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Improved rice varieties adoption and welfare implications among small-holder farmers in south-west Nigeria: An empirical analysis and prospects for food security

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ABSTRACT
This study examines improved rice variety adoption and its welfare implications among small-holder farmers in South West Nigeria. A multistage sampling technique was used to select 300 rice-farming households from two selected states. The study used primary data retrieved with the aid of structured questionnaires. Data were analysed using a five-point Likert scale, a logistic regression model, and the multidimensional poverty index (MPI). The study showed that more than half (56%) of the farmers noted that the acceptance of improved varieties was easy, with a mean score of 3.5. The study also established that age (β = -0.0394; $p < 0.001$), farming experience (β = 0.0758; $p < 0.001$), and extension contact (β = 1.7203; $p < 0.001$) were the factors that influenced the adoption of improved rice varieties in the study area. The results of the MPI revealed that indigenous rice farmers were poorer than improved rice-farming households. Overall, 34% of improved and 54% of indigenous rice farming households are multidimensionally poor. MPIs of 0.11 and 0.21 were obtained for improved and indigenous farmers, respectively. The adoption of improved varieties was influenced by socioeconomic factors, and some households cultivating rice were MPI-poor. The study indicated that the adoption of improved varieties can result in improved productivity and reduce the prevalence of poverty in the study area.

Contribution/Originality: This study examines how the socioeconomic profile of rice farmers can affect their ability to embrace improved rice varieties to increase their farming performance and perceived well-being. The outcomes of this study provide useful information that can lead to improved productivity and the eventual reduction of poverty in the study area.

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1. INTRODUCTION
In recent years, the consumption of rice by households around the world has increased. Growing population pressure, high production costs, and the need to enhance income have compelled rice farmers to boost yield and crop

intensity on restricted lands in order to supply enough food for the world. The improvement of small farmers' welfare and rural employment on a sustainable and economically viable basis, as well as the production of more food for the rapidly expanding rural population, comprise the principal challenge that rice production research and development attempt to address globally.

Rice cultivation in Nigeria is primarily carried out by small-holder farmers who use traditional farming practices, as evidenced by their low productivity (Tsado, Ojo, & Ajayi, 2014). Rice productivity has recently increased due to the introduction and widespread adoption of improved rice varieties. Even though the rise in production cannot be entirely attributed to varietal improvements, the consistent growth in rice production suggests that there is the possibility for further productivity enhancement (Simtowe et al., 2012). Farmers' access to and acceptance of improved rice seed varieties would, it is expected, enhance small-scale rice farmers' production and, as a result, their livelihoods. In general, an increase in farm productivity has the potential to reduce poverty by increasing farmers' incomes and reducing food prices (Adekambi, Diagne, Simtowe, & Biaou, 2009). According to Awotide, Diagne, and Omonona (2012), the yield and quality of a crop are highly dependent on the quality and condition of the seed that is planted. Regrettably, many impoverished farmers have very little land on which to support their rapidly expanding families, let alone access to high-quality agricultural supplies. This makes it difficult for them to continue farming. These farmers typically lack access to essential supplies, which results in lower agricultural production growth and, in the long run, an adverse impact on their well-being.

One approach to improve these farmers' welfare is to boost the agricultural production system, but this is only possible if they adopt improved crop varieties. Most of the research on farmers' income (Baser & Kaynakci, 2019; Jatto et al., 2021; Ogundipe, Ogunniyi, Olagunju, & Asaleye, 2019) has not been able to advance beyond estimating the level of income poverty among small-holder farmers. The answer to the question of how to assess the degree of poverty among rice-farming households is frequently found in the absence of income; therefore, the traditional and restricted focus on income as the only measure of a person's welfare is increasingly being challenged. More than just a lack of income, the farmers are suffering from a variety of other deprivations. Poverty is a multi-dimensional phenomenon, the causes, conditions, and consequences of which continue to be difficult to identify and quantify (Amao, Ayantoye, & Fanifosi, 2017; Babalola & Mohd, 2022). To secure an understanding of the process of adopting improved rice varieties, it is necessary to conduct a comparative analysis of indigenous and improved rice varieties, as well as an examination of the impacts of adopting these varieties on the means of subsistence of farmers. Consequently, the goals of this research are as follows: to determine the level of improved rice variety adoption among rice farmers, to determine the factors that influence the adoption of improved rice varieties among rice farmers, and to determine the extent to which rice farmers in the study area are affected by poverty.

2. MATERIALS AND METHODS

The research area is in South West Nigeria, which is one of Nigeria's geopolitical zones and includes the states of Ekiti, Lagos, Ogun, Ondo, Osun, and Oyo. The research was conducted from January 2022 to June 2022. This study was purposely conducted in the states of Ekiti and Ogun due to the high degree of rice production in these areas across the rice value chain. The study was conducted among rural rice farmers in South West Nigeria, and it was based on both primary and secondary data acquired from rice farmers via questionnaires. The information gathered included rice farmers' socioeconomic profiles, living standards, farm-specific statistics, and income and expenditure.

To identify representative rice farming households from the two selected states, a multistage sampling procedure was adopted. The first phase entailed the deliberate selection of Agricultural Development Project (ADP) zones across each state; the selected ADP zones were areas where rice cultivation was carried out extensively (for Ekiti State: Ikere and Aramoko; for Ogun State: Ikene, Ilaro, and Abeokuta). The second phase was the purposeful selection of at least one Block from the selected zones in the states with a high number of rice farmers (for Ekiti State: Ijero and Gboyin Local Government Areas (LGAs); for Ogun State: Obafemi-Owode, Yewa-North, and Ifo LGAs), making a total of 6 Blocks. The third stage involved the selection of three (3) Cells each from Obafemi-Owode, Yewa-North, and Ifo Blocks, giving a total of 9 Cells, and four (4) Cells each from Ijero and Gboyin Blocks, giving a total of 8 Cells. The final phase was the random selection of 20 and 15 rice farmers, respectively, from the 17 Cells in Ogun and Ekiti States, resulting in a total of 300 respondents. This selection was based on the total population and land mass of the selected states.

2.1. Data Analysis

A combination of various analytical tools was employed in this study. These included a five-point Likert scale, a logistic regression model, and the multidimensional poverty index (MPI).

2.2. Likert Scale

A five-point Likert scale was used to assess the degree of adoption of improved rice varieties among rice-farming households. To determine the adoption level of improved rice varieties among rice-farming households, respondents were asked how frequently they used improved rice types. Their responses were evaluated as 4, 3, 2, 1, or 0 for very often, often, rarely, very rarely, and never. Each farmer's group was determined by his or her position in relation to the grand mean adoption score. A farmer whose score was greater than the grand mean was said to be an "adopter of improved rice varieties", otherwise he or she was labelled a "non-adopter of improved rice varieties". These were the two levels of rice variety adoption.

2.3. Logistic Regression Model

A logistic regression model was used to examine the factors that influence farmers' decisions to adopt improved rice seed varieties. An underlying response variable that captured the farmer's socioeconomic profile determined the likelihood of adopting an improved variety. The logistics function was used to analyse the process of adopting improved rice varieties quantitatively. A logit model results in an estimated probability between 0 and 1. The logit model was expressed as:

$$E(y_i) = p(y_i) = \frac{e^{\alpha+\beta xi}}{1+e^{\alpha+\beta xi}} \ldots\ldots..(1)$$

When rice farmers do not adopt improved rice varieties, the likelihood of non-adopters becomes:

$$P(\text{non-adopters}) = 1 - p(y_i) = \frac{e^{\alpha+\beta xi}}{1+e^{\alpha+\beta xi}} \ldots\ldots.(2)$$

Where:

$P(y_i)$ = The probability that rice farmer i adopts the improved rice varieties; $p(yi) = 1$ if improved rice varieties were adopted and 0 if improved rice varieties were not adopted.
e = Exponential function
y_i = The variable explained: the adoption of improved rice varieties
β = The vector of the parameter to estimate, the sign of which allows the interpretation of the result.
α = The constant
X_i = Characteristics of rice-farming household i; it represents the vector of the explanatory variables.

$$X = \beta_0 + \beta_1 X_i + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_a \ldots\ldots\ldots (3)$$

Where:

X_1 = Age of the farmer (years).
X_2 = Farm income (Naira).
X_3 = Household size (number).
X_4 = Level of education (years).
X_5 = Farm size (hectares).
X_6 = Farming experience (years).
X_7 = Membership of cooperative (1 = member; otherwise = 0).
X_8 = Number of contacts with extension agents (number).
X_9 = Awareness of improved rice varieties (1 = yes; 0 = no).
e = Error term.

2.4. Multidimensional Poverty Index (MPI)

The Alkire and Foster multidimensional (AFM) measure was used to analyse and compare the poverty levels of adopters and non-adopters of improved rice varieties. AFM, according to Fadoju and Adesiyan (2022), is a newly established class of multidimensional poverty indices based on the Foster-Greer-Thorbecke poverty indices that represent the joint distribution of deprivation and satisfy a substantial proportion of poverty measurement axioms. Because it is intended primarily for categorical/ordinal data, the AFM is a robust measure (Mohammed & Ab-Rahim, 2021). The measure has recently been utilized in a few studies (Amao et al., 2017; Babalola & Mohd, 2022) to create multidimensional poverty indices (MPIs) for various groups of people.

Table 1. Deprivation: dimensions, indicators, and weights.

Dimensions	Indicators	Measurements	Weights
Education	Years of schooling	Deprived if no one in the household has finished five years of schooling.	1/6
	Child enrolment	Deprived if any school-aged youngster does not attend school in years one through six.	1/6
Standard of living	Electricity	If the home does not have electricity, they are deprived.	1/18
	Drinking water	Deprived if the household lacks access to safe drinking water or cannot get clean water within 30 minutes on foot.	1/18
	Sanitation	If they do not have an improved toilet or if their toilet is shared, they are deprived.	1/18
	Flooring	If a household has a dirt, sand, or dung floor, it is deprived.	1/18
	Cooking fuel	If they cook with wood, charcoal, or dung, they are deprived.	1/18
	Assets	If the household only has one each of a radio, TV, telephone, bicycle, motorbike, automobile or tractor, it is considered deprived.	1/18
Health	Child mortality	Deprived if any child in the family has died.	1/6
	Nutrition	Deprived if any adult or child for whom nutritional information is available is malnourished.	1/6

2.5. Deprivation Dimensions, Indicators, and Cut-Offs

The MPI employs ten (10) indicators over three dimensions (education (2), living conditions (6), and health (2)). Households' scores in these aspects define their level of deprivation. Table 1 summarises the MPI's dimensions, indicators, thresholds, and weights (Babalola & Mohd, 2022; Mohammed & Ab-Rahim, 2021).

2.6. Computing the Multidimensional Poverty Index (MPI)

The MPI combines two essential pieces of data: (1) the proportion or frequency of rice farming households that experience multiple deprivations (within a given population) and (2) the average degree of their deprivation: the average proportion of (weighted) deprivations they encounter. The first factor is formally referred to as the multidimensional headcount ratio (H_0):

$$H_0 = \frac{q}{N} \ldots\ldots\ldots\ldots (3)$$

Where:

q = Number of households engaged in rice farming that are multidimensionally poor.

N = Total population.

The average intensity (or breadth) of deprivation (A) is the second factor. The multidimensionally poor families' average deprivation score, also known as the average degree of deprivation, is stated as

$$A = \frac{\sum_{i=1}^{d} c_i\,(k)}{q} \ldots\ldots\ldots\ldots (4)$$

Where:

c_i (k) = individual household deprivation scores, which have been censored.

q = the number of rice farming households that are multidimensionally poor.

$$M_0 = H_0 \times A \ldots\ldots\ldots\ldots (5)$$

Where:

M_0 = adjusted headcount ratio or MPI.

H_0 = multidimensional headcount ratio.

A = average intensity of deprivation.

3. RESULTS

3.1. Level of Adoption of Improved Rice Varieties by Rice-Farming Households in the Study Area

Table 2 shows the level of adoption of improved rice varieties by farmers in the research area. According to the findings, more than half (56%) of farmers believe that accepting better varieties is easy. The estimated weighted average (3.38) obtained for output transformation due to improved variety adoption suggested that farmers agreed that improved variety adoption leads to increased agricultural output.

Table 2. Level of adoption of improved rice varieties in the study area.

Statement	Very often	Often	Rarely	Very rarely	Never	Mean score
How easily and often do you accept improved rice compared to the indigenous rice varieties?	28(56.0)	19(38.0)	3(6.0)	Nil	Nil	3.5
Since you have been growing the improved rice varieties, how often do you prefer it to the indigenous rice varieties?	4(2.0)	38(76.0)	8(16.0)	Nil	Nil	2.92
Have you been committed to growing the improved rice varieties since you accepted it?	8(16.0)	17(34.0)	25(50.0)	Nil	Nil	2.68
Are you often adapted to growing the improved rice varieties to the indigenous varieties?	4(8.0)	30(60.0)	16(32.0)	Nil	Nil	2.76
Do you often combine improved and indigenous rice varieties?	14(28.0)	26(52.0)	10(20.0)	Nil	Nil	3.08
Has growing the improved rice varieties consistently transformed your production yield since adoption?	26(52.0)	17(34.0)	7(14.0)	Nil	Nil	3.38
Do you still object to the improved rice varieties that have been adopted?	11(22.0)	10(20.0)	22(44.0)	7(14.0)	Nil	2.5

3.2. Factors that Determine Farmers' Decision to Adopt Improved Rice Varieties in the Study Area

The results presented in Table 3 show the factors that determine farmers' decision to adopt improved rice varieties in the study area.

Table 3. Factors influencing the adoption of improved rice varieties in the study area.

Variable	Coefficient	St. error	t-value
Age	-0.0394***	0.0125	-3.15
Farm income	1.28e-06	1.73e-06	0.74
Household size	-0.0018	0.0907	-0.02
Level of education	0.0273	0.0346	0.79
Farm size	0.0289	0.0385	0.75
Farming experience	0.0758***	0.0206	3.7
Membership of association	-0.2070	0.5625	-0.37
Extension visit	1.7203***	0.4488	3.83

Note: Log-likelihood = -129.29183, Wald chi2(8) = 103.11, Prob > chi2 = 0.0000.
*** = p < 0.01

3.3. Poverty Incidence among Rice-Farming Households in the Study Area

3.3.1. Incidence of Deprivation Indicators among the Rice-Farming Households

The results presented in Table 4 reveal that about 12% and 6% of the farmers growing indigenous and improved varieties were deprived in terms of years of schooling. Those who were deprived in terms of child enrolment accounted for 16.4% and 24% of the indigenous and improved rice farmers, respectively. The majority of farmers, both of indigenous (99.6%) and improved (94%) rice varieties, were deprived in the area of cooking fuel.

Table 4. Distribution of adopters by incidence of deprivation indicators in the study area.

Dimensions	Indicators	Indigenous	Improved
Education	Years of schooling	31 (12.40)	3 (6.0)
	Child enrolment	41 (16.40)	12 (24.0)
Standard of living	Electricity	53 (21.20)	Nil
	Drinking water	103 (41.20)	12 (24.0)
	Sanitation	221 (88.40)	2 (4.0)
	Flooring	51 (20.40)	3 (6.0)
	Cooking fuel	249 (99.60)	47 (94.0)
	Assets	32 (12.80)	2 (4.0)
Health	Child mortality	2 (0.80)	7 (14.0)
	Nutrition	201 (80.40)	7 (96.0)

Note: Figures in parentheses are percentages.

3.4. Distribution of Households by Weighted Sum of Deprivation Indicators (K=3) in the Study Area

Table 5 reveals that 45.2% and 66% of the indigenous and improved rice farmers are below the 0.33 poverty cut-off, which makes them non-poor according to the MPI. More than half of indigenous rice farmers (54%) are considered MPI poor, while only 33% of improved rice farmers (weighted sum of deprivations >= 0.33) fall into this category.

Table 5. Distribution of adopters by weighted sum of deprivation indicators (k=3) in the study area.

Weighted sum of deprivation	Indigenous	Improved	Poverty status
<0.33	108(45.2)	33(66)	Non-poor
≥0.33	130(54.8)	17(34)	Poor

Note: Figures in parentheses are percentages.

3.5. Multidimensional Poverty Assessment of Rice Farmers in the Study Area

Table 6 presents multidimensional poverty estimates based on three dimensions: education, health, and living standards. According to the methodology, a family head and all others in the household are classified as multidimensionally poor if their MPI surpasses the minimum cut-off point (k) of 33 per cent or 0.33 at k= 3.

Table 6. Multidimensional poverty indices of rice farming households in the study area.

Parameters	Indigenous	Improved
Multidimensional headcount (H_o)	0.54	0.34
Intensity of poverty (A)	0.39	0.31
Multidimensional poverty index ($M_{o=} H_o xA$)	0.21	0.11

4. DISCUSSION

4.1. Level of Adoption of Improved Rice Varieties by Rice-Farming Households in the Study Area

It has been noted that adopting different agricultural practices is a key strategy for farmers to overcome low productivity, achieve food security, lower food prices, and increase food accessibility for low-income households. The results in Table 2 suggest that farmers readily adopt improved rice varieties. The farmers agreed that adopting improved varieties results in increased production output, as evidenced by the estimated weighted average of (3.38) for

output transformation due to the adoption of improved varieties. This claim was supported by Bruce, Donkoh, and Ayamga's (2014) study on the adoption of improved rice varieties and the effects on farmers' productivity. In their study, they found that growing an improved rice variety had a favourable impact on farm output. Saka and Lawal (2009) reported that the implementation of improved rice technology resulted in a 19.4% proportional increase in rice output, which further supports the importance of improved rice variety adoption. The weighted average scores (2.92) of farmers' preference for and adaptation to (2.76) the growing of improved varieties are less than average value of 3, which is an indication that farmers still somewhat prefer indigenous varieties, even though they agreed that improved rice variety adoption had a positive effect on output.

4.2. Factors That Determine Farmers' Decision to Adopt Improved Rice Varieties in the Study Area

The results in Table 3 revealed that the effect of the estimated age parameter was negative and statistically significant at the 1% probability level. This indicates that younger farmers tend to adopt improved rice varieties more frequently than older farmers. This conforms to the prior expectation. Young farmers are expected to be more eager than older farmers to adopt new rice technologies on their farms, given that they take more risks in decision-making (Singh & Varshney, 2016). At a probability level of 1%, the estimated coefficient of farming experience was positive and significant. The implication is that farmers are more likely to adopt and continue to use improved varieties as they gain experience. The level of knowledge and information about improved farm operations is proportional to farming experience. Farmers with more experience will have seen the advantages of improved varieties, influencing their decision to adopt them. Extension visits are another significant variable that could explain the adoption of improved rice varieties. This variable positively affects the adoption decision of farmers. Contact with an extension agent could facilitate the farmer's acquisition of technical information regarding the improved rice variety. This result is consistent with the findings of Chandio and Yuansheng (2018), who stated that contact with extension agents during the previous year had a large and beneficial impact on the adoption of improved rice varieties.

4.3. Poverty Incidence among Rice Farmers in the Study Area

Table 4 shows the deprivation across the poverty indicators among the indigenous and improved rice farmers in the study area. Farmers' deprivation in the educational indicators was low compared to the other dimensions. This study's findings are similar to those of Afolami, Obayelu, and Vaughan (2015) regarding rural rice-farming households in Ekiti State. Improvements in educational policy and the government's efforts to fulfil the sustainable development goals in education through free and compulsory basic education provided by the Universal Basic Education (UBE) programme should be credited for this low deprivation status in education. A higher level of deprivation was observed for the cooking fuel indicator. Most households were deficient in one to six indicators. The findings revealed that the rice-farming households in the study area have a very low standard of living, given their deprivation status. Cooking fuel shortages could be related to rising costs of domestic cooking fuels, such as cooking gas and kerosene. Nutrition is the indicator in which rice farming households are most deficient in the health dimension. This implies that poor nutrition is a socioeconomic problem in rural areas.

4.4. Distribution of Households by Weighted Sum of Deprivation Indicators (K=3) in the Study Area

The Chi-squared test results in Table 5 show that there is a substantial difference in poverty status between improved and indigenous rice producers. Farmers growing indigenous rice varieties had a higher poverty rate than those growing improved rice varieties.

4.5. Multidimensional Poverty Assessment of Rice Farmers in the Study Area

The estimated results in Table 6 indicate that 54 per cent of indigenous rice farmers and 34 per cent of improved rice farmers, respectively, are MPI poor. According to the MPI, this indicates they are experiencing extreme poverty. They are deprived in at least one area or a combination of dimensions, such as living with no access to decent health care, no clean water, a dirty floor, and inadequate sanitation. In addition, on average, the indigenous and improved rice farmers are disadvantaged in 39 and 31 per cent of the weighted indicators, respectively. The MPI reflects the proportion of the population that is multidimensionally impoverished, adjusted for the severity of the deprivation endured. This adjustment is necessary because the multidimensional headcount ratio (H) merely reveals that 54 and 34 per cent of the indigenous and improved rice farmer populations, respectively, are MPI poor. The adjustment demonstrated that not all farmers are equally poor and deprived for all deprivation indicators. The typical indigenous and improved rice farmer is deprived in 54 and 34 per cent of the weighted indicators, respectively. To calculate the deprivation score, each deprivation is entered according to its relative weight, hence the term "weighted" indicators. Adjusting the numbers for the severity of poverty, Alkire and Foster (2011) referred to the MPI as the adjusted headcount ratio (A). If there were 54 and 34 per cent of the individuals in the indigenous and improved farmer groups, respectively, were poor, and they were all deficient in all the indicators, then A (intensity of poverty) would be 1, and the MPI would equal H (the poverty incidence). Alternatively, if 100 per cent of the population was poor, the MPI would equal A (intensity of poverty).

5. CONCLUSIONS

According to the study results, the estimated weighted average (3.38) obtained for output transformation due to the adoption of improved rice varieties revealed that farmers agreed that the adoption of improved varieties leads to

increased production output. Farmers still prefer indigenous varieties, as evidenced by the weighted average scores for preference for (2.92) and adaptation to (2.76) growing improved varieties, which are less than the average value of 3. Age, farming experience, and contact with extension agents were factors that influenced the adoption of improved rice varieties. Farmers were least deprived in the educational dimension, and most deprived in the cooking fuel indicator. Given the deprivation status, farming households in the study area have a very poor standard of living. Approximately 45% and 66% of indigenous and improved rice farmers fell below the 0.33 poverty line, making them non-poor according to the multidimensional poverty index (MPI). More than half (54%) of indigenous rice farmers were MPI poor, while 33% of improved rice farmers were MPI poor, with a weighted sum of deprivation greater than or equal to 0.33. Overall, according to MPI estimates, rice farmers were very impoverished. They were deficient in all indicators of a single dimension or a mixture of dimensions, such as living in a household with no access to quality health care, no clean water, a dirty floor, and inadequate sanitation. Furthermore, indigenous and improved rice farmers were deprived in 39 and 31 per cent of the weighted indicators, respectively. The average indigenous and improved rice farmer was deprived in 54 and 34 per cent of the weighted measures, respectively. The study's findings also show that there is a reduction in poverty incidence and severity among farmers growing improved rice varieties compared to farmers growing indigenous varieties in the study area. This is due to the improved varieties' high-yielding characteristics, which result in higher productivity, which means more food for households and a larger marketable surplus to earn income, compared to farmers who grow indigenous varieties, which yield less. In the long run, as more farmers adopt improved high-yielding rice varieties, food insecurity will be reduced.

6. RECOMMENDATIONS

Based on the findings of the study, the following recommendations were made:

- There is a need for government and private agencies to encourage our youths to embrace improved varieties of rice because they are still young and able to take risks and learn new technologies.
- Youthful and energetic rice farmers must be encouraged to take up rice production as a business and a means of livelihood rather than a mere subsistence activity because farmers are more likely to adopt and continue using improved varieties as they gain experience.
- The government, through trained extension services and the private sector, should emphasise the promotion of improved rice varieties among small-holder rice farmers to reduce the incidence of poverty.
- The prevalence of deprivation across all indicators showed that most of the respondents were deprived of basic needs. Therefore, efforts at reducing household poverty should be directed towards the reduction of farmers' deprivation of basic needs by facilitating access to health facilities, cooking fuel, good housing, transport infrastructure, clean water, and rural electrification, rather than focusing on income poverty alleviation, which still leaves most rural farmers deprived of basic needs.

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REFERENCES

Adekambi, S. A., Diagne, A., Simtowe, F. P., & Biaou, G. (2009). *The impact of agricultural technology adoption on poverty: The case of NERICA rice varieties in Benin.* Paper presented at the 27th Conference of the International Association of Agricultural Economists. Beijing, Chin.

Afolami, C. A., Obayelu, A. E., & Vaughan, I. I. (2015). Welfare impact of adoption of improved cassava varieties by rural households in South Western Nigeria. *Agricultural and Food Economics, 3*(1), 1-17. https://doi.org/10.1186/s40100-015-0037-2

Alkire, S., & Foster, J. (2011). Counting and multidimensional poverty measurement. *Journal of Public Economics, 95*(7-8), 476-487. https://doi.org/10.1016/j.jpubeco.2010.11.006

Amao, J. O., Ayantoye, K., & Fanifosi, G. E. (2017). An analysis of multidimensional poverty and its determinants in rural Nigeria. *Journal of Development and Agricultural Economics, 9*(11), 303-311. https://doi.org/10.5897/jdae2017.0857

Awotide, B. A., Diagne, A., & Omonona, B. T. (2012). *Impact of improved agricultural technology adoption on sustainable rice productivity and rural farmers' welfare in Nigeria: A local average treatment effect (LATE) technique.* Paper presented at the African Economic Conference, Kigali, Rwanda.

Babalola, S. J., & Mohd, S. (2022). An analysis of multidimensional poverty and its determinants in the public university host communities in Ondo State, Nigeria. *Journal of Economic and Administrative Sciences, 38*(1), 135-155. https://doi.org/10.1108/jeas-06-2019-0066

Baser, U., & Kaynakci, C. (2019). Determinants of poverty among smallholder farms in central district of Hatay Province, Turkey. *Journal of International Environmental Application and Science, 14*(4), 145-151.

Bruce, A., Donkoh, S., & Ayamga, M. (2014). Improved rice variety adoption and its effects on farmers' output in Ghana. *Journal of Development and Agricultural Economics, 6*(6), 242-248. https://doi.org/10.5897/jdae2013.0544

Chandio, A. A., & Yuansheng, J. (2018). Determinants of adoption of improved rice varieties in northern Sindh, Pakistan. *Rice Science*, *25*(2), 103-110. https://doi.org/10.1016/j.rsci.2017.10.003

Fadoju, D. T., & Adesiyan, O. F. (2022). *Multidimensional analysis of poverty among rural women in Oyo State*. Nigeria: Authorea.

Jatto, K., Akanni, O., Olatunji, B., Arowolo, O., Abegunrin, O., Kareem, A., & Olayemi, O. (2021). Poverty status of arable farm households in Akinyele Local Government area of Oyo State, Nigeria. *Journal of Agriculture and Food Sciences*, *19*(2), 43-50. https://doi.org/10.4314/jafs.v19i2.5

Mohammed, M., & Ab-Rahim, R. (2021). Determinants of multidimensional poverty index of Niger State, Nigeria. *International Journal of Academic Research in Business and Social Sciences*, *11*(14), 205-225. https://doi.org/10.6007/ijarbss/v11-i14/8532

Ogundipe, A. A., Ogunniyi, A., Olagunju, K., & Asaleye, A. J. (2019). Poverty and income inequality in rural Agrarian household of Southwestern Nigeria: The gender perspective. *The Open Agriculture Journal*, *13*(1), 51-57. https://doi.org/10.2174/1874331501913010051

Saka, J., & Lawal, B. (2009). Determinants of adoption and productivity of improved rice varieties in southwestern Nigeria. *African Journal of Biotechnology*, *8*(19), 49230- 44932.

Simtowe, F., Kassie, M., Asfaw, S., Shiferaw, B., Monyo, E., & Siambi, M. (2012). *Welfare effects of agricultural technology adoption: The case of improved groundnut varieties in rural Malawi*. Paper presented at the International Association of Agricultural Economists (IAAE) Triennial Conference, Foz do Iguaçu, Brazil.

Singh, P., & Varshney, J. G. (2016). Adoption level and constraints in rice production technology. *Indian Research Journal of Extension Education*, *10*(1), 91-94.

Tsado, J. H., Ojo, M. A., & Ajayi, O. J. (2014). Impact of training the trainers' programme on rice farmers' income and welfare in North Central. *Nigeria Journal of Advanced Agricultural Technologies*, *1*(2), 157-160. https://doi.org/10.12720/joaat.1.2.157-160