

*Full Length Research Paper*

# Understanding the role of finance in technology adoption among smallholder maize farmers in Nigeria

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Maize is an important staple food in Nigeria; however, Nigeria's local maize production only meets about 60% of its demand due to low yield (t/ha). The low maize yield has been linked to limited technology adoption, while finance has been identified to strongly impact technology adoption. Using a qualitative approach, data were collected through focus group discussions and interviews to identify the typology of existing practices, the technology used and the role of finance in the degree of adoption by smallholder maize farmers. The results indicated that finance was available in the study area, and the smallholder maize farmers' ability to adopt and combine varying degrees of technology can be attributed to the accessibility and affordability of finance. The study identified inadequate collateral, timeliness of disbursement and, more importantly, misconception as significant constraints affecting smallholder maize farmers' financing. Based on the respondents' preference for government source of finance due to its accessibility and affordability, the government is best placed in providing finance for smallholder maize farmers. The study suggests the need for a mechanism to review collaterals and documentation requested from the smallholder farmers by finance providers and the creation of awareness about finance schemes pre-cultivation season.

**Key words:** Availability, accessibility, affordability, finance, technology adoption, Maize, Nigeria.

## INTRODUCTION

Maize production in Nigeria primarily depends on smallholder farmers (Dowswell, 2019). Maize is an important staple food that accounts for 77% of total calorie consumption in Nigeria, and it is used in the production of livestock feed, alcohol, and confectionaries (Dowswell, 2019). About 55% of maize is consumed as food, 31% as livestock feed and about 2% is processed for other uses (Cadoni and Angelucci, 2019).

Nigeria is the second-largest producer of maize in Africa after South Africa, and its high production volume

is attributable to the large area of cultivated maize farmland (Food and Agricultural Organisation, 2018; Karimov et al., 2014). However, the average national maize yield (t/ha) has remained stagnant at 1.8 t/ha since 1990, which is the lowest among the top 10 maize producing countries in Africa and is also below the projected national estimate of 4.2 t/ha (International Institute of Tropical Agriculture, 2019). With an increasing annual population rate of 2%, Nigeria's population is expected to reach 410 million by 2050, which will lead to

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an increase in the demand for maize for domestic consumption and industrial use (Dowswell, 2019; Iken and Amusa, 2004). If this trend persists, Nigeria will have to rely on maize importation to meet its demand. Poor maize yield has been attributed to factors such as poor crop management systems (Olaniyan, 2015), poor soil fertility (Raimi et al., 2017), poor climate (Ogbodo et al., 2018), availability of labour (Bisseleua et al., 2018) and the lack of support services (Oyinbo et al., 2019). In addition to these factors, low technology adoption has also been identified as a significant factor in the stagnation of smallholder maize yield in Nigeria (United States Department of Agriculture, 2020). In the context of this study, technology encompasses hybrid seeds, fertilizers, herbicides, pesticides and storage bags that enhance maize yield and production.

Globally, technology adoption has been shown to play a vital role in improving maize yield (Baiyegunhi et al., 2019; Oyinbo et al., 2019; Selejio et al., 2018). For example, in the United States of America, modern maize cultivation practices have contributed to increasing maize yield from 7 t/ha in 1990 to 11.7 t/ha in 2020, with potential for future growth (United States Department of Agriculture, 2020). Similarly, technology adoption has contributed to increased maize yield in Brazil from 2 t/ha to 5.6 t/ha, Australia from 3 t/ha to 7 t/ha, and Egypt from 4 t/ha to 8 t/ha (Moreira et al., 2020; World Bank, 2020). Therefore, there is a significant potential to increase maize yield and improve maize production in Nigeria through improved technology adoption (Muzari et al., 2012). Technology adoption among smallholder maize farmers in Nigeria is dependent on factors such as the farmer's characteristics, farm characteristics, technology characteristics, institutional support and costs (Mwangi and Kariuki, 2015; Sennuga et al., 2020). These costs include the associated costs of technology acquisition and operation and are often high and beyond the financial capacity of smallholder maize farmers, who are disproportionately responsible for producing 90% of maize cultivated in Nigeria (Dowswell, 2019; Fadeyi et al., 2022).

In an economic analysis of factors affecting the technical efficiency of maize production, Mulinga (2013) identified the availability of finance as a factor that enabled increased production of maize in Rwanda. This view is similar to the findings of Eakin (2000) in Mexico, Tambo and Abdoulaye (2012) in Nigeria, and Poulton et al. (1998) in Africa as a continent. However, the availability of finance alone does not imply that finance is accessible to smallholder maize farmers (Moahid and Maharjan, 2020). In a separate study, Chiona et al. (2014) identified accessibility of finance as a significant contributor to increased farming activities, contributing to increased maize yield and production. This position is supported by the findings of Mgbenka et al. (2016) in Nigeria, where the lack of access to finance was identified as a significant impediment to the development

of smallholder maize production. Other studies by Rhaji (2000) and Ezihe et al. (2014) in Nigeria, Mathenge et al. (2015) in Kenya, and Appiah-Twumasi et al. (2019) in Ghana found that the lack of affordable finance contributed to the poor development of smallholder maize yield and production.

As indicated, majority of the previous studies have only focused on either one or two of the three aspects of finance - availability, accessibility, or affordability. Therefore, there is a need to develop a better understanding of the role of finance in technology adoption through a comprehensive assessment of all the three aspects of finance.

In this study, the authors explore the degree of technology adoption by smallholder maize farmers in Nigeria and seek to understand the role of finance in technology adoption by analysing the availability, accessibility, and affordability of finance to smallholder maize farmers. They also evaluate the major constraints experienced in financing smallholder maize farmers. Based on their findings, they provide critical suggestions essential to improve the provision of finance for technology adoption among smallholder maize farmers in Nigeria.

## METHODOLOGY

### Study area

This study was conducted in three major maize producing states in Nigeria - Kaduna (KD), Niger (NG), and Plateau (PL), which are located in the north-central region and accounts for about 65% of the maize produced in Nigeria (Iken and Amusa, 2004; Olaniyan, 2015) (Figure 1). This region has a unimodal rainfall pattern from June to September with a peak in August which favours rain-fed cultivation of maize. The growing season of maize in the study area is from May to October.

### Data collection and analysis

Data for this study was collected through (i) focus group discussions (FGD) and semi-structured interviews with 60 randomly selected smallholder maize farmers who are beneficiaries of any form of finance; (ii) in-depth interviews with three Agricultural Development Project Managers who coordinate the activities of smallholder maize farmers in the study area; and (iii) in-depth interviews with three representatives of agricultural finance providers.

Two FGD sessions comprising of 10 participants in each group were held in each of the three study areas. The randomly selected participants were of heterogeneous gender of diverse ages and educational backgrounds. Each FGD session lasted for about 75 min, while the semi-structured interviews lasted for about 45 min. The exploratory and interactive discussions offered the opportunity to draw multiple perspectives from the participants. At the same time, the interviews gave a better understanding of the subject from the individual views of each participant. During the FGD, smallholder maize farmers were initially asked about their cultivation practices and the technology used for each practice. Next, the discussion focused on their sources and use of finance as it relates to adopting



**Figure 1.** Map of Nigeria indicating the study areas.  
Source: GIS Map.

technology for maize cultivation. Smallholder maize farmers were then asked about the constraints they encountered in accessing and affording finance for technology adoption.

The interviews with the purposefully selected stakeholders involved in the financing and administration of the activities of smallholder maize farmers were conducted face-to-face at the interviewee's workplace. A set of structured open-ended questions were developed into an interview guide which provide a structure for the questions asked during the interviews. Questions asked during the interviews focused on maize cultivation practices and the technology used.

Secondly, interviewees were asked about their views on the effects of finance on technology adoption by smallholder maize farmers. The authors then asked the interviewees about the challenges they encountered with the financing and administration of smallholder maize farmers in the study area. The discussion also reflected on how smallholder maize farmers addressed these challenges. Where clarifications were required, the authors asked probing questions to gain further insights. Each interview session lasted about 45 min, enabling a significant amount of detailed information to be collected. The FGD and interview sessions were recorded, transcribed, and analysed using the Nvivo 11 software. The authors used the thematic analysis to analyse the data from the FGD with smallholder maize farmers, the interview with the ADP managers, and interviews with the representatives of the finance providers. At the same time, they used the content analysis to analyse the interview with smallholder maize farmers. Furthermore, the authors used the deductive modality approach to create themes from the data collected. Using this approach, the themes for the coding were developed based on the research objective (Azungah, 2018; Hyde, 2000).

Following the current national average maize yield of smallholder

farmers in Nigeria provided by the Federal Ministry of Agriculture and Water Resources (2019) and the projected maize yield estimate by the International Institute of Tropical Agriculture (2019), the authors classified the maize yield into three categories: (i) low, which is below the current average maize yield of smallholder maize farmers of <1.8 t/ha; (ii) medium, which is the current average maize yield of smallholder maize farmers of 1.9 to 4.1 t/ha; and (iii) high, which is the projected maize yield of 4.2 – 7.2 t/ha. Using this matrix, we explored the relationships between the various combination of technology and maize yield achieved by smallholder maize farmers.

## RESULTS AND DISCUSSION

### Technology adopted among smallholder maize farmers

In this study, the authors characterised smallholder maize farmers based on their farm size, which is  $\leq 5$  ha (National Bureau of Statistics, 2007). The maize cultivation activities and practices observed in the study area, from land preparation to storage, are highlighted in Table 1.

Some similarities and differences among the practices and technology in the three study areas were noted. However, to have a consistent basis of comparison, the authors focus on the maize cultivation practices and technology common to the three study areas. These are the hand planter, the hybrid maize seeds - which under

**Table 1.** Smallholder maize cultivation activities and practices.

Cultivation activities	Current practices	Kaduna	Plateau	Niger
Land preparation	Draft animal (Ox)	-	✓	✓
	Tractors (Hired)	✓	-	✓
Seeding	Hybrid seed	✓	✓	✓
Planting	Tractors (Hired)	✓	-	-
	Hand-planter	✓	✓	✓
Weeding	Hoe weeding (1 <sup>st</sup> weeding)	✓	✓	✓
Herbicide application	Knapsack sprayer (2 <sup>nd</sup> weeding)	✓	✓	✓
Fertilizer application	NPK & Urea	✓	✓	✓
Pesticide application	Various brands	✓	✓	✓
Harvesting	Manual-picking	✓	✓	✓
Post-harvest - storage	Purdue Improved Crop Storage (PICS) bags	✓	✓	✓

Derived from field data, 2019.

good management practices produces more yield than local seeds; fertilizers, herbicides, pesticides, and the PICS storage bags. An appraisal of smallholder maize farmers' use of technology indicates that smallholder maize farmers use a varying combination of technology which negatively or positively influences their maize yield (Table 2). Smallholder maize farmers in this study affirmed that their ability to be able to adopt technology could be associated with their access to one form of finance or another.

*“Money is technology. Without money, we cannot talk about technology.” (KDM02<sup>1</sup>)*

The importance of finance in agriculture, particularly smallholder agriculture, cannot be undermined. Finance – either owned or borrowed, enhances the financial capacity of the farmers to carry out their farming activities, in this case, the adoption of technology by smallholder maize farmers in Nigeria.

The authors found that none of the participants in this study fell within the low-yielding category. This could be because the participants have adopted one form of technology or another in the cultivation of maize. The medium-yielding category consists of (i) participants who used hybrid maize seeds combined with the recommended rate of fertilizer and herbicide, with pesticide below the recommended rate; and (ii) participants who used hybrid maize seeds combined with fertilizer, herbicide, and pesticide below the recommended rate. The farmers in this category produced maize yields of between 1.9 – 4.1 t/ha, which is above the national average yield of 1.8 t/ha but below the projected yield of

4.2 t/ha. The participants explained that having limited finance was a reason for using fertilizer, herbicide, or pesticide below the recommended rate.

*“Some of us (smallholder maize farmers) that have limited finance to cultivate their farm try to maximise their limited finance by using some inputs below the recommended rate” (PLM06)*

In the high-yielding category, the participants planted hybrid seeds and applied fertilizer, herbicide, and pesticide at the recommended rates. This category of smallholder maize farmers achieved an average maize yield of  $\geq 4.2$  t/ha. This finding is consistent with the United States Department of Agriculture (2021) result on the impact of emerging technologies on improving maize yield, which determined that the application of technology in maize cultivation significantly enhanced yield. About 66.6% of the participants in this study reported high maize yield; however, given the average national maize yield of 1.8 t/ha, it may be the case that a majority of the maize growers produce a yield of  $\geq 4.2$  t/ha.

Notably, 48.3% of the participants who used hybrid seeds and the recommended fertilizer, herbicide, and pesticide rates were within the age groups of 21 – 30 years and 31 - 40 years. These two age groups represent 71.7% of the total participants indicating that the young category of smallholder maize farmers adheres to recommended rates of technologies.

This finding aligns with the study of Ghimire and Huang (2016), in which younger farmers were observed to be flexible, more exposed to newer technology, and have a higher probability of adopting new technology. The participants included in this study were beneficiaries of financial schemes; however, their finance application varied in the type of technology adopted and its quantity.

<sup>1</sup> KDM02: KD – Location; M – Gender; 02 – Participant identification

**Table 2.** Technology adopted by smallholder maize farmers in Nigeria.

Smallholder maize farmers (participants)	Age distribution					Hand planter R	Hybrid seed R	Chemicals						Storage (PICS) R	Average yield (t/ha)					
	≤ 20	21 – 30	31 – 40	41 - 50	51 - 60			Fertilizer (NPK, Urea)			Herbicide				Pesticide			<1.8	1.9 – 4.1	≥4.2
								AR	R	BR	AR	R	BR		AR	R	BR			
<b>Kaduna</b>																				
11		1	7	1	2	✓	✓		✓				✓			✓			✓	
3	1	2				✓	✓		✓						✓	✓			✓	
3	1	1	1			✓	✓			✓					✓	✓			✓	
3		1			2	✓	✓			✓					✓	✓			✓	
<b>Plateau</b>																				
13	1	3	7	1	1	✓	✓		✓				✓			✓			✓	
3			3			✓	✓		✓						✓	✓			✓	
2		1	1			✓	✓			✓					✓	✓			✓	
2		1		1		✓	✓			✓					✓	✓			✓	
<b>Niger</b>																				
15	1	2	9	3		✓	✓		✓				✓			✓			✓	
1				1		✓	✓		✓						✓	✓			✓	
3		2		1		✓	✓			✓					✓	✓			✓	
1			1			✓	✓			✓					✓	✓			✓	

AR – Above recommended rate; R – Recommended rate; BR – Below recommended rate. Derived from field data, 2019.

A primary reason for this variation is the amount of finance accessible to participants and the relative cost of each technology.

*“It (technology) is available, but it requires a lot of finance to purchase them. Hence, we ration what we purchase.” (KDM07)*

Given the projected smallholder maize farmers’ yield of 4.2 - 7.2 t/ha and the participants’ result presented in Table 2, it can be deduced that increased maize yield can be related to the adoption of recommended technology at recommended rates. However, these technologies

are costly and often out of the reach of smallholder maize farmers, and hence, smallholder maize farmers require financial assistance to adopt the required technology.

**Dimension of finance in technology adoption among smallholder maize farmers**

In this study, finance was define as either (i) cash flow finance - the provision of liquidity, or (ii) input finance - the provision of inputs supplies to smallholder maize farmers in credit. This section discusses our findings relating to the availability,

accessibility, and affordability of finance for smallholder maize farmers to adopt new technology. By analysing these three attributes of finance, we seek to unpack the role of finance in adopting technology by smallholder maize farmers in Nigeria.

**Availability of finance**

Participants in this study acknowledged the existence and participation of the semi-formal (savings and credit cooperatives and money lenders) and informal (friends and family) finance

providers in providing finance for smallholder maize farmers. However, in the context of this study, there was inadequate data from the semi-formal and informal finance providers as they were unregistered and unregulated by the government. Therefore, emphasis was placed on the formal sources of finance - the government Bank of Agriculture, commercial and microfinance banks. Responses from the FGDs with smallholder maize farmers and interviews with the finance providers indicated that there are several finance schemes available to smallholder maize farmers from the finance providers.

*“Several schemes are available for smallholder maize farmers to benefit from, which will enable them to adopt new technologies.” – (Representative of finance provider, Lapo Microfinance Bank)*

*“We have agricultural finance products, and many of them are derived from government intervention schemes” – (Representative of finance provider, First Bank)*

It was found that institutional finance from the government sources dominates the finance supply market for the participants, and they are available through schemes such as the Commercial Agriculture Credit Scheme and Agricultural Credit Support Schemes. These schemes are provided by the government through the Central Bank of Nigeria and the Federal Ministry of Agriculture and Water Resources as per the Africa Union's Maputo 2003 declaration on agriculture and food security, where African governments committed to allocating 10% of their national budgetary resources to agriculture and rural development (African Union Assembly, 2003).

During the interview, smallholder maize farmers explained that the availability of finance from the semi-formal and informal finance providers is unreliable and undependable. Often, the lending conditions and amount to be approved by the semi-formal and informal finance providers approved is dependent on the lender's discretion, which in many cases, might be an individual. Additionally, findings from the FGDs and interviews indicate that the participants consolidate finance from different sources to create a pool that provides them with the financial capacity to adopt new technologies needed for maize cultivation.

*“We can get finance from friends and family, that is, if they have it” (KDF05)*

This finding is consistent with the study by World Bank (1989) and Verhoef (2000), where semi-formal and informal finance, due to their design, were found to be incapable of effectively delivering financial services to the underdeveloped and marginalized smallholder farmers. However, semi-formal and informal finance plays a vital role in developing a contextual approach to agricultural finance policy and must not be easily dismissed.

### **Accessibility of finance**

Access to finance offered the participants the capacity to adopt technology and undertake farming activities aimed at increase maize yield. This finding is consistent with the studies of Makate et al. (2019) and Balana and Oyeyemi (2020) where access to finance was identified as a critical input in enhancing smallholder farmers' yuhtechonology adoption. The authors elucidate from the interviews with the finance providers that while finance for maize production is available, there is a variation in smallholder maize farmers' access to the available finance. In the first case, the finance provider has a portfolio dedicated to the smallholder farmers in the maize sector. The value of the portfolio is determined by the annual budget of the finance provider. When the sum of the applications received exceeds the portfolio's amount, the finance provider creates a rationing structure to accommodate the amounts requested by successful applicants or reject some of the applications using specific criteria.

*“About 70% of our portfolio is channelled to smallholder farmers, with about 40% of that been allocated to the maize farmers” – (Representative of finance provider, Bank of Agriculture).*

In the second case, the amount of finance that an applicant can access is dependent on the value of the collateral and document provided by the applicant. However, smallholder maize farmers do not generally practice proper financial and production record keeping, which puts them at a disadvantage when required to present financial records. This finding is consistent with the study by Obidike (2011), where smallholder maize farmers were found to have limited access to finance due to limited collateral.

*“Accessing these funds is not easy. They ask you to bring too many documents” – (KD01F06)*

*“It is difficult for smallholder maize farmers to access finance as they often lack the required documents” – (Agricultural Development Project (ADP) Manager, Plateau).*

However, requests for collaterals and documents cannot be avoided as the finance providers require some form of security to guarantee repayment by smallholder maize farmers. Disappointedly, the majority of smallholder maize farmers in the study area do not keep proper financial records, thus creating a setback and reducing the number of smallholder maize farmers that can access finance to enhance their farming activities and technology adoption.

### **Affordability of finance**

From the participants' responses, it was noted that finance is available from the finance providers in the study area. However, there are associated costs such as interest rate

and processing costs associated with finance. In many instances, the smallholder maize farmers' ability to access finance is conditioned by the affordability of the finance and a conviction that the finance will add value to the operation of their maize farm.

Further findings from this study indicate that the interest rates on finance provided by the government Bank of Agriculture and government-backed schemes are lower than the interest rates on finance obtained from the non-government sources. The government sources of finance provide finance to smallholder maize farmers at interest rates of between 6 - 12% per annum (p.a.) compared to the non-government sources, which vary between 21 - 30% p.a.

In instances where smallholder maize farmers were provided with input finance, such as hand planter, the interest repayable is calculated based on the value of the hand planter.

*"Our interest rates are favourable. Some of the schemes have interest rates of 6% p.a., while others have 8% p.a. However, no scheme goes beyond 12% p.a. What makes it cheaper is that the repayment rate is not compounded"- (Representative of finance provider, Bank of Agriculture).*

However, an overlooked but important factor that may have also contributed to the preference for finance from the government Bank of Agriculture by smallholder maize farmers could be the availability of their branches in the rural areas where smallholder maize farmers operate. Unlike other finance providers with few rural branches, the Bank of Agriculture has a network of 6 zonal offices with a total of 151 rural branches, among which 15 of these branches are specialised and dedicated to female smallholder farmers. Due to the proximity of the Bank of Agriculture to smallholder maize farmers, the farmers spend lesser time and money when visiting the bank to process their finance. Furthermore, in comparison to the commercial and microfinance banks, finance provided by the Bank of Agriculture is subsidised and requires minimal collateral and documentation.

*"The government funding is preferable because the collateral and documents they ask for is not as much as that of the private banks – (KDM01)"*

Having access to affordable finance assisted smallholder maize farmers in expanding the scope of their adoption of technology and other farming-related operations. While having competitive repayment interest rates can strengthen competitiveness among finance providers and provide great potential to agricultural financing.

### **Constraints to financing smallholder maize farmers**

Previous studies have identified that using technology in

smallholder maize cultivation is crucial for increased yield, enhanced production, and higher returns on investment (Senbet and Simbanegavi, 2017; United States Department of Agriculture, 2020). These technologies are often unaffordable to smallholder maize farmers because of their associated costs. Consequently, the availability of finance from the finance providers coupled with its accessibility and affordability by smallholder maize farmers is essential in adopting technology (Mohamed and Temu, 2008; Mori, 2018).

In this study, there are pointers to the availability of finance from the finance providers. However, some participants mentioned that they encountered one form of constraint in accessing finance. While some of these constraints apply to general agricultural financing, they also impede the financial capacity of the participant to adopt technology.

*"Accessing these funds is not easy at all." (KDF06)*

*"We (smallholder maize farmers) hardly get access to finance because of some stringent conditions attached to it." – (PLM04)*

*"It is sometimes difficult for the smallholder farmers to access it (finance) due to some reasons." (ADP Manager, Plateau)*

Following this, the authors asked the smallholder maize farmers, the ADP managers, and representatives of the finance providers probing questions to better understand the constraints to financing smallholder maize farmers. Three significant constraints were identified, which are (i) inadequacy of collateral and relevant documents; (ii) timeliness of disbursement; and (iii) misconception and diversion of the finance.

### ***Inadequate collateral and relevant documents***

The participants frequently mentioned the lack of adequate collateral and relevant documents as a constraint to accessing the finance needed for technology adoption. Being smallholders, the participants, in many instances, do not have collaterals of values as requested by the finance providers.

*"We hardly get access to finance because of the collateral requirements attached to it." (PLM04)*

*"The process of accessing them (finance) is too difficult. They tell us (smallholder maize farmers) to bring this and bring that, until the planting season has commenced and it's too late to plant." (PTM03)*

This finding is consistent with the outcome of the study by Kersting and Kilby (2016), where using the econometric regression model in assessing the disbursement of finance to smallholder farmers; they found that incomplete documentation was one of the factors that contribute to the delay in the disbursement of approved finance.

Although collaterals are not the primary determinant for approving finance, it is a security against repayment. The representative of the Bank of Agriculture noted that in the past when only guarantors were required instead of collaterals, the application processing period was shorter, and many smallholder maize farmers had easy access to the finance.

However, the unintended outcome of this process was that about 60% of the beneficiaries defaulted in their repayments (Okarie, 2004). By 2019, during the data collection of this study, finance providers in the study area were demanding collaterals with a value of at least 110% of the amount of finance requested by smallholder maize farmers.

The demand for collateral with a value greater than the value of the finance requested by the applicants was made to make provision for depreciation of the collateral and inflation in the economy. Should the farmer default in payment, the finance provider will be able to recover their investment from the disposal of the collateral.

Additionally, to assess the capacity of smallholder maize farmers in using and managing finance, documents such as production records and financial reports were requested by the finance providers. However, a majority of smallholder maize farmers do not keep these records.

*“Some of the farmers do not have the records of their farming activities. In some other cases, the collaterals are not valuable.” (Representative of finance provider, First Bank of Nigeria)*

*“Quite a number of smallholder maize farmers still don’t see agriculture as a business, so it makes it difficult for them to formally put their records together. This is a basis of analysis that we use to appraise them.” (Representative of finance provider, Lapo Microfinance Bank)*

*“Many of smallholder maize farmers do not have financial records and cannot provide collateral as required by regulation.” (Representative of finance provider, Bank of Agriculture)*

Hence, only smallholder maize farmers who could provide the required collaterals and documents, among which are the participants in this study, could benefit from the available finance, which they could use to facilitate technology adoption.

### **Timeliness of disbursement**

Next, the participants identified the time lag between the approval of finance and its disbursement as a constraint to their timely adoption of technology for the commencement of the planting season. In Nigeria, maize cultivation among the smallholder farmers is rain-fed; as such, any delay in the commencement of maize planting season will contribute to its low yield, poor production,

and low returns on investment which impacts the farmers’ ability to repay the finance obtained promptly. This is consistent with the finding of the study by Ndanitsa et al. (2021) on the effect of agricultural credit delivery on the income of arable farmers in the Niger area of Nigeria, where the late release of finance was identified as one of the constraints that impede effective credit delivery.

*“The timing of the disbursement is usually not right as it often comes late. When this happens, we (the farmers) do not have the privilege of obtaining hybrid seeds and engaging technologies for proper land preparation and other farming activities. Hence, we experience delays in commencing the planting season and run the risk of having reduced harvest.” (KDM02)*

On the other hand, the government Bank of Agriculture representative noted that issues relating to delay in the timely disbursement of finance were majorly attributed to the smallholder maize farmers’ late submission of applications for finance and submission of incomplete documents.

*“There are several levels to the finance approval processes – referral checks, farmer’s previous performance evaluation, committee recommendation, and board approval. This can take several weeks, especially in cases where more documentation is requested from the farmer” (Finance Provider, Bank of Agric. representative)*

This constraint can be associated with the smallholder maize farmers’ lack of relevant documents requested by the finance provider and represents the first cycle within the observed constraints.

### **Misconception and diversion of finance**

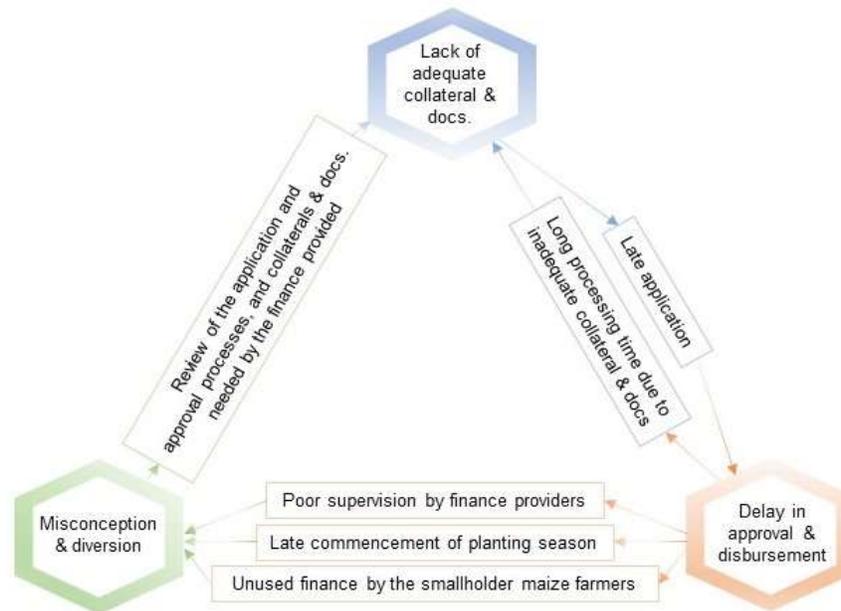
Interestingly, this study’s findings showed how the purpose of finance provided by the finance providers might have been misconstrued by smallholder maize farmers. The problem of misconception was associated mainly with finance from the government bank of Agriculture, which comes at lower rates and has a seemingly lenient operating structure.

Statements from some participants suggest that smallholder maize farmers often have a wrong conception about the finance and consider it as free funds.

*“. . . the finance from the government is very flexible. You can do anyhow. But you cannot try that with those other finance providers.” (PLM06)*

*“The money they give us is just a small portion of the government money. The government has plenty more money.” (NGM01)*

*“The finance is our share of the national cake. I can*



**Figure 2.** Major constraints to financing smallholder maize farmers  
Developed from field data, 2019.

*only pay it back when I can have the money.” (NGF03)*

During further discussions, the finance providers mentioned the diversion of finance by smallholder maize farmers as another constraint to financing smallholder maize farming. In the responses of the ADP managers and smallholder maize farmers, the diversion of finance was related to delays in the disbursement of approved finance.

*“The problem with delay in the release of finance to smallholder maize farmers is that they (smallholder maize farmers) end up using the finance for other purposes as agriculture is time-bound. If it comes late, the objective of the finance becomes defeated.” (ADP Manager, Kaduna)*

*“If the finance gets to us (smallholder maize farmers) late, like after the start of the planting season, we (smallholder maize farmers) end up using it for other purposes.” (NGF03)*

*“In situations where there is a delay in the finance supplied as inputs, some of the maize farmers can divert some of the inputs such as fertilizer, herbicide and pesticide, and sell them off in the open market.” (PLM04)*

Although the ADP managers acknowledge the existence of the issue of misconception and diversion of finance, their positions on the subject varied. The Kaduna state ADP manager mentioned that the finance provider's ineffective supervision of the beneficiary smallholder maize farmers could have contributed to the diversion of

finance. In contrast, the Plateau state ADP manager mentioned that some smallholder maize farmers might have received more finance than they needed, and hence, they would have some unused finance which they would have used for other purposes.

*“Providing finance for smallholder maize farmers is laudable. This should, however, be done with proper supervision.” (ADP Manager, Niger state)*

*“Seriously, one thing with money is that money is tempting. If they have the money they don't need, they can divert it into other things... such as adding another wife, or enjoyment.” (ADP Manager, Plateau state)*

The effects of misconception and diversion of finance, if not addressed, include the low level of technology adoption by smallholder maize farmers. To curb the scope of misconception and diversion of finance, the finance providers take steps to guarantee the commitment of smallholder maize farmers to repayment. One of such steps was reviewing the value of the security (collaterals and documents) requested from smallholder maize farmers.

In this study, the authors observed a systemic cycle within the highlighted constraints. The inability of smallholder maize farmer to provide adequate collateral and documents affected the processing time and caused an eventual delay in approval and disbursement of finance. At the same time, delayed disbursement contributed to the misconception and diversion of the finance (Figure 2).

From the perspective of the finance providers, some of

these perceived constraints were reactive effects of the measures put in place by finance providers to mitigate against repayment defaulting by smallholder maize farmers and ensure that the finance was used for the purpose of enhancing technology adoption in maize cultivation.

## Conclusion

Finance is crucial to technology adoption by smallholder maize farmers in Nigeria. In this study, the authors noted that finance was available in the study area, and they also identified three major constraints that impeded the effective financing of smallholder maize farmers. These are inadequate collateral, timeliness of disbursement, and misconception and diversion. These constraints can result in low maize yield, poor investment returns, and low income for smallholder maize farmers if not addressed. Based on their findings, they propose the following suggestions to enhance the accessibility and affordability of finance to improve smallholder maize farming activities and boost technology adoption by smallholder maize farmers. First, a majority of smallholder maize farmers in this study that adopted the technology at the recommended rate produced maize yield of  $\geq 4.2$  t/ha and were within the age of 21 – 40 years. As such, it is critical that future agricultural finance initiatives to enhance technology adoption for maize cultivation can target this age group, as this can contribute to technology adoption by smallholder maize farmers.

Secondly, finance providers should be encouraged to establish an enhanced mechanism to review the collaterals and documents requested from smallholder maize farmers. There has been a shift in the study area from obtaining finance based on guarantors to requesting for collaterals with a value of 110% of the finance requested. If the trend of increasing the value of the collateral requested continues, finance could be restricted from the majority of smallholder maize farmers who have limited assets that can serve as collateral. The suggested mechanism can include the provision of collateral by a third-party on behalf of smallholder maize farmer and the benchmarking of the amount of finance approved for each smallholder maize farmer to an amount that would not require collateral and is within the risk capacity of the finance provider. If implemented, such a mechanism as this has the potential to improve the access of finance to a larger number of smallholder maize farmers.

Thirdly, to address issues relating to the late application for finance by smallholder maize farmers, finance providers should create awareness about available finance schemes before the cultivation season. Timely awareness about available finance schemes and the procedure of accessing them can provide smallholder maize farmers with ample time to get the required

documents, submit their applications, and possibly access the finance early so as to enhance their farming activities and technology adoption. The finance providers' creation of awareness about available finance can be done in partnership with the ADP extension workers who have regular meetings with smallholder maize farmers. Finally, to address the constraint relating to the misconception and diversion of finance, finance providers can collaborate with the ADP extension workers to regularly evaluate the use of the disbursed finance by smallholder maize farmers. This will discourage smallholder maize farmers from using the finance for purposes other than maize farming. Another step to avert diversion can include the strategic release of finance to smallholder maize farmers according to the cultivation activity to be executed or direct payment by the finance providers to the input suppliers on behalf of smallholder maize farmers. Doing so can ensure that smallholder maize farmers get input and technology within their approved finance and reduce incidences of diversion of finance. If implemented, these suggestions can increase the accessibility and affordability of finance, improve technology adoption, and eliminate the diversion of finance, increase smallholder maize yield and production.

## Study limitation

There are a few limitations to the study. The geographical scope of the study in three states means that certain heterogeneous characteristics, such as social norms, could have been omitted. Moreover, the generalisation of the results obtained in this study and its implications could be limited because of the sampling method, which could favour the selection of smallholder maize farmers that have access to financing.

## Ethics statement

This study involved human subjects and was conducted in accordance with the Australian *National Statement on Ethical Conduct in Human Research*, with Human Research Ethics Application approval number 2019001234, and complies with the regulations governing experimentation on humans.

## CONFLICT OF INTERESTS

The authors have not declared any conflicts of interests.

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