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Adoption of Improved Maize Production Technologies and Livelihoods of Members and Non-members of Maize Farmers' Association in Kaduna State, Nigeria

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Abstract

This study assessed the effect of the adoption of improved maize production technologies on livelihood among members and non-members of maize associations in Kaduna State, Nigeria. A multistage sampling procedure was used to select three hundred maize farmers from eight villages across the study area. Primary data were collected through structured questionnaire and analyzed using descriptive statistics and Z-test. The Z-test results revealed a statistically significant difference in maize output between members and non-members at the 5% level of significance. However, the difference in farm income between members and non-members was not statistically significant (Z = -1.36, p > 0.05), despite the observed variation in mean income.. Similarly, the analysis of level of living, measured using farmers' savings (1.41), revealed no statistically significant difference between association members and non-members. The study concluded that adoption of improved maize production technology had significant positive effect on livelihoods of maize farmers in the study area. It recommends strengthening maize associations, enhancing access to improved inputs, and expanding extension services to promote wider adoption.

Keywords: Improved maize technology, farmers' associations, livelihood

Introduction

Maize production remains an essential component of food security and rural livelihoods in Nigeria, particularly in the northern states where the crop serves as both a staple food and a major source of income for smallholder farmers (National Bureau of Statistics NBS, 2023). Kaduna State is one of the leading maize-producing states in Nigeria, with Local Government Areas such as Soba, Giwa, Ikara, and Lere playing a prominent role in maize cultivation due to their favorable agro-ecological conditions and large population of farming households (National Agricultural Extension and Research Liaison Services NAERLS, 2024). However, despite the strategic importance of maize in these areas, productivity levels among smallholder farmers remain relatively low, largely due to inadequate adoption of improved maize production technologies (Umar, 2022). Empirical studies have consistently shown that adoption of improved maize technologies such as the use of high-yielding and hybrid seed varieties, appropriate fertilizer application, improved agronomic practices,

and effective pest and weed management has a positive and significant effect on maize output and farm income. For instance, Abdulrahman and Olayemi (2021) reported that farmers who adopted improved maize technologies in Northern Nigeria recorded significantly higher yields and income compared with non-adopters. Similarly, Ogunniyi et al. (2021) found that technology adoption among smallholder farmers contributes not only to increased agricultural productivity but also to poverty reduction and improved household welfare.

Despite the documented benefits of improved maize technologies, adoption rates remain uneven across farming communities in Kaduna State. Several studies have attributed low adoption levels to constraints such as limited access to credit, high cost of inputs, poor extension contact, and inadequate technical knowledge among farmers (FMARD, 2022). These challenges are particularly evident among farmers operating outside organized institutional structures, such as farmer associations, where access to information and support services is often limited. Farmer associations have been widely recognized as important institutional mechanisms for enhancing technology adoption through collective action, improved access to extension services, credit facilities, input supply, and market information. Membership in such associations has been shown to positively influence adoption decisions and economic outcomes (IITA, 2021). In the context of maize production, association members are more likely to benefit from training programs, input subsidies, and government or donor-supported agricultural interventions, which may translate into higher output, income, and improved standards of living compared with non-members.

However, there is a noticeable gap in empirical literature concerning the comparative effects of improved maize technology adoption on output, income, and level of living between members and non-members of maize associations, particularly at the local government area level in Kaduna State. Existing studies often focus on adoption or productivity in isolation, with limited attention given to how institutional membership influences livelihood outcomes across different maize-producing communities (Suleiman & Mendelsohn, 2020). This gap is especially significant in Soba, Giwa, Ikara, and Lere LGAs, where maize farming is widespread but socio-economic and institutional characteristics differ across communities.

The general objective of this study was to examine the effect of the adoption of improved maize production technologies on farmers' livelihoods among members and non-members of maize associations in selected local government areas of Kaduna State, Nigeria. The specific objectives were to:

i. examine the effect of the adoption of improved maize production technologies on the output of members and non-members of maize farmers' association in the study area,
ii. assess the effect of adoption of improved maize production technologies on the income of members and non-members of the maize farmers association in the study area and;
iii. Examine the effect of the adoption of improved maize production technologies on the standard of living of members and non-members of maize farmers' associations in the study area.

Methodology

The study was conducted in Kaduna State, Nigeria. Kaduna State is located in the North-West geopolitical zone of Nigeria and lies between latitudes 9°02′ and 11°32′ North and longitudes 6°15′ and 8°38′ East. The state falls largely within the Northern Guinea Savannah agro-ecological zone, which is highly suitable for maize production due to its moderate rainfall, fertile soils, and favorable temperature conditions.

A multi stage sampling procedure was used in selecting the respondents in the study area. The first stage involved purposive selection of four LGAs from Kaduna State. In stage two, two villages were selected from each of the LGAs because of dominance of maize production in the areas. Therefore, a total number of three hundred maize farmers out of the one thousand two hundred maize farmers were selected for the study using the formula developed by (Yamane, 1973).

Table 1: Sampling procedure

State	L.G.A	Villages	Sample frame	Sample size (25%)		Total
				Members	Non Members	
Kaduna	Lere	Saminaka	190	24	24	48
		Lere Town	160	20	20	40
	Soba	Maigana	185	23	23	46
		Soba Town	140	18	18	36
	Ikara	Pampaida	170	21	21	42
		Auchan	130	16	16	32
	Giwa	Shika	120	15	15	30
		Kaya	105	13	13	26
Total	**4**	**8**	**1200**	**150**	**150**	**300**

Primary data were collected through a structured questionnaire administered to maize farmers in the selected LGAs and villages. The questionnaire was designed to capture information on farmers' adoption of improved maize production technologies, maize output, income from maize production, and indicators of level of living. The questionnaire was divided into sections covering technology adoption, production output, income, and level of living.

Table 2: Operationalization of variables

Variable	Operational Definition	Measurement
Adoption of improved maize production technologies (independent variable)	Use of recommended maize production technologies such as improved seed, fertilizer, herbicides, pesticides, recommended spacing, and timely planting	Adopter = 1; Non-adopter = 0
Association membership	Membership status in a recognized maize farmers' association	Member = 1; Non-member = 0
Maize output (dependent variable)	Quantity of maize harvested during the production season	Kilograms per hectare (kg/ha)
Income (dependent variable)	Net income realized from maize production	Naira per hectare (₦/ha)
Level of living (dependent variable)	Farmers' welfare measured by savings from maize production	Annual savings (₦)

Percentages, mean values and standard deviation were used to summarize information relating to maize output, income from maize production and level of living. The Z-test statistic was used to test the level of significance of the effect of adoption of improved maize technologies on output, income and level of living among members and non-members of the maize farmers association.

Results and Discussion

Effect of Adoption of Maize Technologies on Farmers' Output

Table 3 presents the Z-test analysis of the difference in maize output between members and non-members of maize associations. The calculated Z-value of 4.12 exceeds the critical Z-value of 1.96 at the 5 percent level of significance, indicating a statistically significant difference in mean maize output between the two groups. Members of maize association recorded a higher mean output of 2,846 kg per hectare compared to 1,932 kg per hectare obtained by non-members. A greater proportion of members (54%) harvested above 2,000 kg per hectare, while 64.6% of non-members largely concentrated in the lower output categories of ≤1,000 kg/ha and 1,001–2,000 kg/ha. . This result suggests that adoption of improved maize production technologies had a stronger positive effect on output when farmers belong to organized maize associations. The observed difference in maize output can be attributed to the important role played by maize farmers' associations in promoting the adoption of improved maize production technologies. Through these organizations, members have better access to certified seeds, fertilizers, agrochemicals, mechanization services, extension advisory services, demonstration plots, farmer training, and timely agronomic information. Farmers' associations also facilitate collective procurement of production inputs at reduced costs, improve access to agricultural credit, strengthen linkages with extension agencies and research institutions, and promote farmer-to-farmer learning through knowledge sharing and experience exchange. These institutional support mechanisms encourage the adoption of recommended maize production technologies, resulting in improved farm management practices and higher maize productivity among members than non-members. This finding is consistent with Umar (2022), who reported that maize farmers affiliated with farmers' associations achieved significantly higher output than non-members because association membership enhanced access to improved production technologies, extension support, and better farm management practices.

Table 3: Distribution of maize output among members and non-members of Maize farmers' associations

Output(kg/Ha)	Members	Non-members	Pooled
≤1,000	14.3	28.5	21.6
1,001-2,000	24.8	38.9	32.2
2,001-3,000	33.8	22.2	27.8
3,001-4,000	27.1	10.4	18.4
Mean output (kg/ha)	**2,846**	**1,932**	**2,389**
N	**150**	**150**	**300**

Effect of Adoption of Maize Technologies on Farmers' Income

Table 4 presents the Z-test analysis of the difference in income from maize production between members and non-members of maize farmer's associations. The calculated Z-value of –1.36 is less than the critical value of 1.96 at the 5 percent level of significance, indicating that there is no statistically significant difference in income between the two groups. Although there were slight variations in income distribution across categories, the mean income of non-members (₦564,027 per hectare) was marginally higher than that of members (₦501,886 per hectare). However, the difference was not statistically significant, suggesting that the adoption of improved maize production technologies did not produce a meaningful difference in income between association members and non-members in the study area. The absence of a significant income difference may be attributed to high production costs, fluctuating maize prices, inconsistent government policy and limited market integration, which tend to offset the financial gains from increased productivity. Even when improved technologies increase yield, the benefits may be eroded by rising input costs such as fertilizers, agrochemicals, and mechanization services. Consequently, increases in output do not always translate into higher net income for farmers. This finding agrees with Oyinbo and Rekwot (2020), who reported that adoption of improved maize varieties increased output among farmers in Northern Nigeria but had a limited effect on income due to increasing input costs. Similarly, Liverpool-Tasie et al. (2019) observed that profitability of maize production in Nigeria is often constrained by fertilizer prices and unstable market conditions. In addition, Usman, Abdullahi, and Salau (2021) found that although improved cereal technologies enhanced farm productivity in North-West Nigeria, the effect on household income was not statistically significant in the short term.

Table 4: Distribution of Income from maize production among members and non-members of maize farmers' associations

Income from Maize (₦/Ha)	Members	Non-members	Pooled
≤150,000	16.0	20.0	18.0
150,001 – 300,000	32.7	35.3	34.0
300,001 – 450,000	28.7	26.7	27.7
450,001 – 600,000	22.6	18.0	20.3
Mean income (₦)	**501,886**	**564,027**	**532,957**
N	150	150	300

Effect of Adoption of Maize Technologies on Farmers' Level of Living

The Z-test indicated that there was no statistically significant difference in the level of living (measured by savings) between members and non-members of maize farmers' associations ($Z = 1.41$, $p > 0.05$).The result in Table 5 indicates that although maize association members recorded a higher mean savings (₦72,840) than non-members (₦59,430), the difference was not statistically significant. This suggests that adoption of improved maize production technologies has not yet translated into a significantly higher level of living for maize farmers in Soba, Lere, Ikara, and Giwa Local Government Areas of Kaduna State This finding may be attributed to high production costs, inconsistent government policies, household expenditures, debt servicing, and inflationary pressures, which offset the gains from increased output and income among adopters.. Consequently, gains from improved maize technology may improve

productivity without substantially improving long-term welfare indicators such as savings. This finding aligns with Oyinbo and Rekwot (2020), who reported that while improved maize varieties increased output in northern Nigeria, the effect on household welfare indicators such as savings and asset accumulation was weak due to rising input costs. Similarly, Usman, Abdullahi, and Salau (2021) found that technology adoption among cereal farmers in North-West Nigeria improved farm income but did not significantly affect household savings in the short run.

This finding may be attributed to the fact that increased output did not translate into improved savings because of high production costs, household expenditures, and inflationary pressures. This agrees with Liverpool-Tasie et al. (2019), who reported that productivity-enhancing technologies do not automatically improve farmers' welfare without effective market access and price stability. Similarly, Adebayo and Ibrahim (2022) found that although cooperative membership improved farmers' access to production inputs, it had limited influence on their living standards. The finding implies that increased productivity alone is insufficient to improve farmers' level of living without complementary economic and market support.

Table 5: Savings among members and non-members of maize farmers' associations

Savings (₦)	Members	Non-members	Pooled
≤ 30,000	21.7	32.8	28.1
30,001-60,000	38.3	43.6	40.9
60,001-90,000	40.0	23.6	31.0
Mean savings (₦)	**72,840**	**59,430**	**66,135**
N	**150**	**150**	**300**

Conclusion and Recommendations

The study concluded that members of maize farmers' associations recorded significantly higher maize output than non-members, indicating that the adoption of improved maize production technologies contributed to increased productivity. However, no significant differences were observed in income and level of living between members and non-members. This suggests that although improved maize production technologies increased maize output, the resulting productivity gains did not translate into significant improvements in farmers' incomes and standard of living. Government and relevant stakeholders strengthen agricultural extension services to promote the adoption of improved maize production technologies through regular farmer training, demonstrations, and timely dissemination of recommended production practices. Efforts should also be intensified to improve farmers' access to quality inputs for production, including certified maize seeds, fertilisers, agrochemicals, and mechanisation services, to sustain the productivity gains associated with improved maize production technologies. Furthermore, the government should improve market access by strengthening market linkages, developing structured commodity markets, and promoting stable produce prices, enabling farmers to derive greater economic returns from increased maize production. In addition, maize farmers' associations should be strengthened to facilitate members' access to extension services, production inputs, agricultural credit, and market information, thereby enhancing the effectiveness of improved maize production technologies and improving farmers' productivity.

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