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Economic Impact of Maize Technology on Farmers in Some Selected Local Government Areas of Katsina State, Nigeria

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ABSTRACT
This study evaluates the impact of improved maize technology on land holdings, income, and savings of farmers. The study was conducted using both primary and secondary data. The data were collected between June & December 2023 through a field survey conducted by the researcher and assisted by trained enumerators in two-visit interviews using a pre-tested structured questionnaire. The independent t-test produced a value of 6.50, while the corresponding critical value at a 5% significance level is 1.96 and 2.577 at a 1% significance level. This indicates that the calculated t-value exceeds the critical value. Thus, respondents display a significant increase in their land holdings after adopting improved maize technology. The average income of respondents before adopting improved maize technology N91,824.00, which is lower than the income after adopting improved maize technology, averaging N300,945.00. The results also indicated a t-value of 6.95, which is highly significant at the 1% level. The average savings of respondents before adopting improved maize technology was N76,000, while after utilizing improved maize technology, it was N186,000. The independent t-test resulted in a value of 8.82, with corresponding critical values of 1.960 and 2.576 at the 5% and 1% levels, respectively. This indicates that the calculated t-value (8.82) surpasses the critical t-value at both the 5% and 1% significance levels. Consequently, the respondents' savings after using improved technology are significantly higher than their savings prior to using this technology. It was found that though the technology has been widely adopted, its full potentials may not be realized because most farmers are not disposed to the adoption of major components of the technology.

Keywords:
Impact,
Improved Maize Technology,
Farm income,
land expansion,
Agricultural savings

INTRODUCTION

Agriculture used to be the main stay of the economy, but when petroleum, was discovered, agriculture was neglected. Food production become relatively low and a lot of money was spent on importing food from overseas. To safeguard the situation, the government has devised some programmes. These programmes include agricultural policies, agricultural credit and so on all aimed at increasing the production of high quality food and improving efficiency of export crops and mechanized farming for increased output and income for farmers. All these objectives can only be achieved by the introduction of modern agricultural technologies. This may be informed by the observation that the traditional farmer is efficient within the constraints that he finds himself (Norman, 1997). In recent years there has been considerable interest in the process of generation and diffusion of agricultural technologies.

Faced with agonizing and tormenting and crisis which has been lurking in the shadow since the colonial era, the Nigerian government adopted some measures to ameliorate the situation. The problem of agriculture then was seen as basically technology is introduced into the system it will increase production and this would solve the food problem and this lead to the introduction of maize technology in northern guinea savanna (NGS) on a large scale (Williams, 1978).

According to Tatum (2019) ,improved maize technology was introduced in Katsina province now Katsina State as result of depilating food crisis and soaring food import bills in the mid 1970’s. According to Kassam et al, (2021), Katsina has been found to be suitable for the production of maize and the grain yield is estimated at 8,000 - 10,000kg/ha as compared to

4,000-5,000 kg/ha for long seasoned sorghum or millet which are traditional food crops in the area.

It is also believed that climatic yield potential of a single crop maize in the area is considerably higher than in the forest and derived savanna. Other advantages of maize over local sorghum and millet in the area is that it is resistant to bird damage and its husk serves as cover against insects damages by rain during ripening the main constraint of maize production in the study area is the low fertility of the soil. Maize, a key cereal crop cultivated throughout Nigeria's rainforests, guinea, and derived savannah areas, plays a significant role in the country's agriculture. It was brought to West Africa by the Portuguese in the 10th century and has since become an integral part of Nigerian farming. In Nigeria, maize is one of the leading cereal crops, with an average yearly consumption of 43 kilograms per person among a population exceeding 150 million (Oyelade & Awanane, 2013). For generations, this crop has been a fundamental part of the Nigerian diet. Initially grown for subsistence, it has transformed into an essential commercial product that is vital for various agro-based industries (Iken & Amusa, 2014; Yakubu et al. 2024). Its consumption spans a wide range of regions and social classes, establishing it as a key component of Nigerian diets. Every part of the maize plant offers economic benefits, making it a highly versatile crop with numerous uses. Maize's grains, leaves, stalks, tassels, and cobs find applications in a broad spectrum of food and non-food products (Oladejo & Adetunji, 2018). From traditional meals like pap and popcorn to industrial uses such as starch and alcohol production, maize serves multiple functions in Nigerian society. Additionally, maize is a crucial income source for smallholder farmers, who depend on its cultivation for their livelihoods (Oyelade & Awanane, 2018). In developed countries, maize is mainly used as livestock feed and as a raw material for various industrial goods, whereas in low-income nations like Nigeria, it is primarily consumed by humans (IITA, 2019). Despite having sufficient arable land, labor availability, and conducive soil and weather conditions, maize production in Nigeria largely remains at the subsistence level due to factors such as insufficient nitrogen fertilizer use (Falade & Labaeka, 2020), poor soil fertility (Imoloame & Omolaiye, 2016), and recurring droughts that can cause yield losses of up to 15% annually (Falade & Labaeka, 2020). This shortfall in production is concerning, particularly given maize's crucial role in enhancing food security, creating jobs, and generating income for farmers and entrepreneurs. Given the cherished potentials in the area it may be of interest to know what extent it has performed and possible problems. The objective of the paper is to determine how the technology has been perceived, adopted and the prospects of achieving its potentials. It is also believed that information on these will help to guide future research in order to produce acceptable and sustainable varieties of maize in the Katsina State.

MATERIALS AND METHODS

Study Area

Katsina State serves as the focus of this study; however, due to time and financial limitations, the research primarily concentrated on five local government areas: Bakori , Danja, Danmusa, Kafur and Malunfashi L.G.As. These areas were selected for assessing the effects of maize technology and agricultural credit on poverty alleviation in the state, primarily based on their accessibility. Notable initiatives aimed at promoting economic growth, development, and poverty reduction are present within these regions. Katsina State was established on September 23, 1987. It is located in the far northern part of Nigeria, bordered to the south by Kaduna State, to the north by the Niger Republic, to the west by Zamfara State, and to the east by Jigawa and Kano States. The state spans longitudes 11°15' and 13°25' East and latitudes 6° and 8° North. It encompasses an area of approximately 23,983 square kilometers and has a population of around 4.62 million people (NPC, 2022). The climate in Katsina State typically varies with the seasons. Mornings are generally cold, afternoons can be hot, and evenings return to cooler temperatures. The harmattan season (November-February) tends to be cooler, windy, and dusty due to the northeast trade winds. The primary crops cultivated in this area include millet, sorghum, groundnut, beans, cotton, maize, rice, wheat, cassava, and potato, which are mostly arable crops. Livestock raised in the state comprises cattle, goats, sheep, camels, and poultry, which are usually managed under extensive systems (KTSG, 2022).

Sampling Techniques

A combination of purposive and random sampling techniques was employed. Five local government areas (LGAs) namely : Bakori, Danja, Danmusa, Kafur, and Malumfashi. were purposively selected based on accessibility. Within each LGA, two villages were purposively chosen. The villages chosen were Kabomo and Kurami in Bakori LGA, Dabai and Tandama in Danja LGA, Mara and Yantumaki in Danmusa LGA, Dankanjiba and Yari Bori in Kafur LGA, and Dayi and Mahuta in Malunfashi LGA. Finally, 100 farmers were randomly selected after household enumeration. The household was utilized as the unit of analysis. Enumerators were assigned to each village after receiving comprehensive training. The sample size was calculated to guarantee representation from each category, thus allowing the findings to be effectively generalized.

Data Collection

The study was conducted using both primary and secondary data. The primary data were collected from the randomly selected rural farmers using questionnaires. The data were collected between June and December 2023 through a field survey conducted by the researcher and assisted by trained enumerators in two-visit interviews using a pre-tested structured questionnaire. The secondary data were collected from documented materials such as journals, seminar papers, and other relevant literature on maize production through discussion with extension agent in the study area. The secondary data were used to complement the data from the primary source.

Analytical Tools.

The analytical tools used in this study were descriptive statistics and inferential statistics. Descriptive statistics such as the frequencies, tables and percentages were used to determine the sources of maize varieties and problems encountered by the respondents while inferential statistics such as t-test and was used to determine the effects of enhanced maize technology on farm holdings, income, and savings.

RESULTS AND DISCUSSION

Improved maize varieties available in Kastina State

The available improved varieties include TZSR-WY, western yellow (WYS), DMRLSR (W & Y) DMRESR (W & Y), SUWAN (MR & SR). These varieties were found to be resistant and highly tolerant to disease like maize streak virus and downy made and that was why they are widely grown in the study area. These improved varieties were introduced mainly through the Katsina state ministry of agriculture Katsina State Agriculture developments project (ADPS) and through other agencies like private companies and River Basin Development Authorities and so on.

Farmers' perspective on the enhanced maize technology

Farmers in the region categorize maize into three primary types: local varieties (Yar Hausa or Yargari), improved varieties (Yar agric or Yar project), and hybrid maize (Yar aure). They also differentiate maize based on its color, which can be white or yellow. The white maize is the most favored and cultivated by all farmers due to its strong marketability; the appearance of food made from it is more attractive, its cobs are larger, it produces higher yields, its seeds are larger, and it fills bags more easily. Conversely, yellow maize is characterized by smaller cobs and smaller seeds. While it yields less compared to white maize, it is less demanding in terms of fertilizer and requires less maintenance. Yellow maize is typically sown during the early rains in June and July or in Fadama (lowland). It can be consumed boiled or roasted, particularly when it is still green. The dry grains are often processed into Ogi or Akamu, Tuwo, and Agidi (solid paste). Industrially, maize is utilized in various mills, for producing livestock feed, and in the brewing industry.

Sources for improve maize varieties

As per the farmers surveyed in the area (table 1), fifteen (15%) percent reported that their original source of improved seed varieties came from friends and relatives, while fourty-one (41%) percent obtained theirs from the Katsina agricultural and rural developments Authority(KTARDA). All the farmers who were interviewed select seeds for the upcoming growing season from their current year's harvest. They specifically seek out and save larger cobs, as they believe that seeds from these larger cobs germinate and develop more robustly compared to those from smaller cobs. Additionally, it was noted that seeds from different varieties are seldom mixed during storage or planting. To preserve their unique traits, new seeds of the improved varieties should be planted every year. This is due to the fact that these varieties may lose some of their essential qualities or become “stale” if the same seed is cultivated repeatedly. Furthermore, since maize is a cross-pollinated crop, there is a high likelihood of contamination, given the fragmented and closely situated farms with various maize varieties planted nearby. This situation could have serious implications for yields and future maize cultivation in light of rising production costs, a shortage of fertilizers, and competition from traditional crops such as millet and sorghum.

Table 1: Distribution of respondent according sources for improve maize varieties

Input Source(s)	Frequency	Percentage
KTARDA	70	41
Own	13	7.6
Market	10	5.9
Friend and Relatives	26	15.2
KTARDA /Market	18	10.5
Market/Own Source	17	9.9
Friends/Own Source	12	7
others	5	2.9
Total	**171**	**100**

Source: Field Survey 2023.

The perspective of maize production in Katsina State

Prior to the introduction of new maize varieties in the region, maize was primarily cultivated as a backyard crop, benefiting from manure derived from household waste. It was occasionally planted in lowland regions (fadama) where water availability and soil fertility are superior to that of upland areas. However, maize has now become both a significant food crop and a cash crop in Katsina State. Farmers in the surveyed villages were asked to prioritize the food and cash crops they cultivate, and the findings are presented in Table 2. The large-scale introduction of inorganic fertilizers in the 1970s made maize production appealing to farmers, allowing for extensive cultivation in upland areas. Furthermore, the challenges associated with processing maize, which previously hindered large-scale cultivation, were alleviated by the widespread availability of grinding machines in the region. Maize contributes to food security and provides sustenance early enough to help mitigate hunger. While millet also offers early nourishment, farmers favor maize more because they believe millet requires a longer processing time after harvesting before it can be consumed. According to information from the Katsina State Agricultural Development Projects (KTSADP), the introduction of improved maize varieties appears to have led to a decline in sorghum production, which is a long-season crop that farmers say demands more labor.

Table 2: The three major crops grown by the farmers in the sample village given in order to priority.

Local government	Villages	Food Crops	Rank	Cash Crops	Rank
Bakori	Kabomo	Maize	1st	Sugarcane	1st
		Sorghum	2nd	Hot pepper	2nd
		Millet	3rd	Maize	3rd
	Kurami	Sorghum	1st	Maize	1st
		Maize	2nd	Cotton	2nd
		Millet	3rd	Cowpea	3rd
Danja	Dabai	Maize	1st	Maize	1st
		Sorghum	2nd	Sugarcane	2nd
		Millet	3rd	Cotton	3rd
	Tandama	Maize	1st	Cotton	1st
		Sorghum	2nd	Groundnut	2nd
		Millet	3rd	Maize	3rd
Danmusa	Mara	Maize	1st	Maize	1st
		Sorghum	2nd	Cotton	2nd
		Millet	3rd	G/nut	3rd
	Yantumaki	Sorghum	1st	Maize	1st
		Maize	2nd	Cowpea	2nd
		Millet	3rd	Cotton	3rd
Kafur	Dankanjiba	Maize	1st	Maize	1st
		Sorghum	2nd	Sugarcane	2nd
		Millet	3rd	Cotton	3rd
	Yari-bori	Maize	1st	Maize	1st
		Sorghum	2nd	Cotton	2nd
		Millet	3rd	G/nut	3rd
Malumfashi	Dayi	Sorghum	1st	Maize	1st
		Maize	2nd	Cowpea	2nd

	Millet	3rd	Cotton	3rd
Mahuta	Maize	1st	Maize	1st
	Sorghum	2nd	Cotton	2nd
	Millet	3rd	Cowpea	3rd

Source: Field Survey 2023.

Extent of the adaptation of the technology

The technology consists of multiple elements, as illustrated in table 3, along with their awareness and adoption scores, where 0 indicates no awareness. Likewise, a score of 1 is assigned for the adoption of each component of the technology, and 0 signifies non-adoption.

Table 3: Awareness adoption of the improved technology in the sampled villages

Components of the technology	Total awareness score	Average awareness score	Total adoption score	Average adoption score
Improved seed	100	1.0	100	1.0
Seed dressing	40	0.4	20	0.2
Showing date	50	0.5	10	0.1
Spacing	20	0.2	0	0.2
Fertilizer application	100	1.0	20	0
Rate of fertilizer application	30	0.3	0	0.1
Time of fertilizer application	90	0.9	10	0.1
Method of fertilizer	100	1.0	100	1.0
Time of weeding	100	1	90	0.9
Pest and diseases control	90	0.9	40	0.4
TOTAL	**720**	**7.2**	**384**	**3.9**

Source: Field Survey 2023.

Effects of Enhanced Maize Technology on Farm Holdings, Income, and Savings

This involved independent t-tests to check for significant differences between any two distinct groups.

Size of Farm Holding

According to Bruno (2022), the absence of improved seeds hindered farmers from increasing their land holdings. Several hypotheses were tested using the independent t-test. The initial set of hypotheses tested are:

HO: Respondents demonstrate no significant differences in their land holdings, savings, and income before and after adopting improved maize technology.

H1: Respondents exhibit significant differences in their land holdings, savings, and income before and after adopting improved maize technology.

The results relating to the above hypotheses are detailed in Table 4. The independent t-test produced a value of 6.50, while the corresponding critical value at a 5% significance level is 1.96 and 2.577 at a 1% significance level. This indicates that the calculated t-value exceeds the critical value. Thus, the null hypothesis is rejected, and the alternative hypothesis is upheld, leading to the conclusion that respondents display a significant increase in their land holdings after adopting improved maize technology. This aligns with the findings of Bruno (2022).

Income

An individual may experience poverty as a result of their economic circumstances and might remain in poverty unless their income rises sufficiently to elevate them out of this trap. Kassam and Harrison (2021) noted that individuals in higher income brackets frequently use improved seeds. According to IITA (2019), providing improved seeds acts as a crucial mechanism for enhancing micro-enterprises, self-employment, and income-generating activities among impoverished populations. The impact of agricultural credit is illustrated in Table 4. The average income of respondents before adopting improved maize technology N91,824.00, which is lower than the income after adopting improved maize technology, averaging N300,945.00. The results also indicated a t-value of 6.95, which is highly significant at the 1% level. This demonstrates that there is a noteworthy increase in the respondents' income after adopting improved maize technology. Therefore, the alternative hypothesis is accepted while the null hypothesis is rejected. This also corroborates the findings of Oladejo and Adetunji (2021).

Savings

Rural households, regardless of their level of poverty, can save small amounts consistently or larger sums at particular times of the year, such as right after harvest. IITA (2019) found that supplying improved seeds to farmers boosts their income and savings, which in turn enhances their investment capacity. The findings (table 4) further revealed that the average savings of respondents before adopting improved maize technology was N76,000, while after utilizing improved maize technology, it was N186,000. The independent t-test resulted in a value of 8.82, with corresponding critical values of 1.960 and 2.576 at the 5% and 1% levels, respectively. This indicates that the calculated t-value (8.82) surpasses the critical t-value at both the 5% and 1% significance levels. Consequently, the respondents' savings after using improved technology are significantly higher than their savings prior to using this technology. Thus, the null hypothesis is rejected, and the alternative hypothesis is accepted, leading to the conclusion that respondents experience a significant increase in their savings following the use of improved maize technology.

Table 4: Effect of improved maize technology on land size, income and savings

Variable	Before using improved maize technology	After using improved maize technology	T-value
Land size (ha)	3.81	7.45	6.50**
Income (₦)	91,824	300,945	6.95**
Saving (₦)	76,000	186,000	8.25**

Source: Field Survey 2023.

**Significant at 5% probability level.

Problem encountered by farmers in using the technology

In light of the low adoption ratings of the technology, farmers were surveyed about the primary challenges they encountered while cultivating maize. This information will aid in assessing whether the technology aligns with the limited resources of farmers and their biophysical surroundings. Table 5 outlines the issues faced by the farmers. According to the farmers, the primary challenges they experienced included insufficient and untimely access to fertilizer, pest problems during storage, limited credit availability for acquiring modern inputs, unavailability of improved seeds, and challenges related to drought. The issue with fertilizers was so widespread and critical that many farmers, out of frustration, considered ceasing maize production altogether. Several reported that they had significantly reduced their maize output, with some indicating a decrease of about 30%. They noted that fertilizers were not only scarce but also prohibitively expensive, and they expressed a strong need for credit facilities. Most farmers conveyed their willingness to secure fertilizer at any price, provided it was accessible to them, viewing fertilizer use as the sole profitable method for maize cultivation. Thus, the issue of fertilizers was more about availability than cost. Following fertilizer issues, drought was the next significant concern, as farmers noted the consistent pattern of drought following established rains. After the initial rain period, which lasts from weeks 1 to 4 of planting, there is typically a drought phase that endures for 20 to 30 days. This drought can be so intense that it may lead to complete crop failure, as plants are particularly vulnerable during this period. It may hinder the growth of the crops to such an extent that recovery could be impossible. Frequently, entire fields may fail and require replanting with new seeds. Planting early in June could greatly alleviate drought-related problems. Other challenges faced by farmers included pest infestations during storage, which can be addressed by educating them on using insecticides to protect crops throughout the storage process. These findings agree with previous research by Issa et al. (2016) who highlighted the high price of farm inputs, insect pests and diseases, and poor storage facilities as significant constraints to maize production.

Table 5: Problems encountered by famers growing maize in the sampled villages

Problem	Frequency	Percentage (%)
Fertilizer availability	100	100
Pest infestation in storage	80	80
Need for credit	30	30
Provision of improved seeds	60	60
Draught	60	60
Means’s to expand production	10	10
Not as profitable as the local varieties	12	12
Small cob size	10	10

Source: Field Survey 2023

CONCLUSION

The independent t-test produced a value of 6.50, while the corresponding critical value at a 5% significance level is 1.96 and 2.577 at a 1% significance level. This indicates that the calculated t-value exceeds the critical value. Thus, the null hypothesis is rejected, and the alternative hypothesis is upheld, leading to the conclusion that respondents display a significant increase in their land holdings after adopting improved maize technology. The results also indicated a t-value of 6.95, which is highly significant at the 1% level. This demonstrates that there is a noteworthy increase in the respondents' income after adopting improved maize technology. Therefore, the alternative hypothesis is accepted while the null hypothesis is rejected.. The independent t-test resulted in a value of 8.82, with corresponding critical values of 1.960 and 2.576 at the 5% and 1% levels, respectively. This indicates that the calculated t-value (8.82) surpasses the critical t-value at both the 5% and 1% significance levels. Consequently, the respondents' savings after using improved technology are significantly higher than their savings prior to using this technology. Thus, the null hypothesis is rejected, and the alternative hypothesis is accepted, leading to the conclusion that respondents experience a significant increase in their savings following the use of improved maize technology.The enhanced maize technology has seen acceptance and broad usage in Katsina State; however, issues like varietal contamination and the lack of essential inputs seem to pose significant challenges to the sustainable cultivation of the crop. This could be attributed to the technology's inherent suitability to the environment. For any crop to be produced sustainably, the technology must align with both the socio-economic conditions and the biophysical attributes of the environment in which it is implemented. Establishing sufficient markets and storage solutions that ensure lucrative prices for maize producers is essential. Additionally, improved storage options will enhance maize output by allowing farmers to keep their harvest and sell it at a better price.

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