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Adoption and impact of improved maize varieties on smallholder farmers' farm productivity in the Surulere Local Government area of Oyo State, Nigeria

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Abstract

The empirical study examines maize farmers, the rate of adoption, and the level of productivity in the study area. The study is carried out in the Surulere Local Government Area in Ogbomosho Agricultural Zone. Primary data are obtained through interviews with maize farmers. The sampling technique employed is a multi-stage stratified random sampling technique, through which twenty farmers are selected per settlement, making a total of 200 farmers, with only 191 corresponding to the aim of the study. Data analysis comprises both descriptive and probit model analyses. The results indicate that 72.3% of the maize farmers are male, while 27.7% are female, and the majority (59.7%) are in their active age. Among the adopters of hybrid maize, males have a higher adoption rate of 84.03% compared to 15% among women. The probit regression analysis reveals that gender (-3.27) is significant at the 1% level, and the negative coefficient indicates that males are more inclined to adopt hybrid maize than female farmers. The size of tillable farmland (-2.41), source of seeds (-3.11), source of information about hybrid maize (5.70), and the distance from the source of seed acquisition (2.20) are factors influencing the adoption of hybrid maize and are statistically significant. It is therefore recommended that more efforts be made to sensitise farmers on the increased economic returns from adopting hybrid seeds. Where possible, smart subsidies should be introduced to address the issue of affordability of hybrid maize varieties.

Keywords: adoption, farmers, hybrid, maize, productivity

INTRODUCTION

Maize (Zea mays) is a major crop being cultivated in the rainforest and the derived Savannah zones of Nigeria and has been in the diet of Nigerians for centuries. It started as a subsistence crop and has gradually become a more important crop for agro-based industries, which depend on maize as raw material (Sedi et al., 2024). Maize has a wide range of uses, including baking, brewing, and livestock feed. It is an important source of carbohydrate, protein, iron, vitamin B, and minerals. Green maize (fresh on the cob) is eaten parched, baked, roasted, or boiled, playing an important role in filling the hunger gap after the dry season and serving as a staple diet for many people in Nigeria (Adeleye et al., 2020). The importance of maize cannot be overemphasised, with Nigeria producing 43% of the maize grown in West Africa. Maize has a consumption quantity of 53.20 g/capita/day (FAOSTAT, 2018; Banjo et al., 2025). In Nigeria, maize is a notable staple food and cash crop (Edge et al., 2018), and it plays a significant role in the economic well-being and livelihoods. Industrially, maize is used for production of starch and alcohol. The starch can be used as a converter of dextrin, syrup, and sugar; oil obtained from it is used to make soup or refined for cooking and salad dressing.

According to FAO (2018), over the 2009–2014 period, there was an increase in harvested maize area from 3.4 to 5.9 million hectares, with an increase in production from 3.3 to 6.8 million tonnes. Currently, Nigeria's annual maize production is about 10.5 million metric tonnes (Mundi Index, 2018). However, despite the evidence of substantial maize production in the last two decades, maize yield is still low compared to its potential outcomes. The production of the crop should be increased in order to ensure food and income security through the development of improved maize varieties and technologies. Against this backdrop, technological change, which involves introducing modern agricultural technology and improved cultivation practices, becomes crucial for raising agricultural productivity (Bayegunhni et al., 2022; Asmawi & Ahmed, 2022).

In this regard, the Nigerian government collaborates with the International Institute of Tropical Agriculture (IITA), the International Maize and Wheat Improvement Centre (CIMMYT), and the Stress Tolerant Maize for Africa (STMA) project to develop a variety of improved maize seeds. Thus, more than 120 improved maize varieties (IMVs) with different characteristics have been developed and made available (NACGRAB, 2016). IMVs are defined as scientifically bred populations that comply with the International Union for the Protection of New Plant Varieties (IUPV) standards of being distinct, uniform, and stable. Some of the improved maize varieties in Nigeria include the following: DMR-LSR-W, DMR-LSR-Y, DMR-LSR-W, DMR-ESR-Y, SUWAN-1-SR-Y, 8644-3, 8644-27, and 8644-32. These enhanced varieties are sourced from research institutes, seed companies, the National Seed Service, state agricultural supply companies, and other retailers.

The major limitations in maize production are adoption of improved maize hybrids, availability of improved hybrid varieties, and accessibility to quality hybrid maize seed, which are crucial to the transformation of agriculture in Nigeria (Quarshie et al., 2021). Over time, farmers in Nigeria have started to rely on open-pollinated varieties (OPVs), which have low yield potential and are vulnerable to pests, diseases, and drought stress (Sedi et al., 2024). Among the major limitations to maize productivity are: slow adoption of maize hybrid seeds, due to in part to the smallholder farmers' propensity to recycle their grains as seeds, limited knowledge on the benefits of hybrid seeds, misconceptions on the value proposition versus pricing, and limited availability of hybrid maize varieties in key maize-growing areas, (Amah et al., 2020; Wossen et al., 2023).

Adoption of agricultural technologies can be better understood when situated within established theoretical frameworks. Rogers' Diffusion of Innovations (DOI) theory, for instance, posits that the adoption of new technologies is influenced by attributes such as relative advantage, compatibility, complexity, trialability, and observability (Motohashi et al., 2012; Chen, 2024). In the context of improved maize varieties, farmers' decisions are governed, according to Waldman et al. (2017) and Inanda et al. (2025), by how well hybrid seeds align with production goals, cost–benefit perceptions, and risk considerations. Early adopters often act as change agents, influencing the wider farming community's perception of the technology (Obunyali et al., 2019).

Technology Acceptance Model (TAM) as proposed by Davis (1989) emphasises the role of perceived usefulness and perceived ease of use in shaping adoption behaviour (Ishengoma, 2024). Thus, smallholder farmers are more likely to adopt hybrid maize varieties when they recognise the tangible productivity benefits and when access mechanisms—such as seed availability, extension services, and training – help reduce barriers to use. (Martey et al., 2020; Mdoda et al., 2025). Integrating these perspectives highlights that adoption is not merely a technical decision, but a socio-economic process shaped by farmer characteristics (age, gender, education, farm size), institutional factors (extension services, seed supply chains), and information sources (formal and informal networks). These frameworks, therefore, provide a conceptual basis for interpreting the adoption dynamics observed in Surulere, Oyo State, and for linking empirical findings to broader innovation diffusion processes in smallholder agriculture. The study aims to investigate the socio-economic characteristics of maize farmers, the adoption index, and the production rate of hybrid maize among farmers. The factors affecting the adoption of hybrid maize in the study area are also examined.

METHODOLOGY

The study is carried out in the Surulere Local Government Area (LGA) in the Ogbomosho Agricultural Zone of Oyo State, using data collected from maize farmers residing in the area. Ogbomosho is located approximately at the intersection of latitude 8°08' North and longitude 40°15' East. It is about 105 km northeast of Ibadan (the state capital), 58 km northwest of Osogbo, 53 km southwest of Ilorin, and 57 km northeast of Oyo town. The population is approximately 166,034 as of the 2006 census, within an area of 3,542.82 square kilometres, with about 60% of the residents being civil servants who are also engaged in farming (both crop and animal production). Ogbomosho is regarded as a derived savannah vegetation zone and a lowland rainforest area. Surulere Local Government Area is selected for the study because it is one of the major maize-producing LGAs in the Ogbomosho Agricultural Zone.

Sampling Procedure

Primary data are obtained through an interview schedule purposively administered to maize farmers. In addition, observations and supplementary information provided by the farmers, which were not covered by the interview schedule, are also recorded. The sampling technique employed is a multi-stage stratified random sampling method. The first stage involves the purposive selection of small-scale maize farmers from rural areas such as Ireesaadu, Iresapa, Surulere, Oko, Ilajue, Bayeoje, Igbon, Gambari, Arolu, and Maayin in the Surulere Local Government Area, where farmers are more concentrated. The second stage involves systematic simple random sampling to select two hundred maize farmers (limited by funding), with twenty farmers randomly chosen per settlement. Ultimately, 191 questionnaires are valid for the study analysis.

Data analysis

Both descriptive and probit model analyses are used. The data obtained from the field are subjected to analysis using inferential statistics. Descriptive analysis is used to examine the socio-economic characteristics of the farmers, the rate of adoption, and the level of productivity.

Probit Model

To estimate the numerical values of the parameter, a probit model was applied to obtain the statistical significance of the parameters of the explanatory variable, as well as to know the overall cumulative effect of all variables on the dependent variable. A probit model is an econometric model in which the dependent variable y can be only one or zero, and the continuous independent variables x are estimated in:

$$\Pr(y - 1) = F\ (x;' b)$$

Here b is the parameter under assessment, and F is the form of function.

To determine the factors influencing adoption of hybrid, probit model is used as follows:

$$Pr\ (y-1) = F(x,'b)$$

Where: y = dependent variable having values 1 or 0, X = explanatory variables, b = model parameters, Yi = 1 if respondent adopted hybrid maize, Yi = 0 if respondent does not adopted hybrid maize, X1 = Age, X2 = years of schooling, X3 = household size, X4 = farm size, X5 = Access to information, X6 = Source of information (Radio, T.V, extension workers etc) X10 = Frequency of extension visit, X7 = Gender (male=1, female = 2), X8 =Distance from market, X9 = Access to extension services, X11 = Source of Seed.

RESULTS AND DISCUSSION

Analysis indicates that the majority of farmers (nearly 60%) are between 41 and 60 years old—an age group that also records the highest adoption and productivity levels (Table 1). Thus, younger and older farmers participate less, suggesting that adoption is concentrated among those in their economic prime. These results are consistent with FAO (2018) and Ahmed et al. (2021), which emphasize the importance of active working-age groups in driving agricultural technology uptake.

Gender distribution indicates 72.3% (138) male maize farmers, and 27.7% (53) female. This aligned with Bayegunhi et al. (2022), who reporter 74% male farmers and 55 years average age in the Ogun State of Nigeria. Similarly, according to Amah et al. (2020), the male farmers (73.6%) are more numerous than females in the Plateau State, Northern Nigeria.

Among the adoptees of hybrid maize, males have a higher adoption rate of 84.3% compared to 15.7% among females, and productivity on male-managed farms is higher than that of female-managed farms. The implication of these findings is that male farmers are more involved in maize production than female farmers. Bayegunhi et al. (2022) also confirmed that male farmers adopted hybrid maize more than female farmers and achieved higher productivity. This contrasts with Obunyali et al. (2019), who reported that more women (67%) participated in farming activities, including hosting demonstration plots and participating in field days to exchange knowledge and ensure food security for their families in Kenya.

The current study reveals significant gender differences in the adoption of hybrid maize, with male farmers recording higher adoption and productivity rates. This disparity goes beyond simple numerical differences and reflects deeper cultural, social, and institutional barriers. In rural Nigeria, women farmers often face land tenure insecurity, which limits their ability to make long-term investments in improved seeds (Amah et al., 2020). In addition, women typically have restricted access to credit facilities and extension services, reducing their access to the technical knowledge and financial support necessary for adoption. Cultural norms also play a role, as farming activities requiring larger capital investment and higher market participation are often male-dominated, thereby limiting women's engagement in commercial maize production. (Baiyegunhi et al., 2022).

The distribution based on marital status reveales that 58.64% practised monogamous marriage, 32.98% practised polygamous marriage, 2.09% were separated from their spouses, 4.19% never married, and 2.09% are widowed. The married monogamous have the highest rate with 63.87%, followed by married polygamous with 30.25%; singles are 5.05%, and the widowers or widows had 0.84%. The farmers who are not married have the highest average productivity, followed by married polygamous, married monogamous, widowers, and farmers who are separated from their spouses.

Household sizes of farmers show that about 30.9% of maize farmers have a household of one to five members, about 52.4% have between six and ten household members, and

12.6% have between eleven and fifteen household members. About 2.6% of farmers have between sixteen and twenty household members, while 1.6% have between twenty-one and twenty-five household members. A large number of household members living together under one roof and participating in the same farm activities reduces the farm's external labour requirements and is therefore expected to positively influence the adoption decisions of agricultural technologies (Kamara et al., 2020; Adebayo et al., 2023; Babatunde et al., 2023).

Farmers' years of schooling reveal that the majority of maize farmers—35.1%—have never attended school; 27.7% have between one and six years of schooling; and about 8% have between seven and twelve years of schooling, which corresponds to secondary education. About 29.2% have thirteen years or more of schooling at the tertiary level. The adoption rate among farmers without schooling reaches 31.1%, compared to 30.3% among those with one to six years of schooling. Farmers with seven to twelve years of education have an adoption rate 16.3% lower than those with tertiary education, whose adoption rate stands at 24.4%. This contrasts with the findings of Sedi et al. (2024) in Northern Nigeria, who reported that about 80.2% of farmers have at least a primary school education.

The number of years of experience in farming shows that about 30.9% of maize farmers have less than five years of farming experience (Table 2). About 52.3% of the farmers have between 6 and 10 years of maize production experience, 12.6% have between 11 and 20 years of experience, while 4.2% have 21 years or more of maize farming experience. The adoption rate increases along with increase of years of farming experience.

Table 1. Socioeconomic characteristics, adoption, and productivity

Variable	Characteristic	Frequency	Percent	Adoption	Average Productivity
Gender	Male	138	72.3	84.3	9.01
	Female	53	27.7	15.7	6.03
Age	21–40	35	18.3	1.6	2.1343
	41–60	114	59.7	59.7	2.4388
	61≤	42	22.0	19.3	2.0845
Marital status	Married Monogamous	76	58.64	39.8	2.4000
	Married Polygamous	63	32.98	18.8	2.2623
	Separated	4	2.09	3.1	1.1250
	Never Married	8	4.19	0	2.4688
	Widowed	4	2.09	0.5	1.1667
Household size	<5	59	30.9	29.4	2.2295
	6–10	100	52.4	52.9	2.2398
	11–15	24	12.6	15.1	2.9760
	16–20	5	2.6	2.5	1.9667
	>25	3	1.6	0	1.1667
Years of schooling	None At All	67	35.1	19.4	3.80
	1–6	53	27.7	30.3	3.01
	7–12	15	8.0	16.3	9.63
	13≤	56	29.2	24.4	9.71

Source: field survey, 2024

The number of years of experience in farming shows that about 30.9% of maize farmers have less than five years of farming experience (Table 2). About 52.3% of the farmers have between 6 and 10 years of maize production experience, 12.6% have between 11 and 20 years of experience, while 4.2% have 21 years or more of maize farming experience. The adoption rate increases along with increase of years of farming experience.

The majority of farmers, 81.2%, have one to five ha of tillable farmland, and the average productivity is 2.30, while 14.7% of the respondents have 6-10 hectares of tillable farmland, 2.6% of the farmers have 11-15 hectares of tillable farmland, and the average productivity is 2.86 (Table 2). About 1.0% of farmers have 16-20 ha of tillable farmland, and their average productivity is 0.45; 0.5% of farmers have 26-30 ha of tillable farmland, and the average productivity is 1.63. This result indicates that most of the maize farmers are subsistence farmers. This result is similar to the findings of Bayegunhi et al. (2022) among maize farmers in Ogun State.

Productivity and adoption rate based on farmers' cropping system distribution reveal that about 10.5% of the farmers practise a mono-cropping farming system, while the majority (77.5%) practise mixed cropping, and 14.7% practise an integrated system (Table 2). Average productivity for mono-cropping is 3.69, for mixed cropping it is 1.96, and for the integrated system it is 3.05. The distribution based on access to credit facilities shows that 22.5% of the farmers obtain credit, with an average productivity of 3.42, though with a lower adoption rate of 20.4%. However, the majority of farmers (77.5%) do not obtain credit, and their average productivity is 1.98, with an adoption rate of 46.6%.

Table 2. Adoption rate and productivity analysis

Variable	Category	Frequency	Percent	Adoption	Average Productivity
Farming Experience	>5	59	30.9	16.4	4.5470
	6–10	100	52.3	21.6	3.1757
	11–20	24	12.6	35.3	3.8632
	21–30	5	2.6	25.9	3.9179
	>31	3	1.6	0.9	3.6635
Farm Size	1–5	155	81.2	48.2	2.3004
	6–10	28	14.7	11.5	2.4762
	11–15	5	2.6	1.6	2.8679
	16–20	2	1.0	0.5	0.4500
	21–25	1	0.5	0.5	1.6364
	26–30	–	–	–	–
Cropping System	Mono cropping	20	10.5	6.3	3.6975
	Mixed cropping	143	74.8	42.9	1.9628
	Integrated	28	14.7	13.1	3.0590
Credit Facility	Yes	43	22.5	15.7	3.4240
	No	148	77.5	46.6	1.9800
Hired Labour	Yes	120	62.8	41.4	2.5662
	No	21	37.2	20.9	1.8638
Extension Visitation	Yes	58	30.4	23.6	3.1069
	No	133	69.6	38.7	1.9559

Source: Field Survey, 2024

Productivity and adoption rate based on hired labour show that the majority of farmers (62.8%) hire labour, with an average productivity of 2.56, while 37.2% do not hire labour and have an average productivity of 1.86 (Table 2). The distribution based on extension workers reveals that 30.4% of farmers who receive visits from extension workers have an average productivity of 3.10. The majority (69.6%) who do not receive extension visits record a higher adoption rate of 38.7%, with an average productivity of 1.95. This contrasts with findings from Ogun State, where 98% of farmers receive visits from extension agents – a trend that drives high adoption and productivity (Bayegunhi et al., 2022; Victory et al., 2022).

Factors affecting adoption of hybrid maize

The results from Table 3 show the probit analysis of factors influencing the adoption of hybrid maize among maize farmers in Ogun State, Nigeria. The log-likelihood function is -77.573618. The log-likelihood ratio is significant, indicating that the explanatory variables explain changes in the dependent variables. The chi-square value is 97.95, with significance at the 1% and 5% levels, showing that the model is well fitted. The results reveal that gender (-3.27) is significant at the 1% level, and the negative coefficient indicates that male farmers adopt hybrid maize more than female farmers. The size of tillable farmland (-2.41) is significant at the 5% level and implies that the smaller the farm size, the greater the likelihood of adopting the technology.

This finding is supported by Bayegunhi et al. (2022), who reported that larger farm sizes are associated with lower adoption rates. The source of seeds (-3.11) is also significant at the 1% level, implying that farmers are more likely to adopt new maize technology when seeds are sourced externally. The source of information about hybrid maize (5.70) and the distance from the seed source (2.20) are significant at the 1% and 5% levels, respectively, indicating that farmers are willing to travel farther to obtain seeds from trusted suppliers rather than rely on local informal markets, where seed quality may be uncertain. This finding aligns with earlier observations that farmers prioritize input reliability over proximity. This contrasts with Sedi et al. (2024), who found that only the age of the household head, educational level, maize price, and fertiliser use are significant explanatory variables influencing adoption and productivity.

Table 3. Probit Regression Analysis

Adoption Variables	Coef.	Std. Err.	Z	P > z	95% Conf. Interval
Age	-0.138	0.213	-0.650	0.516	-0.555 – 0.279
Sex	-0.901	0.296	-3.270	0.001***	-1.546 – -0.387
Marital Status	-0.124	0.137	-0.900	0.0366	-0.391 – 0.144
Family Size	0.0412	0.157	0.270	0.791	-0.266 – 0.349
Years of Schooling	-0.000	0.133	-0.000	0.999	-0.260 – 0.260
Farming Experience	-0.015	0.135	-0.110	0.914	-0.280 – 0.251
Farm Size	-0.1906	0.791	-2.410	0.016**	-3.465 – -0.357
Source of Seed	-0.190	0.061	-3.110	0.002***	-0.310 – -0.070
Distance Seed Mkt	0.513	0.233	2.200	0.028**	0.057 – 0.969
Information Source	0.378	0.066	5.700	0.000***	0.248 – 0.508
Extension Services	-1.428	0.285	-1.590	0.133	0.986 – 0.130
Freq. Extension Visit	0.004	0.082	0.050	0.964	-0.156 – 0.164
Constant	4.109	1.382	2.970	0.003**	1.399 – 6.818

Legend: significant; ** at 10%, = variable at 5%**; ***= variable significant at 1%; *Source: Field survey, 2024*

However, the regression coefficients of other independent variables reveal their relationship with the adoption of hybrid maize. The probit results confirm that male farmers are more inclined to adopt hybrid maize, reflecting structural barriers such as women's limited access to land, credit, and extension support – constraints that align with gendered adoption patterns documented in previous studies (Amah et al., 2020; Baiyegunhi et al., 2022; Mojisola et al., 2022). Additionally, adoption of hybrid maize does not increase with years of farming experience, extension workers' visits, age, or frequency of extension visits; these variables are not significant and do not positively influence adoption.

CONCLUSIONS

The socio-economic characteristics of maize farmers reveal that most are in their highest productive age and therefore record the highest adoption rate and productivity. The maize farmers are mostly male. The study finds that farmers with low educational levels adopt hybrid maize more than those with higher educational attainment. Additionally, adoption of hybrid maize does not increase with years of farming experience, extension workers' visits, age, or frequency of extension visits. These variables are not significant at any level and do not positively influence adoption. The results show that gender, size of tillable farmland, and obtaining seeds from external sources increase farmers' adoption of hybrid maize. These factors are significant at various levels, positively influence adoption and productivity, and are identified as key drivers of hybrid maize uptake. It is therefore recommended that the government and other stakeholders promoting hybrid maize varieties increase their sensitisation efforts among maize farming communities, considering the benefits of increased productivity and resistance to pests and diseases. Greater efforts are needed to raise awareness of the economic returns associated with adopting hybrid seeds. Where possible, smart subsidies are introduced to address the high cost of quality seeds and make them more affordable for maize farmers. More targeted policy interventions are required to enhance adoption and productivity outcomes among smallholder maize farmers. First, the establishment of community-based seed distribution outlets closer to farming settlements reduces farmers' transaction costs and ensures timely access to certified hybrid seeds. Second, targeted extension services – particularly those designed for women farmers – are necessary to bridge the gender adoption gap by providing tailored training, field demonstrations, and knowledge-sharing platforms that account for women's time and mobility constraints.

Third, the introduction of microcredit schemes and smart subsidies helps address the financial barriers that currently limit many farmers' ability to purchase hybrid seeds. These instruments should be designed to be flexible and accessible, particularly for smallholders who often lack collateral. Finally, the adoption and sustained use of improved maize varieties can be supported through public–private partnerships with seed companies, which strengthen seed supply chains and guarantee the consistent availability of high-quality hybrid seeds in rural markets. Moreover, as the findings reveal, addressing gender inequality in agricultural innovation requires more than the provision of hybrid maize varieties. There is a need for gender-sensitive extension programmes, policies that promote women's land rights, and tailored microcredit schemes that consider women's limited access to collateral. Without tackling these systemic constraints, women are likely to remain disadvantaged in accessing and adopting improved maize technologies. Collectively, these measures not only promote equitable adoption but also enhance the long-term sustainability of maize production in Nigeria.

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