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Adoption of Improved Varieties among Rice Farmers in the Kindia Region of Guinea

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AOA (45%): Conceptualization, methodology, data curation, validation, visualization, supervision, writing - review & editing

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CMLF (25%): Conceptualization, methodology, data collection, writing - original draft

Abstract

This study investigated the adoption characteristics of improved rice variety among rice farmers in the Kindia region of Guinea. A Multistage sampling procedure was used to select 180 rice farmers and a well-structured interview guide was used to elicit information from the respondents. Data were analysed using percentages, mean statistics, standard deviation and Chi-square. The most adopted rice variety was CK 90 (86.6%). Factors influencing the adoption of improved rice varieties were market channels (84.9%), membership of associations (91.7%) and contact with extension personnel (85.5%). Most (97.2%) rice farmers knew about growing improved rice varieties. Most (66.1%) of the respondents had a favourable attitude towards growing improved rice variety but faced constraints like insufficient loan ($\chi = 2.89$), weed infestation ($\chi = 2.37$), storage losses ($\chi = 2.19$) and low extension activities ($\chi = 2.11$). The adoption characteristics of respondents were good (88.3%) with economic characteristics having the highest mean ($\chi = 2.71$). Educational qualification was significantly related ($\chi^2 = 1.149$) to the adoption characteristics of improved variety. Efforts should be made by research institutes to ensure increased access of rice farmers to improved seed varieties with attractive characteristics which could aid its adoption and ensure food security in Guinea.

Introduction

Rice (*Oryza sativa*) is a major staple food and mainstay for food security, livelihood and income for rice-farming communities. It is important in the diet of large parts of the population in Asia, Latin America and all parts of Africa (Rathna et al., 2019; Okoro et al., 2023). Rice, one of the widely produced, accepted and consumed staple grains by both urban and rural populations in Guinea is the most important calorie source in the region and has become an ideal substitute for most traditional grains including root and tuber crops (Soullier & Mendez del Villar, 2020). In recent years, population growth has threatened Guinea's food security. Guinea currently spends over US \$300 million annually to import rice for local consumption (Zhang et al., 2020). The demand-supply gap in rice production in Guinea is 6.3 million tonnes in demand as against 2.3 million tonnes in supply (Shaikh et al., 2022). The shortfall is a result of the numerous challenges facing the tiers of the rice value chain from production, processing, marketing and consumption (Koivogui et al., 2018). Guinea has implemented several initiatives to improve the production of rice to limit dependence on imports.

A major way to achieve this objective of meeting rice demand and export is by employing high-yielding improved varieties with desirable characteristics as opposed to the local variety which requires more manpower and human resources (Okoro et al., 2023). Farmers' awareness and receptiveness to the adoption of the improved varieties is still low although suppliers of improved varieties have been increasing and there is high production of such varieties in Kindia region.

To improve food security and close the demand-supply gap in the rice sector, the government of Guinea collaborated with international partners for the dissemination of new technologies, such as improved varieties (Nerica and CK series) and yield-enhancing farming practices which was developed by Africa Rice Center (ex-WARDA). Some of the unique characteristics of NERICA and CK series are high yield potential, short growth cycle, and early vigour during the vegetative phase which is a good trait in combating weeds and resistance to pests and diseases (Adeleye, 2016).

Adoption is vital to the use of any technology or variety in any agricultural value chain. According to Natson et al., (2022), the nature and state of technology will influence whether a farmer will adopt such technology or not. It has also been established that the adoption of improved variety is hinged on several factors like personal traits, risk, inputs and most recently, the inclusion of social networks or organisations. Also, it has been established that the characteristics of technology and the ability of a farmer to try it out before adoption is a good step to its full utilisation (Natson et al., 2022).

The desirable characteristics of a rice variety could aid its adoption and improve farmers' preference for the variety. In Guinea, the informal seed system supplies the bulk (90%) of seed to farmers, only 8% of rice farmers have access to seed from the formal sector (The Conservation, 2016). Farmers and local seed dealers save seed from the previous harvest for the next cropping season and pass it on through barter, gift or sale. Like many countries in the region, Guinea has tried to establish a formal national seed system with several projects addressing seed production, multiplication and distribution. However, such efforts have yielded little success.

Twenty improved rice varieties have been officially released in Guinea and its region since 1986 and their adoption has been encouraging when compared with the local

varieties. This intense adoption is expected to enhance productivity, income, and livelihood as well as reduce poverty (Kaliba et al, 2018; Azuma et al, 2022). The study seeks to validate empirically the characteristics that aid the adoption of improved varieties among rice farmers in the Kindia region of Guinea which most studies have not been able to establish. This is important to guide future up-scaling efforts in the bid to ensure the further spread of improved rice varieties across all the rice-growing regions in the Guinea Republic. The specific objectives of the study were to: (i) describe the major varieties grown by farmers, (ii) examine the factors influencing the adoption of improved rice varieties, (iii) determine the attitude of rice farmers to improved rice varieties, (iv) ascertain the knowledge of rice farmers about improved rice seeds, (v) identify the constraints faced in using improved rice variety and (vi) ascertain the adoption characteristics of improved rice variety among farmers.

Methodology

This study was carried out in the Kindia prefecture of Guinea. It is the main region in Guinea with high agricultural production. The population of people living in the region is 171, 005 (World Population Review, 2023). The study area is home to the Agronomic Research Centre of Kindia which specialises in the experimentation of improved varieties of crops. It is located in the east of lower Guinea with an altitude of 458.13 m in transition from lower to middle Guinea. The annual temperature ranges from 15°C to 38°C. The dominant activities in the study area are agriculture, crafts, trade and mining. Development programmes and projects evolving in the Prefecture are the Village Community Support Programme (VCSP) and National Support Programme for Actors in the Agricultural Sectors (PNAFA) in the Kindia Region.

The population of this study comprised all rice farmers in Kindia region of Guinea. A multistage sampling procedure was used to select respondents for this study. Guinea has 5 prefectures namely; Kindia, Telemine, Coyah, Foricariah and Dubrica. Kindia Prefecture was purposively selected for this study due to the prevalence of rice production in the area (Fadairo & Keita, 2021). Kindia Prefecture has 10 communities, out of which 30% were purposively selected because of long engagement in rice production in the area. Selected communities were Kindia Centre, Molota and Friguigbe. The total number of districts in Kindia centre, Molota and Friguigbe was 15, 13 and 16, respectively. Thirty percent of districts in Kindia Centre (5), Molota (4) and Friguigbe (5) were randomly selected to give a total of 14 districts. A proportionate sample to the size of the rice farmers' association was done in each district. Thereafter, 10% of rice farmers were randomly selected in each of the selected districts to give 180 respondents used for this study. Data were collected using a structured interview schedule and field observations on the respondents' knowledge, attitude and adoption characteristics of improved rice varieties including the constraints faced in adopting the varieties.

Respondents were presented with knowledge statements about improved rice varieties which they responded to as correct and incorrect. The correct answer was assigned 1 and the incorrect answer was 0. Respondents' attitude was measured using statements presented on a five-point Likert-type scale of strongly agree, agree, undecided, disagree and strongly disagree with scores of 5,4,3,2 and 1 assigned, respectively to the positive statements. The attitude score was computed and the mean value of 33.29 was used to categorise respondents as having favourable and unfavourable attitudes to improved rice variety. Constraints were measured using a three-point Likert-type scale of very severe, severe and not severe response options to a list of constraint items with scores

of 2, 1 and 0 assigned, respectively. The mean score of each constraint was used to rank them in order of severity. Adoption characteristics were measured on a four-point Likert-type scale of high, moderate, low and not a characteristic with scores of 3,2,1 and 0 assigned, respectively. The characteristics were measured using five domains of production/planting characteristics, climatic/geographical characteristics, economic characteristics, institutional characteristics and consumer preference characteristics. A mean score of 55.20 that was generated was used to categorise respondents into good and fair levels of adoption characteristics of the improved rice variety. Also, a grand mean was generated for each of the five domains. The domain with the highest mean score was selected as one with the most favourable characteristics. Data collected were analysed using percentages, standard deviation, mean statistics and chi-square.

Results and Discussion

Major improved rice varieties grown by farmers

Table 1 reveals that CK 90 (86.6%) was the most-grown rice variety in the study area. This was followed by CK 21 (67.3%), CK 43 (45.8%), CK 73 (56.4%) and Nerica (21.1%) varieties which were also popular. This implies that improved rice varieties of CK series were the most cultivated varieties in the study area. This is plausibly due to the desirable and beneficial characteristics of the varieties like high yield, taste and disease resistance (Fadairo and Keita, 2021). Farmers will prefer crop variety with higher yields because it will lead to an increase in production and income which should improve their standard of living and livelihood. This is in tandem with the findings of Okoro et al., (2023) that farmers grow rice varieties with drought resistance and higher yield attributes in Nigeria.

Table 1: Major improved varieties grown by farmers

Varieties	%
NERICA	21.2
CK 21	67.3
CK 43	45.8
CK 73	56.4
CK 90	86.6

Factors influencing the adoption of improved rice varieties

Factors influencing the adoption of improved rice varieties are presented in Table 2. Market channels/outlets (open market, local markets, agro-dealers, individuals) were identified by 84.9% of rice farmers as an important factor. This implies that a ready-made market for selling produce will influence the rate of adoption as the promptness of selling off commodities will encourage farmers to adopt such variety. This will likely guarantee quick returns and better profit thereby encouraging further production. Access to land was indicated by 85.2% of respondents. This implies that farm or land size will prompt farmers to adopt better. The reason for this is not far-fetched as land constitutes an important factor in any production process. This is in line with the report of Agboklou and Ozkan (2023) that land size is crucial in the adoption and production of rice varieties in Togo. Access to credit was stated by 86.7% of rice farmers as a factor essential for the adoption of improved rice varieties. This is because capital is important in engaging in rice production to ensure the maximum provision of several inputs and services. This supports the findings of Tekeste et al., (2023) that access to credit is significantly related to the adoption of teff in Central Ethiopia. Furthermore, 91.7% of the respondents

indicated membership in association as a factor in adopting improved variety. This implies that joining an association will offer an effective channel for interaction and dissemination of information which will later enhance farmers' use of new varieties. This finding corroborates the findings of Adeleke and Alani (2020) that the greater the participation of farmers in social organisations and groups, the more benefits they derive

Such benefits include access to credit, information dissemination and the adoption of new ideas for agricultural activities in Nigeria. Also, 35.2% of the respondents thought that the literacy rate may influence adoption. This finding agrees with Checco et al., (2023) who reported that farmers' education positively influences the adoption of improved rice varieties in the Global South. In the same vein, 65.5% felt that contact with extension agents will help the adoption of improved variety as they will be able to give accurate and reliable information which will aid their production. Information from research institutes was also a factor that influenced the adoption of improved varieties as indicated by 55.5% of respondents. This implies that research institutes have a pivotal role to play in ensuring that an improved variety of desirable characteristics is disseminated to rice farmers through their associations and extension agents.

Table 2: Factors influencing the adoption of improved rice varieties

Factors	Percentage (n=180)
Market channels/outlets	84.9
Land/Farm size	85.2
Access to credit	86.7
Membership of association	91.7
Contact with an extension agent	65.5
Literacy level	35.2
Information from research institutes	55.5

Source: Field survey, 2020

Knowledge of Improved Rice Varieties Characteristics

Studies have shown that knowledge of people influences to various extents, their adoption behaviour (de Kok et al., 2020; Al Sayegh et al., 2023). Adequate knowledge of the important characteristics of an innovation or agricultural technology can thus play an important role in helping prospective adopters make the right decision about the technology. Table 3 on the respondents' knowledge of improved rice variety characteristics shows that the farmers were mostly knowledgeable about each of the characteristics given the overwhelmingly positive responses indicated for each of the knowledge statements. For instance, more than 95% of the farmers correctly indicated that improved rice variety has a shorter duration of maturation, performs well under both organic and inorganic farming, and are resistant to pest and diseases of crops. More than 50% of the farmers indicated in the affirmative to other knowledge statements. Furthermore, the table shows that most of the farmers (97.2%) fell within the high knowledge category while only 2.8% of them had low knowledge of improved rice variety characteristics. This high knowledge about improved rice variety is expected to translate to better adoption behaviour among the farmers other things being equal.

Table 3: Knowledge of rice farmers on improved rice variety characteristics

Knowledge statements	Correct (%)	
Improved rice varieties require more capital than local varieties	53.0	
Improved varieties can be cultivated with ease	91.6	
Improved rice varieties like NERICA is a short-duration variety	99.4	
Growing improved rice varieties can be distinguished by low management and input cropping systems	85.4	
The production of improved rice varieties requires more labour and input	91.7	
Improved rice varieties can only do well under inorganic farming	96.1	
Improved rice varieties are resistant to pests and diseases	99.4	
Improved rice varieties compete well with weeds	80.4	
Improved rice varieties can be produced both on lowland and upland	75.6	
Improved varieties have a greater yield per hectare	90.0	
Improved rice varieties thrive and survive stress	85.5	
Level of knowledge on improved variety characteristics	%	Scores
Low	2.8	7.00-8.24
High	97.2	8.25-10.00

Source: Field Survey, 2020

Attitude of Rice Farmers on Improved Rice Variety

Table 4 on the respondents' attitude towards the adoption of improved rice variety shows a generally positive disposition of the farmers towards the attitude statements. More positive reactions were observed for statements that taste and grain quality (2.52 ± 1.30), good market value (1.74 ± 0.70), and accessibility of improved rice variety encouraged their adoption (1.73 ± 1.20). Better pricing for produce has been argued as a major selling point for most agricultural technologies (Pan et al, 2018). In a similar vein, the attendant improvement in the quality of produce realised from adopting improved agricultural technologies has been well documented as a factor driving adoption among users (Gondwe et al, 2019). It is therefore not surprising as these factors seemed to have played key roles in engendering a positive attitude of the farmers toward the improved rice variety in the study locations. However, the fact that the farmers mostly affirmed the statement that local rice varieties are widespread in accessibility and availability (2.76 ± 0.40) suggests that some local varieties are still enjoying some level of patronage despite the availability of improved variety. This calls for a continuous effort to ensure increasing availability and accessibility of the farmers to the improved variety in order to avoid discontinued adoption as reported among rice farmers in India (Chandio and Yuansheng, 2018). On the whole, respondents' categorisation based on their level of attitude towards the adoption of improved rice variety shows that most of the farmers (66.1%) had a favourable attitude to the adoption of improved rice variety. The largely positive attitude of the farmers is plausibly connected with their high knowledge of the importance and relevance of improved technologies in agricultural production systems. This will invariably lead to high adoption of such technology. Several authors have

established interrelationships between farmers' knowledge and attitude toward the adoption of technology (Kato-Nitta, 2019; Tokede et al, 2020).

Table 4: Attitude towards adoption of improved rice variety

Attitudinal statements	Mean	Standard deviation
Improved rice variety is more profitable than the local seed varieties	1.23	2.10
Improved rice variety gives more yield than the local variety	1.07	1.01
Early maturity is a more important factor when choosing improved rice varieties than yield	1.64	1.30
Price is not a limiting factor for the adoption of improved rice variety	1.61	0.60
Farmers have access to improved rice variety because of the availability of information	1.30	1.30
The high rate of adoption of improved rice variety among farmers is attributed to the availability of agro-inputs dealers	1.54	0.90
Farmers adopt improved rice variety because of its market value	1.74	0.70
Smallholder farmers have access to improved rice variety on time leading to a high adoption rate	1.73	1.20
Taste and grain quality are more important when choosing rice varieties	2.52	1.30
Farmers prefer local rice seeds because of its accessibility and availability	2.76	0.40
Level of attitude on improved varieties	%	Scores
Unfavourable attitude	33.9	25.00 - 33.29
Favourable attitude	66.1	33.30- 43.00

Source: Field survey, 2020

Constraints in the Use of Improved Rice Variety

Table 5 presents the constraints to the adoption of improved rice variety by the respondents. Major constraints reported were insufficient loan ($\chi = 2.89$), weed infestation ($\chi = 2.37$), storage losses ($\chi = 2.19$), unavailability of land ($\chi = 2.13$) and low extension activities ($\chi = 2.11$). The finding that insufficient loan was a constraint to farming in the study area is not far-fetched as most recent studies have revealed the unwillingness of most credit institutions to give loans to farmers due to the general perception that farmers do not repay loans (Appau et al., 2019; Ume et al., 2018) and the high risk associated with crop farming due to the problem of climate change (Fadairo et al., 2020). In addition, the finding is corroborated by Fadairo & Keita (2020) who explained poor accessibility to loans for extensive rice production in the Kindia region of Guinea. Also, Ojo et al., (2020) confirmed that loan and credit constraints have adverse effects on farm production and the adoption of new technologies in rural areas of Nigeria.

The foregoing therefore implies that technology development and dissemination are not enough to revamp the agriculture sector as these elements are just a part of the complex

variables that must be looked into in the efforts towards attaining self-sufficiency in food production of any nation. In this respect, certain extension approaches such as the commodity association traders of the Sasakawa Africa Association (SAA) are now emerging which attempt to bridge the gap of poor funding for farming by mobilising farmers to aggregate produce for bulk sales and investments.

Also, weed infestation, unavailability of land and storage losses would reduce yield, thereby incurring losses to farmers and affecting their income. Extension activities are also limited in the study area suggesting the inability of farmers to get prompt and adequate information that will be of help in the use of improved rice variety. The poor extension-farmers ratio in most parts of Africa cannot be overemphasised. This justifies the urgent need for more private sector involvement in agricultural extension service provision. The current efforts by private organisations and specialised projects such as Sasakawa and the West Africa Agricultural Productivity Programme amongst others are laudable, however, more efforts are still required to reach the critical mass that is required for sustainable extension service provision to farmers.

Table 5: Constraints in the Use of Improved Rice Varieties

Constraints	Mean	SD
Insufficient loan	2.89*	0.32
Weed infestation	2.37*	0.68
Storage losses	2.19*	0.88
Unavailability of land	2.13*	0,37
Low extension activities	2.11*	0.89
Availability of planting materials	2.01	0.47
Low prices	1.76	0.43
Bird scaring	1.32	0.48
Marketing	1.13	0.36
Diseases	1.10	0.37

Source: Field survey, 2020

Adoption of Improved Rice Variety

Table 6 reveals the adoption characteristics of respondents towards improved rice variety. Overall, the study reveals that the most desirable characteristics border on economic features with a mean score of 2.71. This was followed by geographic/climatic characteristics (\bar{x} =2.46) and consumer preference characteristics (\bar{x} =2.25). This implies that respondents in the study area prioritise economic gain above all other characteristics in their consideration of technology for adoption. The farmers' preference for economic gain above all other factors in their adoption behaviour can be viewed as a positive development as it is an indication of a business mindset among them. Subsistence mindsets among most smallholder farmers have been blamed as the major cause of widespread poverty among them (Wale & Chipfupa, 2021). In this vein, efforts are currently being stepped up to promote agribusiness orientation among the rural farming population so that agriculture can be seen as a career and a profitable one (Yami et al., 2019).

Climatic/geographical characteristics were the next important to the farmers after economic factors. The table shows that the farmers were mostly interested in the disease and drought-resistant ability of the improved variety, in addition to its requirement of less rainfall. The importance of drought-tolerant and disease-resistant crop varieties in agriculture is underscored by the current challenge of climate variability and change which has been a serious threat to farming. The priority placed on climatic and

geographical characteristics of improved rice variety suggests that the farmers were conscious of climate change impacts on agriculture and were interested in climate-smart agricultural practices that can help them cope well with its adverse effects.

Consumer preference characteristics with a grand mean of 2.25 were next to geographical/climatic considerations among the farmers. In this wise, the farmers prioritised the improved variety's good cooking quality ($\bar{x} = 2.88$), swelling of the grains when cooked ($\bar{x} = 2.85$) and good taste of the grain ($\bar{x} = 2.79$). Production/planting characteristics that followed had a mean score of 2.09 and the least prioritised factor was institutional characteristics ($\bar{x} = 2.02$) which relate to credit accessibility, extension contact and membership of association. The table further revealed that 88.3 % of the respondents opined that improved rice varieties that were disseminated to farmers were of desirable characteristics and would be readily adopted by rice farmers.

Table 6: Adoption of improved rice variety

Adoption characteristics	Mean	Standard deviation
Production/Planting characteristics ($\bar{x} = 2.09$)		
High yield	2.93	0.22
Allowance to toxicity ironwork	2.23	0.46
Improved line spacing	0.52	0.66
Planting depth	0.99	0.38
Improved harvesting	2.44	0.61
Timely transplanting	2.04	0.36
Early maturity	2.94	0.37
Optimum seed rate	1.47	0.53
Climatic/ geographical characteristics ($\bar{x} = 2.46$)		
Drought resistance	2.97	0.28
Disease resistance	2.98	0.22
Requires less rainfall	2.05	0.37
Moderate soil cover	1.83	0.41
Economic characteristics ($\bar{x} = 2.71$)		
Easy to market	2.94	0.29
High income	2.50	0.53
Market information	2.68	0.52
Institutional characteristics ($\bar{x} = 2.02$)		
Credit accessibility	1.19	0.51
High extension contact	2.28	0.58
Subsidy accessibility	2.01	0.34
Membership of association	2.62	0.69
Consumer preference characteristics ($\bar{x} = 2.25$)		
Good taste	2.79	0.48
Good aroma	2.03	0.32
Good cooking quality	2.88	0.38
Grain swells when cooked	2.85	0.40
Easy threshing	0.98	0.34
Good milling quality	1.98	0.24
Level of adoption characteristics of improved rice varieties		
Good	88.3	11.4- 55.2
Fair	11.7	55.3- 61.0

Source: Field survey, 2020

Table 7 shows that there was a significant relationship between educational qualification ($\chi^2=1.149$) and the adoption characteristics of improved rice variety. This suggests that

the educational level of respondents will help farmers to be well informed about improved rice varieties which will in turn aid the adoption of such varieties. This means that a well-educated and informed farmer will likely adopt an improved rice variety than a farmer who is not educated. This is in line with the findings of Bello, Baiyegunhi and Danso-Abbeam (2020) that educational attainment is positively significant to the adoption of improved rice variety in Nigeria.

Table 7: Socioeconomic characteristics and adoption characteristics of improved rice variety

Variables	χ^2
Marital status	0.011
Sex	0.148
Educational qualification	1.149*

Source: Field survey, 2020

Conclusion and Recommendations

Farmers in the Kindia region of Guinea were positively skewed in their adoption characteristics towards improved rice varieties with desirable economic features followed by geographic/climatic characteristics and consumer preference characteristics. Institutional and production/planting features occupied the lower rung of the ladder in the farmers' motivation for adopting improved rice variety. Adoption of improved rice variety in the region was limited by constraints that bordered on limited access to loans, weed infestation, storage losses and unavailability of land for agricultural intensification. To boost the agriculture sector, especially the rice sub-sector, improved agricultural technology development and dissemination should be matched with efforts to link farmers with agricultural credit sources for achieving enduring production systems. Also, more private sector involvement in agricultural extension service provision should be advocated to achieve the critical mass of extension workers that is required for sustainable extension service provision to rice farmers. Investments in the infrastructural development of rural communities should be prioritised by the Government of Guinea Republic and other relevant agencies, while farmers should also form cooperative groups for collective investments which will give them access to loans, aid production, and income and ensure food security in Guinea.

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