## Socioeconomic Characteristics Influencing the Adoption of Improved Maize Production Techniques among Farmers in Billiri Local Government Area, Gombe State, Nigeria
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## Abstract

*The research evaluated the socioeconomic characteristics influencing the adoption of improved maize production techniques among farmers in Billiri Local Government Area of Gombe State, Nigeria. A multi-stage sampling procedure was employed. From a population of 900 maize-growing households, 218 respondents were randomly chosen as the sample size. Data were analysed using percentages, mean, and logit regression. Results reveal that the mean age of the farmers was 39.6 years, the majority (61.9%) of the farmers were male and most (81.7%) of the respondents were married. About three-quarters (72%) of the respondents attended tertiary education,* the average household size of the participants was 9 persons, and the average farming experience was 9.2 years. *Improved maize varieties were the most introduced maize technology to the farmers (80.8%), but fertilizer had the highest adoption rate (50.2%). The high cost of fertilizer was revealed by 68.1% of the respondents to be the major constraint facing the farmers Farmers' education and credit were both significant at 1% and positive while experience obtained from farming and contact with extension agents were both statistically significant at 10%; farming experience was positive while extension contact was negative. Fertilizers should be subsidized by the government and education made affordable.*

**Keywords**: Maize technologies, adoption rates, farmers' socioeconomic

**Introduction**

-Africans cultivate maize due to its abundant harvests, minimal labour demands, and brief growing cycle (Cherniwchan and Moreno-Cruz, 2019). Its cultivation swiftly proliferated owing to its superior yield compared to established native staples, predominantly millet and sorghum, and its capacity to serve as an interchangeable dietary essential (Cherniwchan and Moreno-Cruz, 2019)

Nigeria's maize export volume and worth are modest, primarily conducted through informal trade routes across the Sahel. Despite this, domestic demand for maize consistently exceeds supply, resulting in an annual deficit of approximately 4 million metric tons (PricewaterhouseCoopers, Nigeria (PwC), 2021). Consequently, the country occasionally resorts to maize imports. However, the importation of maize is heavily regulated, with the Nigeria Customs Service imposing a tariff of around 5% on imported maize, and the Central Bank of Nigeria maintaining its foreign exchange ban on maize imports (PwC, 2021). Maize serves diverse roles in Nigeria. Fresh maize is commonly boiled or roasted and remains a staple in numerous Nigerian households. Additionally, maize is in high demand within the country's industrial sector, notably for livestock feed production, breweries, and confectioneries operated by fast-moving consumer goods (FMCG) companies. Approximately 6.5% of Nigeria's maize output is allocated to brewing beer, while 13% is used for producing industrial flours, cornflakes, and other confectioneries. Household consumption accounts for between 10% to 15% of Nigeria's total maize production. (PwC, 2021)

According to the National Agricultural Extension and Research Liaison Services (NAERLS) (2020), Nigeria harvested around 12.40 million tons of maize in 2020, marking a decrease of approximately 1.55% compared to 2019. The NAERLS attributed this decline to various factors, including insufficient rainfall in the southwest and parts of the southeast, flooding in certain areas of the northeast and northwest, and inadequate use of fertilizers on maize farms. In the Sahel region, unlocking the considerable maize production potential necessitates extensive use of fertilizers, enhanced seeds, increased land area, and effective weed management. By ensuring ample availability of these resources and providing adequate storage infrastructure, sustained growth in maize cultivation can be achieved (Makama et al., 2022).

The adoption of advanced technology is crucial for boosting agricultural productivity and improving the livelihoods of small-scale farmers in developing nations. Moreover, ensuring food security necessitates the utilization of enhanced seeds, which play a key role in enhancing agricultural productivity and global food stability (Almekinders et al., 2019). Farmers' yields must be boosted through existing resources and technology. Despite the allocation of human and material resources to maize production in Nigeria, the yield and harvest of maize have not risen as expected. Rural farmers often struggle to acquire high-quality seeds that are well-suited to their regional climate. Furthermore, in northern Nigeria, local seed reserves are being depleted for food consumption and are not being replenished. Moreover, commercial suppliers of superior-quality seeds are scarce in most rural areas, and local merchants are hesitant to stock seeds due to demand uncertainty. These factors have detrimental impacts on adoption, as the absence of access to improved varieties renders adoption impossible and precludes yield enhancement. Adoption decisions among farmers are influenced by various factors, some of which are beyond their control. It is against this backdrop the following objectives were addressed in the study which was to (i)identify

the enhanced maize technologies introduced to farmers and assess their uptake rates; (ii) investigate the factors influencing the adoption of enhanced maize technologies in the study area; and (iii)identify the challenges farmers face in adopting the enhanced maize technologies. The hypothesis of the study stated that the socio-economic characteristics of maize farmers do not exert a significant influence on the adoption of enhanced maize technologies.

## Methodology

The research was conducted in Billiri Local Government Area (LGA) of Gombe State, located in northern Nigeria. Billiri is positioned between latitude 9° 51' 4.9968" N and longitude 11° 6' 59.202" E. The area experiences an average annual rainfall of 700mm, with mean daily maximum and minimum temperatures of 35°C and 19°C respectively. The

A multi-stage sampling procedure was employed for this study. Initially, Billiri LGA was purposively selected from the 11 Local Government Areas (LGAs) in Gombe State, primarily for its concentration of maize growers. Subsequently, five villages were purposively chosen in the second stage based on their substantial maize cultivation. In the third stage, farmers were randomly selected from each of these villages to ensure impartiality in the study. From a total sample frame of 900 maize-growing households, 218 respondents were randomly chosen as the study's sample size. This study utilized primary data collected through a structured questionnaire administered to household heads who were maize farmers in the study area. Farmers who adopted any of the technologies were scored 1 while those who did not adopt were scored 0

Data were analysed with percentages, frequency counts, and means, while the Binary Logistic Regression Model was utilized to identify socio-economic factors influencing adoption.

## Results and Discussion

## Maize Technologies Introduced to Farmers and Their Adoption Rates

Table 1 shows the information on new maize technologies introduced to maize farmers and their adoption rates. The results reveal that out of the six technologies introduced, farmers were more introduced to improved maize variety (about 81%) than any of the new maize technologies. Improved maize variety had an adoption rate of 35.7%, this implies that out of the 218 farmers, 78 farmers adopted and practised the improved maize variety introduced to them. About 70% of the farmers were introduced to fertilizer for maize farming but surprisingly, fertilizer had the highest adoption rate (50.2%) compared to all the new maize technologies introduced. The high adoption rate of fertilizer means fertilizer caught farmers' attention more than all other technologies introduced to them. The Table further revealed that 55.1% of the farmers were introduced to plant spacing and depth and an adoption rate of 45.5% of the technology was recorded. Furthermore, 45.0% of the respondents were introduced to the improved maize storage facilities and it had an adoption rate of 37.6%. Farmers who were introduced to herbicides and pesticides were about 60.0% and an adoption rate of 40.8% was recorded for the technology.

The Table also shows that 25.0% of the farmers were introduced to the use of tractors and the adoption rate (20.1%) was the lowest of all the technologies introduced. The adoption rate of tractors was low probably because most of the farmers had farm sizes between 1-5ha which can easily be ploughed using animal traction. This finding contradicts the study of Onwuaroh *et al.* (2021b) which showed improved maize variety to be the most adopted new technology in maize production. With regards to technologies introduced to maize farmers, Onwuaroh *et al.* (2021b) identified herbicides, pesticides, enhanced storage infrastructure, optimal plant spacing and depth, and improved maize varieties as recent innovations introduced to maize farmers in Gombe State, findings which are consistent with the present study.

**Table 1:  New maize technologies introduced to farmers and their adoption rates**

| New Maize technology | Percentage | Adoption rate (%) |
|---|---|---|
| New fertilizer | 69.7 | 50.2 |
| Herbicide and pesticides | 60.0 | 40.8 |
| Improved storage facilities | 45.0 | 37.6 |
|  | 25.0 |  |
| Use of tractor | 55.1 | 20.1 |
| Plant spacing and depth | 80.8 | 45.5 |
| Improved maize variety |  | 35.7 |

**Source: Field Survey, 2021**

**Determinants Affecting Maize Farmers' Uptake of Enhanced Technologies**

Table 2 presents the results of the binary logistic regression analysing factors influencing maize farmers' adoption of new agricultural technologies. In this study, P-values and Odds ratios were used to interpret the regression outcomes. The findings indicate that education level, years of farming experience, income, and access to credit were statistically significant and positively associated with technology adoption, except for extension contact, which showed a significant negative relationship. Specifically, education was significant at the 1% level, yielding an odds ratio of 1.656. Farming experience was significant at the 10% level, with an odds ratio of 1.275, while access to credit was significant at the 1% level, showing an odds ratio of 1.008. This suggests that an increase in education, farming experience, and access to credit is likely to increase the adoption of new maize technologies by factors of 1.656, 1.275, and 1.008, respectively. Moreover, extension contact was significant at the 10% level with a negative odds ratio of 0.664, indicating that higher levels of extension contact make the adoption of new maize technologies less likely by a factor of 0.664.

Loyce et al. (2023) found that education significantly and positively influences the adoption of new maize technologies in the Kuje Area Council of FCT-Abuja, which aligns with the findings of this study. Tekeste et al. (2023) found that highly educated farmers have better access to knowledge and are more aware of new technologies, which can drive technology adoption. Similarly, Shehu *et al.* (2020) identified education and credit as significant positive factors influencing the adoption of improved maize varieties. Furthermore, Muddassir *et al.* (2020) demonstrated that both education and extension contact positively influence the adoption of improved maize

technologies. These findings are consistent with the results of this study. Increased access to credit enables farmers to obtain sufficient capital for purchasing inputs such as fertilizers, improved seeds, chemicals, and labour costs associated with new technology usage. Therefore, higher levels of credit availability correlate with increased adoption rates of improved maize varieties by farmers

**Table 2. Determinants of the uptake of enhanced maize technologies**

| Adoption | Odds ratio | Std. err. | T-value |
|---|---|---|---|
| Age | 0.984 | 0.017 | -0.84 |
| Sex | 1.470 | 0.473 | 1.20 |
| Education level | 1.656 | 0.273 | 3.06*** |
| Size of Household | 1.059 | 0.043 | 1.41 |
| Size of Farm | 0.955 | 0.164 | -0.27 |
| Exp. in Farming | 1.275 | 0.177 | 1.75 |
| Extension contact | 0.664 | 0.150 | -1.81 |
| Credit | 1.008 | 0.001 | 4.61** |
| **Constant** | 0.070 | 0.066 | -2.82** |
| **Number of obs = 218** | | | |
| **Chi$^2$ = 46.70** | | | |
| **Prob>chi2 = 0.0000** | | | |
| **Pseudo R$^2$ = 0.1546** | | | |

**Source: field survey, 2021**                 **\*\*\*p<0.01, \*\*p<0.05**

**Challenges Faced by Maize Farmers**

Table 5 shows the results of the major constraints faced by the maize farmers in the study area with respect to up taking maize technology promoted. The results reveal that the high cost of fertilizer (68.1%) was the most challenging constraint farmers faced, followed by the high cost of labour (52.3%). This finding is in line with the study of Makama et al. (2022) which revealed the high cost of fertilizer, high cost of transportation, limited availability of credit, and high cost of labour as some of the major constraints faced by maize farmers in Kaduna State.

**Table 5: Challenges encountered by maize farmers in the research area**

| Challenges | Percentage |
|---|---|
| Low extension contact | 22.7 |
| The problem of finance (credit) | 39.5 |
| High cost of labour | 52.3 |
| Problems of transportation | 48.2 |
| High cost of fertilizer | 68.1 |
| Poor/low maize price at harvest | 16.7 |

**Source: Field survey, 2021**

**Conclusion and Recommendation**

Without subsidies, farmers may find fertilizers unaffordable, which could result in a decline in maize production. To promote and sustain the adoption of agricultural innovations, it is crucial to focus on education and credit availability. The government should subsidize fertilizer prices to make them affordable, as high costs have been a significant barrier to adopting new maize technologies. Additionally, farmers should have better access to low-interest loans to enable timely purchase of necessary agricultural inputs.

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