ADOPTION OF IMPROVED *BAMBARA* NUT PRODUCTION TECHNOLOGIES AMONG SMALLHOLDER FARMERS IN OBI LOCAL GOVERNMENT AREA OF BENUE STATE, NIGERIA

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ABSTRACT

The research assessed adoption rates and determinants of improved Bambara nut technologies amongst 115 smallholder farmers from the Obi Local Government Area, Benue State, through a multi-stage sampling methodology. Data were analyzed using descriptive statistics and binary logit regression. Findings indicated selective adoption with adoption rates being high regarding on-time planting (66.1%). Techniques on how to harvest was at 64.7%, while improved methods of post-harvest storage, like silos and neem leaf powder, were at 64.3%. For row planting and spacing, adoption rates were moderate at 53.0%. Nevertheless, adoption rates were lower at 47.0%, 40.0%, 38.3%, 37.4%, and 37.4%, taking on aspects of control of pests/preceding diseases, improved varieties, fertilizer/analysis of manure, weed control, and crop rotation/intercropping. Inferential results showed that although the overall logistic regression model was not statistically significant, farm size was the only positively significant predictor of adoption at p < .05. This indicates that resource endowment, through farm sizes, earned farmers to test novel adoption methods. Essentially, other demographic variables like age, gender, education, and income lacked overall significance. It can, therefore, be concluded that adoption was impeded by limited government interactions and resource poverty. It is, consequently, advocated that to improve rates of adoption, administration assistance through governmental interactions be strengthened, input assistance to better access improved input requirements be subsidized, and greater emphasis be placed on farmer-based groups to improve resource management on which food security in livelihoods are established.
Keywords: Adoption, Technology, Bambara nut, Production & Smallholder farmers

INTRODUCTION

The development of agriculture in Nigeria and other sub-Saharan countries is largely contingent on smallholder farmers' ability to adopt and adapt new technologies to productivity, yield, and household food security. Nevertheless, this is more pressing for rain-fed agricultural systems that are highly sensitive and vulnerable to climate change variability. Although there is a great deal known about the adoption literature among major staples such as maize, rice, and cassava, the same cannot be said for underutilized legume species, including Bambara nut or Vigna subterranea, due to its remarkable adaptability and nutritional value (Gerrano *et al.,* 2021).

Bambara nut is a hardy, and stress-tolerant legume which grows well under low-input soil conditions. These are the exact conditions found on many farms in South Africa. One of its valuable uses includes its relatively high protein and storage life, making it an important provision ingredient for farm indegree and income diversification (Mabhaudhi *et al*., 2021). Although the productivity level for Bambara nut is still very low, this can mainly be attributed to the limited usage of agronomic and post-harvest technology (Gerrano *et al*., 2021).

Agricultural extension research has found that adoption is seldom a single-choice process but rather a multidimensional outcome of social, economic, farm, and institutional factors (Asfaw *et al*., 2023). Variables like farm size, input availability, extension contacts, and the risk attitude of the farmer have been found influential in determining the adoption process in Nigeria (Oluwatayo & Ojo, 2022). However, very little information on Bambara nut adoption can currently be found in the empirical domain of the afore-said scope of the current topic.

However, this raises a problem evidence play for extension agencies and policymakers. In the absence of evidence for a particular crop, interventions by extension agencies will have to follow general guidelines that may not address the distinct challenges of Bambara nut growers. In pursuit of the mandate of agricultural extension, which is the promotion of appropriate and responsive location-based technologies, there is a crucial role in this endeavour. The study hence seeks to investigate the level and factors influencing the adoption of improved Bambara nut production technology in Obi LGA of Benue State, Nigeria.

METHODOLOGY

The research adopted a cross-sectional survey approach for this work, which has often been followed in agricultural technology adoption studies. Primarily, data were collected from *Bambara* nut farmers using a structured questionnaire administered via personal interview. Techniques of improved production of *Bambara* nut were targeted by this work. The study used a multi-stage sampling approach. The approach involved first purposively sampling communities known for production of *Bambara* nuts. This was followed by proportionate and random sampling to yield a total of 115 study participants. The study analyzed the data by employing descriptive statistics such as percentages to outline the rate of adoption. A binary logistic regression model was later employed to determine the factors that affect the levels of adoption by the farmers. The study employed binary logistic regression approach because it is commonly used in agricultural extension studies when outcomes are binary (Asfaw *et al*., 2023).

RESULTS AND DISCUSSION

Socio-economic profile of the respondents

The result of Table 1 of the socio-economic profile of the respondents revealed that majority were female (69.6%), aged 40 years and below (65.2%), married (60.9%), have formal education (80.0%) and have average annual farm income of N450,000.

TABLE 1: Socioeconomic Profile of the respondents

Variables	Frequency	Percentage	Mean
Sex			
Male	35	30.4	
Female	80	69.6	
Age			
21-30	29	25.2	
31-40	46	40.0	
41-50	20	17.4	38
>50	20	17.4	
Marital status			
Single	26	22.6	
Married	70	60.9	
Divorced	19	16.5	
Level of Education			
No Formal education	23	20.0	
Primary	44	38.3	
Secondary	13	11.3	
Tertiary	35	30.4	
Farming Experience			
1-5	28	24.3	
6-10	48	41.7	
11-15	37	32.2	9
Farm Size			
0-5	35	30.4	
6-10	33	28.7	4
11-15	27	23.5	
16-20	7	6.1	
>20	13	11.3	
Annual Income			
50,000-100,000	16	13.9	
100,001-150,000	36	31.3	
150,001-750,000	7	6.1	N450,000
200,001-300,000	13	11.3	
>300,001	43	37.4	

Source: Field Survey 2025

The lower male involvement in the cultivation imply they do not consider it as a major source of household income. However, the involvement of more younger married persons with formal education indicate a potential that can be explored by extension agencies to push innovation and improve the cultivation of the crop. The low average annual farm income of these farmers shows they are not earning much from farming hence the need for innovation introduced to gear toward increased earning.

Improved Bambara nut Production Practices used by respondents

The findings shown in Table 2 indicate that quite a high percentage of farm respondents had adopted some of the best practices in their production, such as planting in time (66.1%), correct harvesting practices (64.7%), as well as better post-harvest handling practices using silos and neem leaf powder (64.3%). These production practices mainly require little investment but extensive knowledge or skills; hence the possibility of their being widely adopted. These practices also appear to target the post-harvest stage which is considered a constraint in the production of underutilized legumes. Row planting and spacing had a medium level of adoption at 53.0 percent.

TABLE 2: Distribution of Respondents According to Improved Bambara nut Production Practices used in the study area.

Practice	ADOPTED			NOT ADOPTED		
	Frequency	Percentage	Rank	Frequency	Percentage	Rank
Timely planting	79	66.1	1	39	33.9	9
Harvesting method	74	64.3	2	41	35.7	8
Post-harvest Storage	74	64.3	2	41	35.7	8
Row planting/spacing	61	53.0	4	54	47.0	7
Improved Storage	56	48.7	5	56	48.7	6
Pest and disease control	54	47.0	6	61	53.0	5
Improved varieties	46	40.0	7	69	60.0	4
Fertilizer/ manure	44	38.3	8	71	61.7	3
Herbicide/weed control	43	37.4	9	72	62.6	2
Crop rotation/intercrop	43	37.4	9	72	62.6	1

Source: Field Survey 2025. Note: *Multiple Responses Recorded*

However, the adoption of the more input-demanding methods remained low. These methods include the adoption of improved varieties of the Bambara nut (40.0%), the use of fertilizer or manure (38.3%), the use of herbicides and methods for controlling weeds (37.4%), the management of pests and diseases (47.0%), and crop rotation or intercropping (37.4%). The low adoption of improved varieties of the Bambara nut is especially interesting and relates to challenges associated with the availability of the improved varieties and a lack of understanding of the benefits associated with the varieties, as highlighted in the study carried out by Asante *et al.* (2021).

Naturally, the lack of optimized agronomic practices and the unavailability of improved inputs has continued to restrict the productivity of the Bambara nut in the sub-Saharan region, as highlighted in the study carried out by Tan, Azam-Ali, and Massawe (2020).

Table 3 classifies the adoption levels of the respondents, with most of the respondents having a medium adoption rate for on-time planting, crop rotation/intercropping, and post-harvest storage. Nonetheless, fertilizer use, weeding, pests and disease control, and more sophisticated storage methods were generally adopted at low rates. These results concur with Majola, Gerrano, and Shimelis (2021), who found that Bambara nut has traditionally received scant attention in research studies when compared to major legumes such as cowpea groundnuts. Additionally, Obura (2021) and Masindeni (2022) attributed low rates of adoption for intensive methods to a shortage of training, costs, as well as a lack of market-based incentives.

TABLE 3: Distribution of respondents according to level of adoption of improved Bambara nut production practices

Improved Production Practice	Level of Adoption			Percentage	Mean	S.d
	High	Medium	Low			
Iimproved Bambara nut variety		**		42.6	2.20	0.85019
Timely planting	**			54.8	2.59	0.49374
Row planting/spacing		**		49.6	2.24	0.43106
Pest and disease control		**		42.6	2.27	0.45010
Crop rotation and intercropping	**			54.8	2.26	0.48360
Use of fertilizer/manure		**		55.7	2.86	0.33826
Use of herbicides/ weed control		**		49.6	2.34	0.47836
Proper harvesting methods		**		55.7	2.22	0.42013
Use of improved storage method		**		42.6	2.00	0.00000
Improved post-harvest storage method	**			54.8	1.86	0.71189

Source: Field survey 2025. Note: *multiple responses were recorded.*

The societal, economic, and institutional factors, are presented in Table 4. Among those factors, the size of households, being organized in farmer groups, or the ease of access to markets emerged as the most significant factors. These factors emphasize the significance of the role of the labour force in the diffusion of new technology. These results align with those of Adong (2022) when it was highlighted that it is important to have farmer organizations, which play an important role in disseminating information. Farm size, cost of inputs, age, gender, education level, and risk perception had moderate, lesser, or less significant effects, respectively. Perhaps the least significant influence was observed in access to extension services, reflecting about the limited coverage of extension services for less common crops such as Bambara nut (Obura, 2021).

Analysis of the logistic regression output (Table 5), however reveals that the overall model fit is not statistically significant (χ^2 = 8.226; p = 0.512) and that the model explains only 9.4% of the variance in adoption. This, of course, means that, collectively, the socio-economic variables studied have nothing much to do with adoption in this region. However, farm size was found to be the individual variable that has a statistically significant positive impact on adoption (p = 0.026).

This, of course, means that farmers who own larger farm sizes tend to be more adopting of improved Bambara nut technologies, presumably because of farm size flexibility, which, to a certain extent, mitigates risks of adopting new technologies. This has been attested by other studies, such as those of Tambo & Mockshell (2020) & Olayiwola *et al*. (2021), which found that farm size or landholding has often played a crucial role in adoption, particularly of minor crops.

Table 4: Distribution of respondents according to factors influencing the Bambara nut farmers adoption of improved production practices

Variable	Frequency	Percentage	Rank
Age	47	40.99	9
Sex	54	47.0	7
Level of education	43	37.4	12
Farming experience	43	37.4	12
Household size	79	68.7	15
Farm size	61	53.0	4.5
Access to credit	79	68.7	1.5
Membership in farmers group	54	47.0	7
Access to extension services	18	15.7	14
Availability of inputs	46	40.0	11
Market access/opportunity	76	66.1	3
Cost of inputs	61	53.0	4.5
Labor availability	44	38.3	10
Risk perception	54	47.0	7
Cultural beliefs/tradition	43	37.4	12

Source: Field Survey, 2025. Note: *Multiple Response recorded*

TABLE 5: Logit Regression result of factors influencing farmers on adoption of improved Bambara nut production practices

Variable	Coefficient	Std. Error	Z-value	P>|z|	Significance
Sex	0.233	0.527	0.195	0.659	Not significant
Age	-0.093	0.050	3.531	0.060	Not significant
Marita status	-0.099	0.274	0.132	0.716	Not significant
Level of education	0.244	0.279	0.763	0.382	Not significant
Farm experience	-0.048	0.054	0.792	0.374	Not significant
Household size	0.074	0.163	0.208	0.648	Not significant
Farm size	0.428	0.192	4.979	0.026*	Significant
Income	0.000	0.000	0.529	0.467	Not significant
Constant	0.732	1.212	0.365	0.546	

Number of Observations: = 100

Likelihood Ratio: Chi-square (X^2) = 8.226

P-value: (Prob> X^2) =0.512ns

Pseudo R²: The Pseudo R^2 =0.094

Source field survey 2025

CONCLUSION AND RECOMMENDATIONS

The study reveals that farmers in the Obi Local Government Area appear to choose among improved methods of producing Bambara nut, selecting those that are less expensive or lower-risk. in encouraging farmers to adopt new methods.

Based on this understanding several suggestions are made.

1.   The Benue state extension agency should strengthen training and extension programs focused on affordable and easily adoptable technologies,

2.   The extension agency should also improve farmers access to improved seeds and inputs, promoting farmer organization and cooperative development.

3.   The extension agency should integrate Bambara nut into extension programs to train farmers on new farming methods and innovation that will help them increase their production.

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