstration of SRI practices, with the broader goal of achieving national rice self-sufficiency. However, adoption rates among rural farmers remain low, and rice yields and incomes are often still below levels recorded two decades ago. Several barriers to adoption persist, including poor dissemination of innovation and limited uptake of recommended practices. Farmers are generally more likely to adopt new technologies if they are simple, offer comparative advantages, are compatible with existing practices, and are both accessible and affordable (Bawa & Ani, 2014). In Nasarawa State, agencies such as the Commercial Agriculture Development Project (CADP), Fadama III Project, and the IFAD/FGN/Community-Based Natural Resource Management Programme (CBNRMP) have been active in promoting rice production, including SRI techniques. Despite these interventions, many farmers in the region remain economically vulnerable, and the overall awareness and adoption of SRI remain unclear. Therefore, this study was designed to assess the extent of adoption of the System of Rice Intensification (SRI) among rice farmers in Nasarawa State, Nigeria.

1.1 Objectives of the Study:

The broad objective of this study is to assess the level of adoption of the System of Rice Intensification (SRI) among rice farmers in Nasarawa State, Nigeria.

The specific objectives are to:

a) Describe the socio-economic characteristics of rice farmers practicing the System of Rice Intensification(SRI);
b) Assess the level of awareness of SRI among rice farmers in the study area;
c) Evaluate the extent to which rice farmers have adopted and adhered to the recommended SRI practices;
d) Determine the factors influencing the adoption of SRI among rice farmers in the study area;
e) Identify the constraints affecting the adoption of SRI among rice farmers in the study area;
f) Examine the sources of information available to farmers on SRI practices.

1.2 Hypotheses of the Study:

The study was guided by the following null hypotheses:

- **H_{01}:** There is no significant relationship between the socio-economic characteristics of rice farmers and their adoption of the System of Rice Intensification (SRI).
- **H_{02}:** There is no significant relationship between the use of SRI-recommended practices and the factors influencing adoption.

II. MATERIALS AND METHODS

2.1 Study Area:

The study was conducted in Nasarawa State, located in North Central Nigeria. Created in 1996 from the western part of Plateau State, Nasarawa is bordered by Taraba and Plateau states to the east, Kaduna State to the north, Benue and Kogi states to the south, and the Federal Capital Territory (FCT) to the west. The state comprises thirteen local government areas, with Lafia serving as the capital and Karu Urban Area as a key economic hub. As of 2025, the state has an estimated population of 3.1 million (NPC, 2025). Nasarawa's landscape features the tropical Guinean forest–savanna mosaic, with significant geographical features like the River Benue and a portion of the Jos Plateau. It is home to a diverse mix of ethnic groups such as the Koro, Eggon, Mada, Fulani, Hausa, Tiv, and Alago, with Islam, Christianity, and traditional religions practiced widely (NADP, 2010).

Historically, Nasarawa underwent multiple administrative transformations from incorporation into the Sokoto Caliphate during the Fulani jihad, to British colonial rule under the Northern Nigeria Protectorate, and through various post-independence state

reconfigurations, until it became a distinct state in 1996. Economically, it is endowed with abundant mineral resources, including gold, marble, barite, gypsum, and kaolin (NASIDA, 2023). Despite this mineral wealth, agriculture remains the mainstay of the population, with key crops including rice, yam, cassava, cowpea, and groundnut.

Nasarawa is one of Nigeria's leading rice-producing states. From 2003 to 2008, it recorded an estimated rice production capacity of 655,000 metric tons per hectare. Between 2007 and 2014, about 642.16 hectares produced roughly 1.45 million metric tons of rice (NADP, 2010; NAERLS, 2014). The state government is committed to enhancing the agricultural value chain, with a focus on rice, sesame, and ginger, as well as investing in aquaculture, forestry, and livestock farming. These initiatives are aimed at fostering climate-resilient, market-oriented agricultural development (NASIDA, 2023).

2.2 Sampling Procedure and Sample Size:

The study employed a multi-stage sampling technique. The first stage involved the purposive selection of the Southern Agricultural Development Programme (ADP) zone out of the three ADP zones in Nasarawa State, as it is the largest rice-producing area and has been introduced to SRI practices. In the second stage, all ten (10) extension blocks within the Southern ADP zone were purposively selected to capture the full range of rice farming activities and ensure that no major rice-producing block was excluded from the study. The third stage involved the use of stratified random sampling to draw respondents proportionately from each of the ten blocks. A sampling fraction of 10% was applied to the total number of registered rice farmers (3,049) within the zone, resulting in the random selection of 306 farmers for the study.

2.3 Data Collection and Analysis:

Data for the study were collected from primary sources using a well-structured questionnaire that included both open- and close-ended questions. The instrument was vetted by experts from the Department of Agricultural Extension and Rural Sociology, University of Abuja, to ensure validity and clarity. Following this, the questionnaires were administered to respondents with the assistance of trained enumerators from the Nasarawa State chapter of the Rice Farmers Association of Nigeria (RIFAN). The questionnaire was divided into four sections, each addressing a specific aspect of the study. Both descriptive and inferential statistical tools were used for data analysis. Descriptive statistics such as frequency, percentages, means, and standard deviations were used to summarize the demographic characteristics and general trends in SRI awareness and practices. Adoption and extent of use of specific SRI practices were analyzed using a 4-point Likert scale: Always = 3, Often = 2, Rarely = 1, and Never = 0. Inferential statistics including logistic regression model was employed to identify the factors influencing the adoption of SRI. Principal Component Analysis (PCA) was used to identify and categorize the major constraints to SRI adoption by reducing complex variables into core components.

III. RESULTS AND DISCUSSION

3.1 Socioeconomic Characteristics of Rice Farmers Practicing SRI in the Study Area:

The socioeconomic characteristics of rice farmers practicing the System of Rice Intensification (SRI) in the study area are summarized in Table 1. The data revealed that 51% of the SRI rice farmers were men, while 49% were women. This near-equal gender distribution suggests that SRI practices are accessible and not perceived as overly labor-intensive or gender-exclusive. This aligns with FAO (2022), which emphasizes the potential of inclusive agricultural innovations to bridge gender gaps. Nonetheless, the slight male predominance may reflect existing gender disparities in access to agricultural resources and decision-making power, consistent with observations by the World Bank (2021).

In terms of age distribution, the majority of farmers (40%) were aged between 41 and 50 years, followed by 25.33% aged 51 and above, 21% aged 20–30, and 13.67% aged 31–40. The mean age was approximately 45 years, indicating that middle-aged farmers dominate the adoption of SRI. This group is typically more receptive to new technologies, balancing accumulated farming experience with the physical ability to manage labor-intensive practices. Rahman, Alam & Haque (2021) supported this view, stating that middle-aged farmers are more open to innovations that offer productivity gains and long-term sustainability.

Regarding marital status, 46% of the respondents were married. This demographic is often associated with higher investment motivation in sustainable practices to secure family welfare, as highlighted by Rahman *et al.,* (2021). Kumar *et al.,* (2020) also noted that married farmers tend to take calculated risks for the benefit of household stability. The remaining farmers were separated (17.33%), widowed (15%), divorced (13.67%), and single (8%).

Education levels among SRI farmers showed that 49% had attained secondary education, 42% pre-secondary, 9% primary education, and only 1.43% had no formal education. This distribution reinforces the importance of education in the adoption of modern agricultural technologies. Educated farmers are more likely to understand and apply technical knowledge associated with SRI practices, as affirmed by (Manda, Alene, Gardebroek, Kassie and Tembo, 2021).

Household size data indicated that 44.67% of the respondents had 6–10 members, 35.33% had 11–15 members, and 20% had 1–5 members. With an average household size of nine persons, the availability of family labor likely supports the implementation of labor-demanding practices associated with SRI. Kassie, Teklewold, Jaleta, Marenya and Erenstein (2020) noted that larger households have an advantage in adopting such practices due to labor availability. In terms of farming experience, 49% of SRI farmers had 11–21 years of rice farming experience, followed by 24% with 22–32 years, 26.33% with 1–10 years, and 0.67% with over 33 years. The average farming experience was about seven years. Experience plays a critical role in decision-making and the adoption of innovations, with Manda *et al.,* (2021) and Wainaina, Tongruksawattana, and Qaim (2022) highlighting that experienced farmers are more adept at evaluating and implementing new practices.

Lastly, 59.33% of farmers reported annual earnings between ₦1,801,000, and the average farm size was 1.38 hectares. This income level and limited landholding suggest that SRI is particularly suited to smallholder farmers, who often seek innovations that increase productivity and profitability on small plots (Abro, Alemu & Hanjra, 2022).

TABLE 1
FREQUENCY DISTRIBUTION OF SOCIOECONOMIC CHARACTERISTICS OF FARMERS

Variables	Frequency	Percentage	Mean
Sex			
Male	153	51.00	
Female	147	49.00	
Age			44.56 years
20 – 30	63	21.00	
31 – 40	41	13.67	
41 – 50	120	40.00	
≥ 51	76	25.33	
Marital Status			
Single	24	8.00	
Married	138	46.00	
Divorced	41	13.67	
Widowed	45	15.00	
Separated	52	17.33	
Level of Education			
Primary Education	27	9.00	
Secondary Education	147	49.00	
Post-Secondary Education	126	42.00	
Household Size			9 persons
1 – 5	60	20.00	
6 – 10	134	44.67	
11 – 15	106	35.33	
Rice Farming Experience			7.31 years
1 – 10	79	26.33	
11 – 21	147	49.00	
22 – 32	72	24.00	
≥ 33	2	0.67	
Annual Income			₦220,700.00
₦1,000,000 – ₦1,800,000	68	22.67	
₦1,801,000 – ₦2,601,000	178	59.33	
₦2,602,000 – ₦3,402,000	54	18.00	
Rice Farm Size			1.38 hectares
0 – 1.5	210	70.00	
1.6 – 3.1	73	24.33	
≥ 3.2	17	5.67	
Total	**300**	**100**	

Source: Field survey, 2024

3.2 Awareness of SRI Practices among Rice Farmers:

The data from Table 2, which presents the levels of awareness of System of Rice Intensification (SRI) practices among rice farmers, provides essential insights into the factors influencing the adoption of SRI in the study area. Awareness remains a crucial precursor in the technology adoption continuum, as farmers must first become knowledgeable about specific practices before evaluating and applying them.

The findings indicate very high levels of awareness for certain components of SRI. Notably, 98.33% of the farmers were aware of nursery planting, 90.33% were familiar with manual weeding, and 83.67% acknowledged the use of organic fertilizers. These figures suggest that these practices have already been integrated into the local farming systems, likely due to their alignment with traditional agricultural methods. As Kassie *et al.,* (2020) and Melesse *et al.,* (2021) argue, practices that are simple and contextually relevant tend to enjoy wider diffusion and acceptance among smallholder farmers.

In contrast, awareness of more technical or distinctively SRI-specific practices is considerably lower. Only 61.33% of farmers were aware of transplanting younger seedlings aged 10–15 days, while an even lower proportion (42.33%) were familiar with the recommended 25 × 25 cm seedling spacing. These practices are vital for realizing SRI's productivity potential, as they contribute to optimal plant growth and resource utilization. Manda *et al.,* (2021) suggest that the limited awareness of such practices may be attributed to the complexity of the techniques or insufficient extension support that hinders effective dissemination.

Moreover, although 76.33% of farmers were aware of intermittent irrigation as an essential element of SRI nearly a quarter remained unaware of this core practice. Given that water management is central to the efficiency and ecological sustainability of SRI, this gap in awareness could significantly impact adoption outcomes. As Abro *et al.,* (2022) point out, inconsistent or improper water regulation undermines the benefits of SRI, particularly in contexts where water resources are becoming increasingly scarce. The observed variation in awareness levels across SRI components highlights the need for targeted education and farmer support, focusing on the less understood yet crucial elements of the system.

TABLE 2
LEVEL OF AWARENESS OF SRI PRACTICES AMONG RICE FARMERS IN THE STUDY AREA

Practices	Aware (%)	Not Aware (%)	Total
Nursery planting	98.33	1.67	100
Transplanting of young seedlings at 10-15days old	61.33	38.67	100
Spacing 25cm – 25cm apart	42.33	57.67	100
Use of organic fertiliser	83.67	16.33	100
Manual weeding	90.33	9.67	100
Irrigation (application of water intermittently i.e control of water)	76.33	23.67	100

Multiple-choice Response Recorded

Source: Field survey, 2024.

3.3 The Adoption and Extent to Which Rice Farmers Followed the Recommended Practice of SRI:

The adoption and extent to which rice farmers followed the recommended practices of the System of Rice Intensification (SRI) are presented in Table 3. The results reveal varying degrees of compliance with SRI principles, indicating that while some practices are regularly implemented, others are adopted less consistently. This pattern suggests that many farmers engage in partial adoption of SRI, potentially limiting the overall effectiveness of the system. Among the practices assessed, nursery planting recorded the highest mean score (3.55), implying that farmers "always" adhere to this component. This consistency may be attributed to the simplicity and familiarity of nursery planting within traditional farming systems, requiring minimal technical skills or inputs. Its widespread use underscores the potential for integrating low-barrier practices into smallholder farming contexts.

Other practices such as transplanting young seedlings at 10–15 days old (mean = 3.14), the use of organic fertilizer (3.19), manual weeding (3.15), and intermittent irrigation (3.19) were generally followed "often." Although adoption levels are relatively high, they fall short of full compliance, which can undermine the system's potential. Timely transplanting is critical for yield maximization, and irregular implementation may affect results (Manda *et al.,* 2021). Similarly, intermittent irrigation, central to SRI's water-saving and plant health objectives, requires precision; its inconsistent application reflects challenges such as limited knowledge, labor availability, or access to water infrastructure (Hailu, Tegegne & Belay, 2022). Spacing seedlings 25 × 25 cm apart received the lowest mean score (2.65), indicating irregular adherence. Yet, this practice is essential

for reducing inter-plant competition and optimizing nutrient uptake and light exposure. The low compliance rate may be due to the technical difficulty of maintaining uniform spacing or limited training on its importance. Addressing these gaps is vital for achieving the full agronomic potential of SRI.

TABLE 3
RESULT OF THE ADOPTION AND EXTENT TO WHICH RICE FARMERS FOLLOWED THE RECOMMENDED PRACTICE OF SRI

Recommended practices	Always (3)	Often (2)	Rarely (1)	Never (0)	Total	Mean	Remark
Nursery planting	668 (62.66)	396 (37.15)	2 (0.19)	0 (0.00)	1066	3.55	Always
Transplanting of young seedlings at 10 -15days old	352 (37.41)	513 (54.52)	70 (7.44)	6 (0.64)	941	3.14	Often
Spacing 25cm – 25cm apart	236 (29.72)	363 (45.72)	150 (18.89)	45 (5.67)	794	2.65	Often
Use of organic fertiliser	344 (35.91)	564 (58.87)	48 (5.01)	2 (0.21)	958	3.19	Often
Manual weeding	348 (36.86)	516 (54.66)	78 (8.26)	2 (0.21)	944	3.15	Often
Irrigation (application of water intermittently i.e control of water)	392 (40.96)	483 (50.47)	82 (8.57)	0 (0.00)	957	3.19	Often

Source: Field survey, 2024

Table 4 presents the sources of information through which farmers learned about the System of Rice Intensification (SRI), underscoring the pivotal role of information dissemination in shaping agricultural innovation adoption. Social media emerged as the most significant source (32.18%), suggesting its growing influence in agricultural knowledge transfer. With features such as real-time updates, broad accessibility, and user interactivity, social media platforms are proving particularly effective for spreading awareness of SRI practices. This trend aligns with findings by Abro *et al.*, (2022), who noted that digital technologies increasingly enhance access to agricultural knowledge, especially among younger and tech-savvy farmers.

Extension agents were the second most reported source (24.39%), reaffirming the relevance of traditional extension systems in knowledge dissemination. Their role remains critical, as they provide localized, experience-based advice and often facilitate on-site demonstrations. As trusted liaisons between research and rural communities, extension agents continue to play an important part in promoting practices like SRI.

Traditional media radio (12.52%), television (9.20%), and newspapers (10.73%) remain part of the information ecosystem, though less dominant. Radio, in particular, retains value in rural areas due to its affordability and reach. However, the relatively lower reliance on these outlets compared to social media may reflect a shift toward digital communication, likely influenced by the growing accessibility of smartphones and internet connectivity (Wainaina *et al.*, 2022). Friends and peer networks (10.98%) also played a notable role, highlighting the importance of informal, community-based learning in the adoption process. Peer influence and firsthand testimonials often drive trust and willingness to adopt innovations like SRI.

TABLE 4
SOURCE OF INFORMATION ON SRI.

Source of Information	Frequency*	Percentage (%)
Radio	98	12.52
Extension Agent	191	24.39
Television	72	9.20
Friend	86	10.98
Social medial	252	32.18
Newspaper	84	10.73
Total	**783**	**100**

*Multiple-choice Response Recorded

Source: Field survey, 2024.

3.4 Factors Influencing the Adoption of the System of Rice Intensification (SRI):

To examine the factors influencing the adoption of the System of Rice Intensification (SRI) among rice farmers in the study area, a binary logistic regression model was employed. The dependent variable was the adoption status of SRI, while the

explanatory variables included age, sex, education level, marital status, household size, rice farm size, farming experience, and annual income. The results of the regression analysis are presented in Table 5. The model produced a Log-likelihood value of -162.3034 and a Wald chi-square value of 53.20, which is statistically significant at the 1% level. This indicates that the model fits the data well and that the explanatory variables jointly influence the likelihood of adopting SRI.

Out of the eight variables considered, six were found to significantly influence the adoption of SRI. These include age, sex, education level, household size, farm size, and annual income while farm experience and marital status were not significant. Consequently, the null hypothesis stating that there is no significant relationship between farmers' socioeconomic characteristics and SRI adoption is rejected.

Age was negatively associated with SRI adoption and was significant at the 10% level (coefficient = -0.0324), indicating that younger farmers are less likely to adopt SRI. Although younger individuals are typically more open to innovation, this result may reflect barriers like digital literacy or conservative tendencies among older farmers (Oladele, Akinwale & Ajani, 2022). Sex also significantly influenced adoption (coefficient = 0.9426, $p < 0.01$), with male farmers more likely to adopt SRI. As noted by FAO (2023), women often face structural barriers such as limited access to resources, cultural restrictions, and lower digital literacy, which impede their participation in innovative practices.

Education level had a strong positive effect on adoption (coefficient = 0.9426, $p < 0.01$). Educated farmers are better equipped to understand, access, and implement the knowledge-intensive components of SRI. Manda *et al.,* (2021) also observed that education enhances a farmer's likelihood of engaging with training and extension services, which are critical for adopting technical innovations like SRI. Household size, on the other hand, had a significant negative effect (coefficient = -0.5898, $p < 0.01$), suggesting that while larger families offer more potential labour, internal competition for time and resources may reduce the likelihood of adopting labour-intensive systems like SRI.

Rice farm size was positively related to adoption (coefficient = 0.8413, $p < 0.01$), indicating that farmers with larger plots are more likely to adopt SRI. Larger holdings allow for cost distribution and may offer better economies of scale, increasing the attractiveness of investing in a new system. Lastly, annual income also showed a positive and significant relationship with adoption (coefficient = -4.53e-06, $p < 0.05$). This indicates that wealthier farmers are more capable of absorbing the initial costs and risks associated with adopting new technologies like SRI, corroborating the findings of Wainaina *et al.,* (2022).

TABLE 5
FACTORS INFLUENCING THE ADOPTION OF SRI AMONG RICE FARMERS

Variables	Parameters	Coefficient	Robust Std. Err	z-value
ICT Specific Variables				
Age (X_1)	β_1	-0.0324	0.0192	-1.69*
Sex (X_2)	β_2	0.9426	0.2859	3.30***
Level of Education (X_3)	β_3	1.1283	0.3514	3.21***
Marital Status (X_4)	β_4	0.0504	0.1516	0.33
Household Size (X_5)	β_5	-0.5898	0.2091	-2.82***
Rice Farm Size (X_6)	β_6	0.8413	0.1437	5.86***
Rice Farming Experience (X_7)	β_7	0.0087	0.0322	0.27
Annual Income (X_8)	β_8	-4.53e-06	1.89e-06	-2.39**
Constant	β_0	-1.2260	0.8282	-1.48
Diagnostics Statistics				
Pseudo R-Square	-162.3034			
Wald Chi-Square (8)	53.20			
Prob > Chi-Square	0.0000			
Observation	300			

*** = significance at 1%, ** = significance @ 5% and * = significance @ 10%.

Source: Field survey, 2024

3.5 Constraints to the Adoption of the System of Rice Intensification (SRI) Among Rice Farmers:

The constraints to adopting the System of Rice Intensification (SRI) among rice farmers in the study area are presented in Table 6. The results reveal a number of significant challenges that hinder the widespread adoption of SRI practices, despite their potential for enhancing productivity and sustainability. Foremost among these is the high cost of labour. As a labour-intensive methodology, SRI demands substantial manual input for transplanting young seedlings, maintaining wider plant

spacing, and engaging in regular manual weeding. In areas where labour is either scarce or expensive, these requirements become a major barrier, especially for smallholder farmers with limited resources (Tadesse, Azam-Ali & Kedir, 2023).

Transportation costs emerged as another substantial constraint. Farmers must often transport both inputs (such as organic fertilisers) and harvested produce, a process that becomes costlier with poor rural infrastructure. These elevated costs can make the adoption of SRI practices less appealing, as farmers are deterred by the additional financial burden associated with logistics (Hailu *et al.,* 2022; Mwakaje, 2023). Similarly, inadequate financial resources limit the capacity of farmers to invest in necessary inputs like organic fertilisers and herbicides. Smallholder farmers, in particular, may lack access to credit or institutional support, making it difficult to adopt practices whose financial benefits accrue only in the longer term (Mekonnen, Noreen & Fikru, 2022).

Insecure land tenure also restricts adoption. Farmers are unlikely to commit to labour-intensive and soil-enhancing practices such as SRI if they do not have long-term rights or security over the land they cultivate. Additionally, the high cost and inconsistent availability of essential inputs such as organic fertilisers and eco-friendly pesticides further constrain adoption. As Gautam, Kumar & Singh (2023) note, input costs remain a critical factor influencing the willingness and ability of farmers to adopt new technologies.

Other notable challenges include poor soil fertility, which undermines confidence in SRI's effectiveness, and the prevalence of pests and diseases, particularly when chemical pesticide use is reduced under SRI systems (Srinivasan *et al.,* 2023). Furthermore, environmental hazards such as floods and droughts, inadequate access to modern farm implements, poor storage systems, and practical difficulties with spacing practices collectively create an environment in which adopting SRI can be perceived as risky or impractical. According to Kato, Matusi & Tanaka (2023), extreme weather events and infrastructural deficits pose serious risks to the implementation of controlled irrigation and other sensitive practices central to SRI.

TABLE 6
THE CONSTRAINTS TO THE ADOPTION OF SYSTEM OF RICE INTENSIFICATION BY FARMERS

Constraints	Frequency*	Percentage (%)
High cost of labour	289	25.04
Cost of transportation	206	17.85
Inadequate resources to finance your farm activities	113	9.79
Poor soil fertility	98	8.49
Land tenure system	83	7.19
Drought	57	4.94
Planting spacing of 25cm – 25cm is difficult	50	4.33
High cost of inputs e.g Herbicides, organic fertiliser and pesticides	49	4.25
Poor storage system	46	3.99
Flood incident	45	3.90
Low extension contact/services	44	3.81
Inadequate access to modern farm implements and machinery	37	3.21
Prevalence of pest and diseases	37	3.21

*Multiple-choice Response Recorded

Source: Field survey, 2024.

3.6 Test of Hypotheses:

3.6.1 Null Hypothesis One:

The z-values from the logit regression model were employed to test the first null hypothesis, which states that there is no significant relationship between the socioeconomic characteristics of rice farmers and their adoption of the System of Rice Intensification (SRI). As presented in Table 7, the log-likelihood value of –162.3034 and the Wald chi-square statistic of 53.20, significant at the 1% level, confirm the overall statistical significance of the model. These results indicate that the explanatory variables included in the regression model collectively influence the adoption of SRI among rice farmers in the study area.

Among the variables tested, six were found to be statistically significant: age, sex, level of education, household size, rice farm size, and annual income. This outcome clearly demonstrates that the adoption of SRI is shaped by farmers' demographic and socioeconomic profiles. Consequently, the null hypothesis is rejected, and the alternative hypothesis is accepted—there is a

statistically significant relationship between the socioeconomic characteristics of rice farmers and their adoption of the System of Rice Intensification.

3.6.2 Null Hypothesis Two:

To test the second null hypothesis, which posits that there is no significant relationship between the use of SRI-recommended practices and the factors influencing adoption, the Pearson correlation analysis was applied. The results are presented in Table 5.

The analysis revealed statistically significant positive correlations between several variables. Specifically, there was a correlation coefficient of 0.5315 between nursery planting and household size, 0.3129 between nursery planting and rice farm size, 0.0375 between spacing and rice farm size, and 0.4904 between age and the use of organic fertilizer. These significant relationships suggest that as the values of these influencing factors change, so too does the likelihood of adopting specific SRI practices. Given the statistical significance of these correlations, the second null hypothesis is also rejected. Therefore, it is concluded that there is a significant relationship between the use of SRI-recommended practices and the factors influencing their adoption.

TABLE 7
THE RESULT OF THE PEARSON CORRELATION TEST

Pearson Correlation		Nursery planting	Spacing 25cm-30cm apart	Use of organic fertiliser
Age	Sig. (2-tailed) N	1.0000 300	2.1810 300	0.4904** 300
Household size	Sig. (2-tailed) N	0.5315*** 300	1.0000 300	1.000 300
Rice farm size	Sig. (2-tailed) N	0.3129* 300	0.0375** 300	1.0000 300

*** = significance at 1%, ** = significance @ 5% and * = significance @ 10%.

Source: Field survey, 2024

IV. CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion:

The study revealed that variables such as age, gender, education level, household size, rice farm size, and annual income significantly influenced the adoption of the System of Rice Intensification (SRI) among rice farmers in the study area. Hence, the null hypothesis stating no significant relationship between socioeconomic characteristics and SRI adoption is rejected. Similarly, the second null hypothesis is rejected due to the significant results from the Pearson correlation analysis, confirming a relationship between the implementation of SRI practices and factors influencing adoption. These findings highlight the need for context-specific strategies, including targeted extension services and capacity-building programs, to enhance the effective and widespread adoption of SRI for sustainable rice production in the study area.

4.2 Recommendations:

Based on the findings of this study, the following recommendations are proposed to improve the adoption and effective implementation of System of Rice Intensification (SRI) practices:

a) Government and agricultural development agencies should promote the use of labour-saving technologies such as mechanised weeders and rice transplanters to reduce the high labour demand associated with SRI. Community-based labour-sharing cooperatives can also be encouraged through support from local governments.

b) Non-governmental organisations (NGOs), women-focused groups, and agricultural extension services should design and implement gender-sensitive programs that empower female farmers with training, access to finance, and tailored support to increase their adoption of SRI practices.

c) Microfinance institutions, commercial banks, and government credit schemes should provide low-interest loans or input subsidies to smallholder rice farmers to help them adopt and sustain SRI practices.

d) Ministries of agriculture and ICT innovators should collaborate to utilise social media, mobile applications, and other digital platforms for timely dissemination of SRI information, advisory services and market updates.

e) Youth development programs and agricultural entrepreneurship schemes should actively engage and support young farmers in adopting SRI, including offering start-up kits, technical mentoring, and agribusiness incubation.

f) Federal and state governments should subsidise key agricultural inputs such as organic fertilisers and provide access to affordable, modern farm implements through public-private partnerships.

g) Extension service providers and ADPs should be strengthened with adequate funding, staffing, and training to ensure regular contact with farmers and effective delivery of SRI-related technical support.

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