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Empowering South African Smallholder Farmers: Integrating Climate Resilience into Credit Assessment

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Abstract: Agriculture, a sector vulnerable to climate change, relies heavily on debt to invest in modern technology for efficiency and increased production in the face of changing climatic conditions. Despite this, a large group of smallholder farmers in South Africa are excluded from accessing credit at commercial banks, yet they make up a significant proportion of the farming population. The current funding framework in South Africa encompasses the five Cs of credit with a complex view of climate risk. Therefore, this study aimed to propose a simple climate-inclusive credit approach tailored for smallholder farmers. Specifically, this study (1) profiled the respondents and identified the status quo of credit access at commercial banks of smallholder farmers and (2) assessed smallholder farmers' compliance with the determinants of the credit application outcome determined by commercial banks. This study used a semi-structured questionnaire to collect data from 223 smallholder farmers, who were interviewed through a referral system in two provinces. Descriptive statistics and a logistic regression model were used to analyse the data. The results reveal that the majority (71.75%) of farmers were female, with an average age of 49 years. This study also established that a substantive number of smallholder farmers operated in communal lands without a title deed, posing a challenge in accessing bank credit. The results from the logistic regression model show that the five Cs of credit were significant in determining the decision to apply for a credit facility at the bank. The model further showed a positive relationship between climate-resilient technologies/assets and credit accessibility. This study recommends the need for a simple climate-inclusive credit model that considers climate change so as to foster climate change resilience. This study suggests that banks look at the ownership of assets that promote climate resilience when it comes to assessing the credit applications of smallholder farmers.

Keywords: climate change; credit assessment; smallholder farmers; financial inclusion; risk management

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1. Introduction

South Africa is regarded as a country with water scarcity, highly unpredictable climatic conditions, and inadequate fertile land. A minor change in mean temperature and rainfall may magnify existing water issues; the challenge is thus for farmers to remain productive, contribute to food security, and minimise poverty levels at the household level [1]. Agriculture is, therefore, heavily reliant on debt to invest in modern technology to enhance efficiency

and increase production outcomes amidst changing climatic conditions [2]. However, a large group of smallholder farmers experience high constraints in obtaining credit from commercial banks yet predominantly rely on commercial banks for external capital [3].

Studies conducted in Pakistan and Asia highlighted that for smallholder farmers to grow into commercial or larger-producing farmers, access to credit is a necessity. Access to credit enables farmers to invest in the latest technologies, which enhance productivity and the quality of produce. However, access to credit from formal banks for smallholder farmers, when compared with larger farmers, has been limited for various reasons, such as collateral requirements and high borrowing costs. Studies have further emphasised that access to informal credit markets has also been highly restricted [4–6].

Amjad and Hasnu [4] conducted about 105 interviews to determine access to credit for smallholder farmers in two districts of Peshawar, Pakistan. The findings were that in a formal credit market, tenure status, literacy, and the quality of infrastructure, to mention a few, played a major role in credit provision; however, in informal credit markets, these attributes were not considered. On the other hand, Chandio et al. [5] conducted a study with 300 rural farmers in Sindh province, Pakistan, to determine the importance of collateral and cash flow in access to credit. The results highlighted that smallholder farmers in Sindh had limited access to formal credit; however, they underlined that attributes such as the farmers' age negatively affected farmers' access to credit, while gender, education, farming experience, farm size, collateral, and income positively affected access to credit [6]. A study conducted in Punjab, India, also shared the same sentiments regarding the Pakistani constraints on credit access [7].

There is a common trend between studies in both Asian countries and African countries. Researchers in credit accessibility acumen agree not only that access to credit facilities for smallholder farmers will enhance their adoption of new technologies that can better the quality and quantity of their produce but also that an improved income received could possibly alleviate poverty levels in rural populations [8]. A study conducted on 120 cassava smallholder farmers in the Niger state of Nigeria revealed that access to formal markets was determined by farm size and the farming experience of the potential borrower; characteristics such as the farmer's age and education level determined the amount of loan provided, and the lack of collateral was the major constraint on credit access [9]. Jerry and Ngozi [10] also added that the previous loan amount granted, interest, and repayment on the previous loan contributed to factors that resulted in credit provision.

The Strauss Commission [11] report highlighted that there is a vast number of agricultural opportunities the country's economy could benefit from by tapping into utilising the offering of smallholder farming. According to [11], "The provision of appropriate financial services in these areas should be one of the important mechanisms in a rural development strategy for unlocking development potential".

The Strauss Commission [11] found the following problems influencing access to rural financial services:

- The employed rural population is unorganised and thus lacks strength in having its voice heard at the national level.
- Although it is legally possible to provide immovables as collateral, this is one of the most difficult types of collateral to propose as a security.
- Accessibility to small loans is somewhat a constraint, as this is reliant on transactional history.
- Tenure is considered a credible security for credit lending; however, several rural farmers do not hold title deeds to their farmed land.
- Savings play a crucial role in capital retention, but rural farmers do not have access to savings institutions.

- There is a need for risk sharing for lenders to tap into this market, and this shall serve as an incentive to soften lenders that are reluctant to borrow from rural farmers.

The primary aim of the commission's report was to, therefore, address the provision of rural financial services through (1) the promotion of agricultural activity in the rural area; (2) the empowerment of disadvantaged individuals, particularly women, in rural areas; (3) financial services to be made available in rural areas; and (4) the restructuring of the agricultural sector to allow access to land to smallholder farmers.

Research on South African smallholder farmers' access to credit has highlighted various reasons for the lack of accessibility of credit for smallholder farmers [12–14]. Some of the constraints on funding smallholder farmers include a lack of collateral to support the requested facility; capital portion contribution; the cost of obtaining credit, which can be high; and factors related to the buyer. There have not been, however, studies in the South African context that have looked at developing a credit model that will accommodate smallholder farmers. A number of studies on South African smallholder farmers' access to credit have predominantly focused on how access to credit can enhance farmers' production and factors prohibiting access to finance. This study aims to assess factors affecting credit accessibility with an integration of climate change in credit assessment. It follows a line of identifying factors affecting credit access and provides a simpler integration of climate change into credit assessment.

2. Conceptual Framework: Climate Change Consideration in Credit Assessment

This section assesses factors leading to credit accessibility and the impacts of climate change on credit accessibility.

2.1. Factors Affecting Credit Accessibility

Credit accessibility is important in the development of any country's economy, and in emerging countries, it is even more crucial. Domeher and Abdulai [15] and Henning and Jordaan [16] highlighted that "credit makes investment capital available to the poor and, with the consequent improvement in their income levels, such poor households can accumulate their own capital to engage in employment, creating economic activities much to the benefit of the whole economy". The section below evaluates credit factors that may contribute to the approval or denial of credit from financial institutions.

2.1.1. Financial Position of Business

Financial institutions conduct a thorough assessment of the borrower's financial strength. Credit ratio analysis aids in determining whether businesses can fulfil financial obligations both in the long and short run. This analysis can be both qualitatively and quantitatively conducted. According to the Corporate Finance Institute (CFI) [17], quantitative credit analysis can be divided into four main categories, namely, profitability, leverage, coverage, and liquidity.

Profitability ratios measure the capability of a company to make profits relative to revenue. This shows lenders how much the business has grown from year to year and its ability to repay debt. The ratios, which are evaluated in this group, include earnings before interest, tax depreciation and amortisation (EBITDA) margin, gross profit margin, operating profit margin, and return on both assets and equity.

Leverage ratios assess the level of debt in the company. A higher ratio means that the company's assets are predominantly funded through debt, and lenders do not favour this situation, as the business is deemed riskier compared with those with a low ratio.

Coverage ratios include the interest cover ratio and the debt service cover ratio, to mention a few, where the higher the ratio, the greater the ability to repay debt or service interest on debt.

Liquidity ratios evaluate the conversion of assets into cash to repay current debt. The lower the ratio is, the more difficult it can be for a business to service outstanding debts. The ratios that financial institutions assess include working capital, current ratio, and quick ratio.

2.1.2. Repayment Ability

A lender needs assurance that the business generates enough to service the debt offered or required. A debt service cover ratio (DSCR) is thus a crucial ratio that lenders continually base credit decisions upon [18]. Lenders can often stress this ratio by (1) decreasing income while expenses remain the same, (2) increasing expenses while income remains the same, and or (3) decreasing income while expenses increase. The primary reason for stress-testing the DSCR is due to the uncertainties that businesses, especially small and medium enterprises, encounter.

2.1.3. Quality of Collateral

Land registration has been identified as a key component in enhancing economic growth within the small- and medium-business sectors, as it makes it easier to obtain credit for investment and the purchase of advanced machinery [19–21]. Domeher and Abdulai [15] argued that owning land can assist with the following:

- It reduces ownership uncertainty, which in turn provides confidence to lenders who have taken collateral over the land, as conflicts can be costly to the lender.
- It facilitates transactions related to land; according to MacGee [22], registered land enables businesses to receive low-cost credit in the form of lower interest rates.
- It lowers the time and financial costs involved in the verification of land ownership.

2.1.4. Background of Borrower

The primary characteristics of the borrower, such as age, education, personal wealth, and credit delinquencies, are taken into consideration when an application is received by the lender. According to Cole and Sokolyk [23], these attributes are perceived as follows.

Age: The older the borrower is and the more experienced they are within the industry of operation, the higher and the better the chances of loan approval. It is assumed that age comes with more creditworthiness, as the owner is viewed as wiser with a track record when compared with younger borrowers.

Education: It is believed that educated owners are well equipped for running a business; therefore, owners with tertiary qualifications are deemed as creditworthy compared with those with primary education.

Personal wealth: It examines the personal assets that an owner possesses. It is assumed that an owner with personal assets can meet financial commitments as she/he can use collateral owned as a means of security should a default occur.

Credit delinquencies: It looks at the owners' default on personal credit facilities; it is accepted that owners that have a history of defaulting on loan payments, are under debt counselling, or have declared bankruptcy are likely to default on a business level, which in turn results in the decline of the requested credit.

2.1.5. Diversification of Enterprise

There is a conception that the more diverse a farming entity is, the better it will be able to service its financial obligations from its creditors because when one enterprise

is not performing, the other can assist [24]. A study conducted by [2] showed that a farming business with three or more enterprises was more likely to be successful in its credit application than a single enterprise farming business. Therefore, diversification is viewed as risk mitigation for both the borrower and the lender.

2.2. Climate Change and Credit Accessibility

The United Nations [25] described climate change as a shift in temperatures and weather patterns in the long run. This shift can naturally occur due to the sun's activity; however, human activities have been the main driver of climate change. Climate change, therefore, poses a global challenge to global socioeconomic and financial systems. Primary agriculture's uncertainty originates mainly from production uncertainty, where unpredictable climate conditions have impacts on produce quality and quantity. Farmers are faced with the challenges of adjusting their farming practices to weather changes so as to remain economically relevant through maintaining productivity and profit margins. Adapting to climate change involves the acquisition of new technologies that aid in sustainable farming; this may, therefore, call for a financial resource that is not readily available for smallholder farmers [26].

Oguntuase [27] examined the complex connections among climate change, credit risk, and the stability of financial systems. The article highlighted climate-related risks—both physical, such as extreme weather events, and transitional, like policy shifts toward a low-carbon economy—that can negatively affect borrowers' creditworthiness. These risks may lead to increased default rates and asset devaluation, thus threatening financial stability. This, therefore, emphasises the importance of integrating climate-related risks into credit risk assessments and corporate risk management strategies to mitigate potential disruptions in financial systems.

Lenders offering loans to agricultural businesses need to take into consideration the influence of climate change on the farmer's repayment ability. This includes the consideration of crop failure and reduced market demand for the produced goods. Credit provides farmers with the financial flexibility to mitigate risks, even out income fluctuations, and invest in post-drought recovery programmes. Additionally, credit plays a crucial role in enabling farmers to invest in drought-resistant technologies, such as water-saving irrigation systems and drought-tolerant crops, which can reduce their vulnerability to water scarcity. It is, therefore, important that financial institutions offer tailored financial products and policies that cater specifically to the needs of smallholder farmers, as well as the role of institutional support in ensuring that credit reaches the most vulnerable populations. This timely credit is important in building climate change resilience in farmers and can significantly improve the ability of farmers to cope with and recover from drought conditions [28].

According to Batung et al. [29], the effects of climate change have resulted in agriculture becoming a high-climatic-risk activity, where smallholder farmers remain vulnerable due to reliance on rain-fed farming. Banking institutions play a vital role in addressing climate change through the lending products offered to their client. Lenders are to consider climate risk change in credit assessment at all stages of the credit lifecycle. This can be performed by reassessing the markets, segments, and clients that the banks choose to service. Deloitte [30], Thalakotunna [31], and Experian [32] highlighted that there are seven credit risk stages where climate risk can have an impact and banks, without making provision of credit an onerous process, can take this into consideration. The stages are the following:

- Strategy and products: Banks should develop products that promote environmental sustainability; these products include green lending, which focuses on energy efficiency.
- Prospect and origination: Banks thoroughly inspect businesses before getting into a relationship through Know Your Client (KYC) methods. This due diligence helps determine whether the potential borrower's business does not put biodiversity at risk. This further helps determine the risk the lender can take on the client.

- Underwriting and approval: Developed banks hire specialists with scientific backgrounds to assess their potential client's decarbonisation progress and future plans, which enables the bank to know the client's risk profile given the climatic response.
- Collateral management and hedging: Banks conduct stress test measures to determine damages to tangible assets in response to climate change.
- Portfolio monitoring and management: Banks perform ongoing relationship management to better understand the economic impacts that climatic shock can have on the credit worthiness of their clients. These include extreme weather events that can impact crop yield efficiency and income realised.
- Default management: Banks assess the impact of climate on loss realisation.
- Reporting and disclosures: Comprehensive disclosures are required by banks concerning climate-related risks and opportunities by regulators and investors.

Figure 1 depicts a conceptual framework illustrating the embedding of climate change into factors affecting credit access for smallholder farmers. The first C of credit is character, which looks into the farmer's personal attributes, and climate change can also be included by assessing the assessing farmer's commitment to Environmental, Social, and Governance (ESG). Capacity assesses the farmer's repayment ability, and banks do well to note if the client has diversified farming operations to help mitigate climate-related risk from one commodity to the other. Capital deals with the client's own contribution to requested finance and also the assessment of whether there are excess funds for climate adaptation measures. Collateral is the type of collateral that the farmer offers to the bank for the requested facility as security; banks can evaluate the collateral's resilience to climate change, and conditions are imposed by the bank when approving a credit facility. This can include taking up crop insurance for risk mitigation purposes.

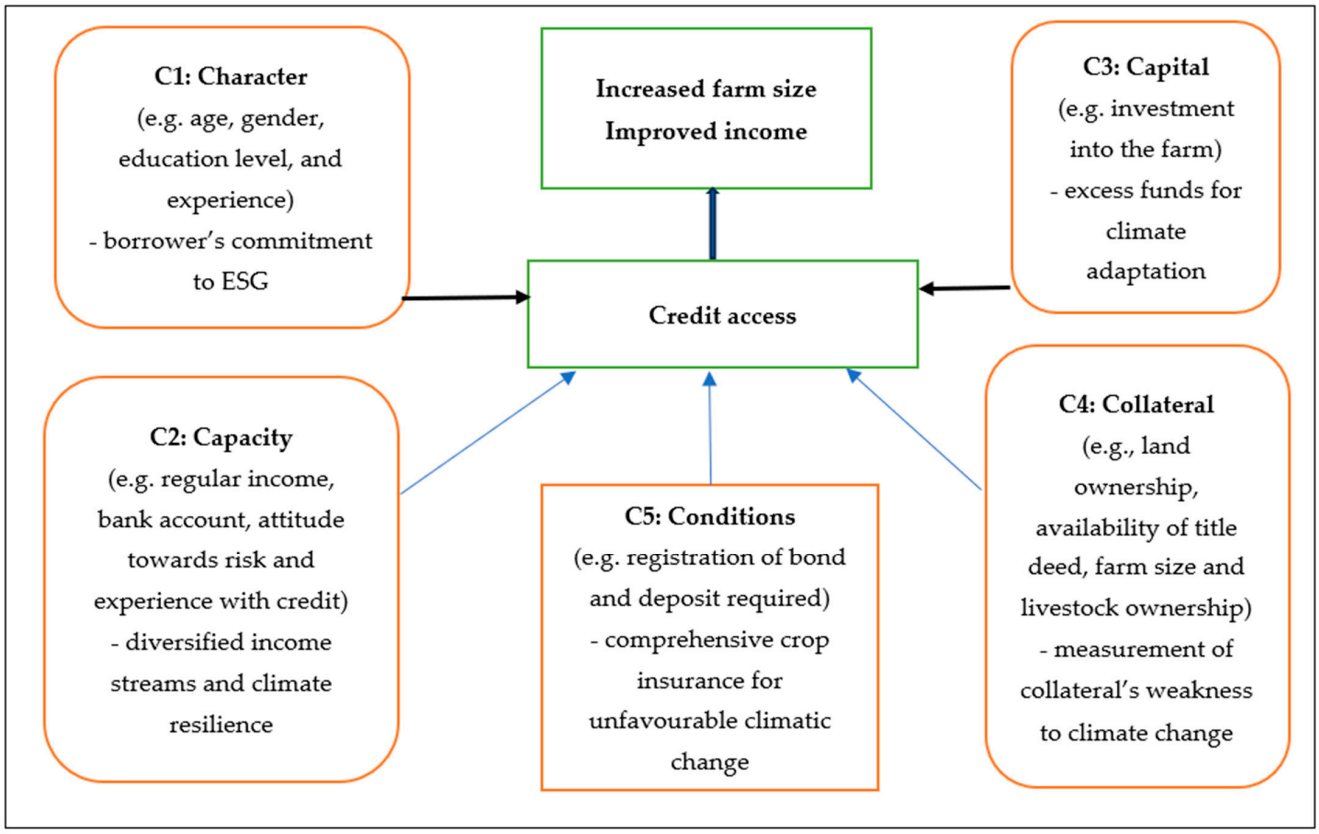

Figure 1. Conceptual framework illustrating the embedding of climate change into factors affecting credit access for smallholder farmers. Source: Compiled by the authors.

3. Research Methodology

3.1. Research Design and Rationale

A research design is a blueprint of a research study, showing ways in which the whole research process is conducted to achieve the stated objectives [33]. With respect to this study, the objectives were stated as follows: (1) describe the demographics and socioeconomic characteristics of farmers and (2) evaluate the factors affecting credit access and (3) the factors that should be considered by banks when performing credit assessment on applications. Due to the nature of the study objectives, a descriptive research approach was adopted [34]. In addition, the data for this study were collected at a single point in time. As such, the study is categorised as cross-sectional.

3.2. Description of Study Areas

This research study was conducted in two provinces of South Africa, namely, Mpumalanga and KwaZulu Natal. These two provinces were selected due to their significant contributions to the agricultural sector. These provinces rank third and fourth on households involved in agricultural activities in the country [35], and diverse agricultural activities are practised in these provinces. Details on each province are reported below.

3.2.1. KwaZulu Natal

KwaZulu Natal is the second most populous province in South Africa, after Gauteng, with a population of over 11 million. Approximately, 18.2% of the households in the province are actively involved in agriculture [35]. Spanning an area of 94,361 km^2, KwaZulu Natal contributes about 16% to the country's gross domestic product (GDP), making it the second-largest economy in South Africa [36]. The province boasts diverse agricultural activities, with sugarcane being among the largest in the country; yet, there is an enormous potential for agricultural expansion, which, if fully utilised, could drastically increase yields [36].

3.2.2. Mpumalanga

Mpumalanga province, although the second smallest in South Africa after Gauteng, is the fourth-largest economy in the country. According to the Mpumalanga Government [37], the area size of the province is 76,495 km^2, with a total population of over 4 million. The Mpumalanga Economic Growth Agency (MEGA) [38] highlighted that the province is one of the country's' most productive and important agricultural regions, which also exports produce such as citrus and nuts. In addition, 28.1% of households in the province are involved in agricultural activities [35].

3.3. Sampling Procedure, Sample Size, and Data Collection Process

The target population of this study included farmers in Mpumalanga and KwaZulu Natal who were affiliated with the South African Farmers Development Association (SAFDA). As of 2017, the SAFDA had over 2500 members in KwaZulu Natal and Mpumalanga [39]. By using a 95% degree of precision, 5% marginal error, and 0.5 variance of the 2500 SAFDA members, the study was supposed to be conducted on a total of 334 participants; however, upon liaising with the SAFDA's Chief Operating Officer, the researchers were advised that due to the POPI Act, the SAFDA cannot share the database of its members; the researchers, therefore, relied on referrals from farmers who belonged to the SAFDA known to the researchers.

The scientific sampling method technique, which was used, is a non-probability snowballing technique. The disadvantages of the snowballing technique are that it is uncontrolled, and surveys conducted through the referral system have mostly similar

characteristics to those of the respondents. The tool is, however, a useful one in cases where access to the entire population size for random selection is not possible (in regards to this study, the SAFDA member list was unavailable) [40].

Telephonic interviews were conducted, during which a researcher read out the consent form to the participant and completed it. Interviews were conducted from August 2022 to April 2023. Due to referrals and time limitations, interviews were conducted with 223 consenting participants. Primary data were collected by using detailed copies of a structured questionnaire. The questionnaire was pre-tested on a small sample of participants to ensure its accuracy, appropriateness, and reliability. All data collection procedures adhered to the ethical guidelines, and the permission to conduct research was given by the North West University Ethics Committee.

3.4. Data Analysis

Upon primary data collection from smallholder farmers, the information was coded, cleaned, and stored in a Microsoft Excel 365 spreadsheet. Subsequently, the coded data were exported to SPSS, version 29, and STATA, version 18. This research study made use of commonly used regression models to assess credit application outcomes. The details of how the analytical tools were applied are provided below.

3.4.1. Content Analysis

Factor and content analyses were used to examine the respondents' reasoning for access to credit or lack thereof in commercial banks. This method is used to capture significant factors that contribute to access to finance [41].

3.4.2. Logistic Regression Model

This study used a logistic regression model to analyse the factors affecting credit access by smallholder farmers. Logistic regression is defined as a statistical model that uses a logistic function to model conditional probability. In credit risk modelling, this technique is used to determine the probability of the borrower defaulting on credit obligation. According to Khandelwal [42], the logistic regression model has the following assumptions: (1) the data set being analysed should not have outliers—this can be identified by analysing each independent variable; (2) there should be no correlation/multi-collinearity between the independent variables.

The probability of a smallholder applying for finance in a financial institution is expressed below:

$$\text{Probability of applying } (Y = 1) = F\,(\beta, X) \tag{1}$$

where β represents the impact of changes in X (independent variable) on the probability of the farmer borrowing from a commercial bank. According to Spio [43], a logit analysis, depicting the probability of applying for credit, can, therefore, be given as

$$\text{Probability of applying } (Y = 1) = \frac{e^{(\beta' X)}}{1 + e^{(\beta' X)}} \tag{2}$$

The probability of applying is

$$(Y = 1) = \frac{1}{1 + e^{(\beta' X)}} \tag{3}$$

By using Equation (3), a logistic cumulative distribution can be written as

$$\beta' X = \beta_0 + \sum \beta_i X_i = v_i \tag{4}$$

where e is the natural logarithm.

Table 1 presents a summary of the explanatory variables used in evaluating a decision to apply for credit or not to apply. The questionnaire used had four sections, which looked at attributes of the 5Cs of credit. Section A—Farmer's characteristics: This section was used to understand the farmer better, as it addressed things such as the farmer's age, level of education, and years of farming experience. The researchers further asked about the farmer's interest in progressing from smallholder to commercial farmer. Section B—Farm's attributes: This section aimed at evaluating farm ownership status, the size of the farm, the type of farming activities conducted on the farm, and the reasons for farming the commodity. For efficient farming, a farmer needs farming equipment and machinery; Section B, therefore, enquired about assets on the farm. Section C—Financial management: This research study focused on credit accessibility; therefore, understanding the financial position of the participants played a significant role in addressing some of the objectives. Section D—Loan features: For the researchers to conclude if smallholder farmers had credit access or not, section D was one of the important parts of the questionnaire, and the questions focused on (1) access to banking, (2) information on the requested loan, (3) the credit history of the applicant, (4) collateral information, and (5) challenges.

Table 1, therefore, presents the chosen variables that aid in farmers' decisions in credit application, specifying the measurement type and outlining the theoretical relationship between these variables and the dependent variable studied. It was expected that an increase in farmers' age corresponded to a decrease in the likelihood of making the decision to apply for credit. Studies show that male participants are likely to apply for credit. It was expected that an increase in farming experience, education level, and years of banking had a positive relationship with the decision to apply for credit. A badly conducted account and history of default on debt were expected to decrease the likelihood of access to credit. Ownership of land with a valid title deed and an increase in the size of the unit of this land were expected to increase the chances of applying for credit. An increase in the amount applied for and a longer repayment term were expected to decrease the chances of applying for debt because a higher loan and a longer term increase the odds of default. Farm income, assets value, and the presence of financial records (cash flow projections, and solvency and profitability financial information) were expected to increase the likelihood of applying for credit. Climate change resilience assets were expected to have a positive relation with credit access.

Table 1. Explanatory variables used in factors leading to decision to apply for credit.

Variable Name	Type of Measurement	Prior Expectations
Decision to apply for credit	Dependent variable (applied = 1/not applied = 0), binary	
Farmer's age	Actual number in years (continuous)	−
Gender	Gender of farmer (female = 0; male = 1) (dummy)	+
Education	Level of education (high school and lower = 0; post-high school = 1) (dummy)	+
Farming experience	Actual number in years (continuous)	+
Account standing	Conduct of business bank account (0 = bad; 1 = good) (dummy)	+/−
Years banking	Number of years of business account (continuous)	+/−

Table 1. *Cont.*

Variable Name	Type of Measurement	Prior Expectations
No. of times applied	Number of times farmer applied for credit (categorical)	−
Default	If farmer has defaulted on debt or not (Yes = 1; No = 0) (dummy)	−
Size of farm	Actual farm size in hectares (continuous)	+
Farm ownership status	Measured farm ownership (0 = not owned; 1 = owned; 2 = leased) (categorical)	+
Amount applied for	Actual loan amount applied for in ZAR (continuous)	−
Purpose of loan	Reason for loan (0 = short term; 1 = long term; 2 = not applied) (categorical)	+/−
Repayment period	Actual number in months (continuous)	−
Collateral	Presence of collateral (0 = no; 1 = yes) (continuous)	+
Farm income	Actual turnover in 2022/23 production season in ZAR (continuous)	+
Farm asset value	Market value of moveable assets in ZAR (continuous)	+
Cash flow, solvency, and profitability	If the farmer has cash flow, business is profitable and solvent	+
Climate resilience	Presence of climatic resilience assets (yes = 1; no = 1) (dummy)	+

+/− represents the direction of influence (either positive or negative). Source: authors, 2024.

4. Results and Discussion

This section presents the results of the present study. The results are divided into two main subsections, namely, Section 4.1, which includes descriptive statistics, and Section 4.2, which covers empirical results.

4.1. The 5Cs of Credit for Smallholder Farmers

This section presents the results of the descriptive statistics. The descriptive results are presented as the five Cs of credit assessment, namely, character, capacity, capital, collateral, and conditions.

4.1.1. Farmers' Characteristics

The character or background of farmers is important. The primary characteristics of the borrower, such as age, education, personal wealth, and credit delinquencies, are taken into consideration when an application is received by the lender. According to [23], these attributes are perceived as follows: older borrowers are likely to have access to credit, as it is assumed that age comes with worthiness.

Table 2 presents the mean value for variables measuring a farmer's characteristics. On average, the farmers were 49 years old, with 8 years of schooling and 18 years of farming experience. Farmers were predominantly women, as 71.75% of the sample population were females. The average farm size the farmers operated on was 11.15 ha.

Table 2. Farmer characteristics in KwaZulu Natal and Mpumalanga provinces, 2023 (n_f = 223).

Variables	**Frequency**		**Percentage**	
Farmer's gender	0 = 160; 1 = 63		0 = 71.7%; 1 = 28.3%	
	Mean	**Std. Dev**	**Max**	**Min**
Farmer's age	49.05	12.66	70	19
Years of formal schooling	8.17	3.49	0	15
Years of farming experience	18.43	11.87	1	52
Farm size	11.15	43.43	0.9	451.5
Credit history for smallholder farmers—How is the business account conducted? (%)				
Bad, with unpaid debit orders		1.8		
Good, with no unpaid debit orders		22.0		
Not applicable, no business account		76.2		
Ever defaulted on account? (%)		**Ever been blacklisted? (%)**		
Yes	No	Yes	No	
1.8	98.2	2.2	97.8	
If blacklisted, has debt been cleared? (%)				
Yes/not applicable	99.6			
No	0.4			

Source: Survey, 2023, generated with SPSS.

Credit history is one of the most important background checks considered when an applicant seeks debt in a financial institution. The credit checks include understanding how the current account is conducted, if the farmer has defaulted on previous debt, if the client is blacklisted, and if debt from the listing has been cleared. An account with more than three dishonoured debit orders can raise alarming concerns in a creditor, unless it was arranged with a bank and prior authorisation had been granted for the account to be overdrawn. A default is listed under a debtor if the account has not been settled within a certain period. The account is then in default, where a financier can try to get the debtor to settle the debt, and failure to settle the default subsequently leads to the debtor being blacklisted. Table 2 above shows that 76.2% of the participants did not have a business account; therefore, account conduct on those participants was not determined. The remaining 23.8% had business accounts, where 1.8% had bad conduct on their accounts, had had a default, and were blacklisted and 0.4% had not cleared debt.

Smallholder farmers are vulnerable to climatic changes, as they rely primarily on rain for their produce; it is, therefore, of concern that according to Figure 2, only 6% had irrigation means. Irrigation systems and water tanks aid in water management during drought seasons, and fences and chicken houses protect the farmer's crops from harsh weather conditions, while tractors and implements enable efficiency and increase produce quality. It is evident from the statistics of this research study that the ownership of climate-resilient assets was low; however, access to finance can increase the adoption of these technologies, thus emphasising the importance of credit inclusion of smallholder farmers.

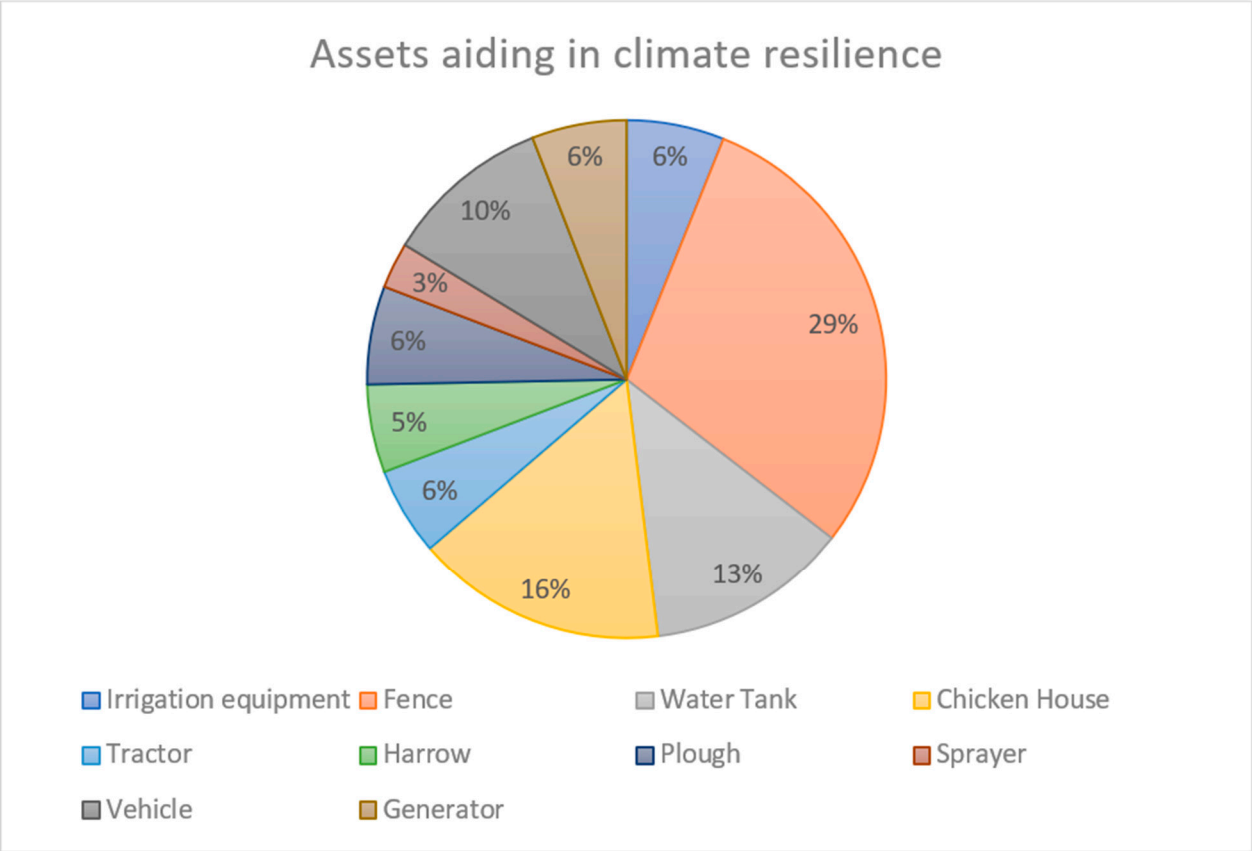

Figure 2. Assets associated with climate change resilience.

4.1.2. Assessing Farmers' Repayment Capacity

In order to understand farmers' repayment capacity, financial statements are required to assess the affordability of the requested debt. By law, banks are not allowed to lend funds to individuals and/or companies that are insolvent and unprofitable. Table 3 shows that only 5.8% of farmers had financial statements that were prepared by the bookkeeper and 2.7% had discussions with the bookkeeper to better understand the final information presented. Other farmers had other means of financial management; therefore, taking that into consideration, 21.5% of the financial statements showed profitability, and 16.1% showed solvency.

Table 3. Financial management in 2021/2022 for smallholder farmers, 2023 (n_f = 223).

Financial Management	Understanding of Financial Standing of Farm (%)	
	Yes	Bookkeeper
Do you have bookkeeper-prepared financial statements?	5.8	-
Method of day-to-day financial management	-	5.8
Do you discuss the prepared financial statements?	2.7	-
Financial statements show profitability	21.5	-
Financial statements show solvent position	16.1	-

Table 3. *Cont.*

Financial Management	Understanding of Financial Standing of Farm (%)		
	Yes	Bookkeeper	
Lack of financial statements in 2021/2022 for smallholder farmers			
If no bookkeeper prepared the financial statements, how are farm finances managed?	**Method of day-to-day financial management (%)**		
No financial management	39.5		
Book to capture debtors	39.5		
Excel template for record keeping of all transactions	15.2		
Cash flow analysis in 2021/2022 for smallholder farmers			
Cash flow projection	**Percentage (%) of cash flow construction**		
	Yes	**Bookkeeper**	**Extensionist**
Do you construct your own cash flow projections?	4.0	-	-
Who assists with cash flow projections?	-	0.4	3.6
Do you discuss the drafted cash flow projections?	-	-	3.6

Source: Survey, 2023.

The above table further shows how 94.2% of farmers who did not have prepared financial statements managed the day-to-day financial activity of farming operation. In total, 39.5% of the farmers did not have any form of financial management, as they did not sell their produce. Then, 39.5% had a book where they kept records of debtors. The remaining 15.2% used an Excel template for the record keeping of all the farming transactions.

Cash flow projections help banks to see how the granting of debt can improve farming operation through cash inflows and outflows. Table 3 additionally shows that only 4.0% of farmers constructed their own cash flow, 0.4% were assisted by bookkeepers, and 3.6% were assisted by extensionists. It is concerning that only 8.0% of farmers knew and understood the importance of having cash flow projections when approaching a financial institution for a credit facility.

4.1.3. Farmers' Capital Resource

Capital contribution can be a monetary deposit or an asset the borrower puts on the table for the required credit facility. According to Cole and Sokolyk [23], personal wealth speaks of personal assets that an owner possesses. It is assumed that an owner with personal assets can meet financial commitments, as she/he can use collateral owned as a means of security should a default occur. However, a study by [44] highlighted capital contribution as one of the barriers to credit inclusion for smallholders. Table 4 shows that the majority of farmers (95.1%) did not own land which could be provided as collateral.

Table 4. Collateral and its quality, 2023 (n_f = 223).

Ownership of Land on Which Farming Operation Is Conducted				
Owned land (%)		Leased land (%)	Communal land (%)	
3.1		1.8	95.1	
Presence of Tangible Collateral (%)		**Tangible Collateral Type (%)**		
Yes	No	Not applicable	Bond	Investment
4.0	96.0	96.0	2.2	1.8

Table 4. *Cont.*

Ownership of Land on Which Farming Operation Is Conducted							
Was quality accepted? (%)		**Importance of collateral when applying for debt * (%)**					
Yes	No	0	1	2	3	4	5
4.0	96.0	72.2	-	0.9	-	2.7	24.2

Notes: * 0 = not applicable, 1 = not at all, 2 = slightly, 3 = somewhat, 4 = quite, 5 = extremely. Source: Survey, 2023. (-) in the table means 0 as there was 0 respondents that choose 1 as a response on the question regarding importance of collateral when applying for credit.

4.1.4. Farmers' Collateral Security in Lending

Capital and/or collateral is one of the stated barriers to participation in the credit market through the main commercial banks in the country. Table 4 shows that out of the 223 participants, 95.1% of the farmers did not own the land but operated on communal land where a title deed was not available. Also, 3.1% of farmers operated on owned land, which was predominantly land received from land redistribution. A total of 1.8% of the farmers operated on long-term-leased land with signed lease agreements between the farmer tenant and land owners, which mainly regards land owned by the Department of Agriculture.

When asked if the farmers had tangible collateral when applying for debt, 4.0% had collateral, where 2.2% of this was a title deed so that a bond could be registered, and 1.8% had cash investment to offer to the bank as collateral, where this collateral was accepted by the bank for the requested credit facility. Lastly, when asked about the importance of collateral when needing debt, 24.2% said collateral was extremely important.

4.1.5. Conditions for Credit Approval

Once a credit facility is approved, the bank advises the applicant of the conditions of the approval. Here, 0.9% of the participants were granted unsecured credit facility, 2.7% required a bond to be registered over a farming property, and 2.2% did not have conditions, as the approached bank already had a security registered over the property (see Figure 3).

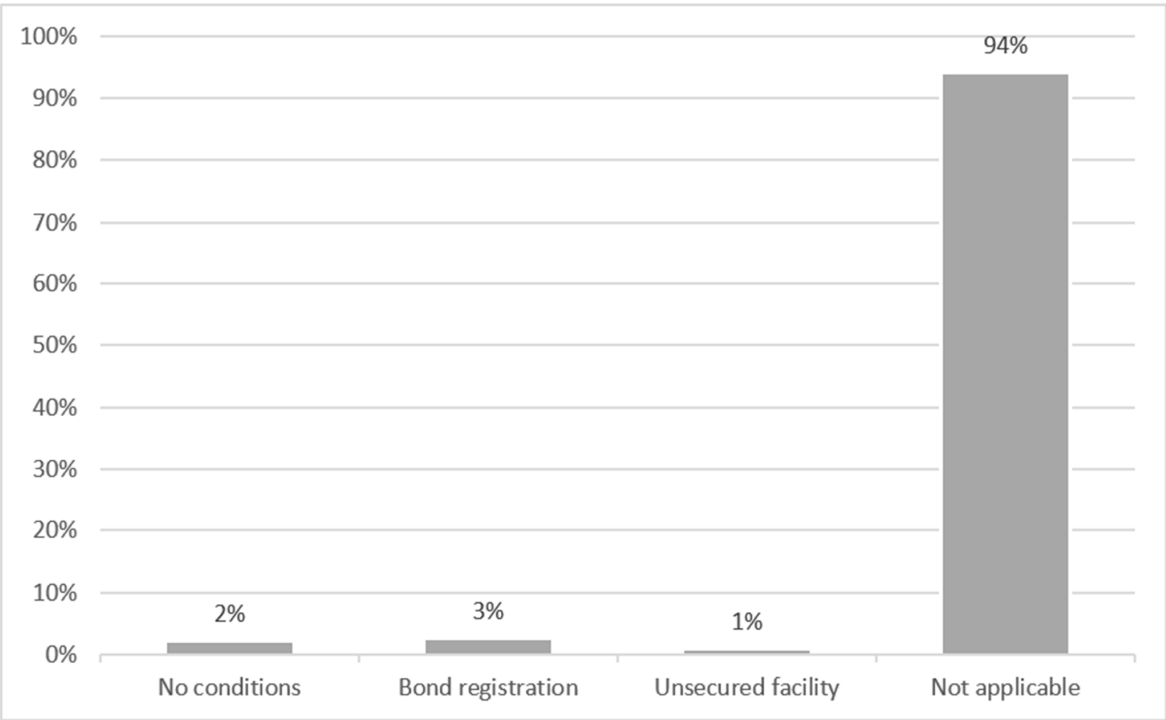

Figure 3. Conditions for credit approvals. Source: Survey, 2023.

4.2. Factors Affecting Credit Access by Smallholder Farmers

A logistic regression model was used to analyse potential variables that a smallholder farmer considers when making a decision to approach a commercial bank for a credit facility. Table 5 shows the variables which were tested, grouped into five categories: (1) personal attributes of a farmer, (2) credit background, (3) farm attributes, (4) loan attributes, (5) financial aspect, and (6) climate resilience. The models were all statistically significant; however, the personal attributes, climate resilience, and farm attributes models demonstrated a low fit, as the R^2 were 0.1324, 0.1588, and 0.2071, respectively. The overall models of credit background, loan features, and financial attributes had satisfactory fits of 0.3710, 0.4563, and 0.3376, respectively.

In the analysis of personal attributes, this study examined factors such as farmers' age, gender, education level, and farming experience. Farmers' age was found to be statistically significant at the 5% level. The results indicate that the odds of a successful application decreased by 3% with each increase in farmer's age (since 0.97 is less than 1). This suggests that age plays a critical role in credit assessment, as banks tend to favour applicants who are neither too young nor too old, ensuring they are capable of repaying debt.

Farming has traditionally been a male-dominated sector; thus, results show that male farmers are more likely to make a decision to apply for credit; this is in line with the findings of [45], which highlighted that females are less likely to obtain credit. This constraint is one of the reasons why South Africa and other African countries have implemented women empowerment initiatives to support women in agriculture.

The results show that having post-high school qualifications was associated with more than 12 times the odds of making a decision to apply for credit. This is because persons with higher qualifications are said to be less likely to default on loan repayment; post-high school education is thus statistically significant at 1%, and the results are in line with those of [5].

Farming experience was not statistically significant at 1% and 5%; however, the *p*-value of 0.13 for the farming experience range of 10–14 years is close to 10%, thus supporting the results of [46] indicating that experience is associated with no defaults, thus resulting in credit access.

The credit background is typically more accurate when sourced from external organisations like Experian, which maintain the applicant's historical credit history. However, in this study, the researchers relied on the farmers' responses and assessed the conduct of their bank accounts. Specifically, account conduct was assessed to determine if the bank account was managed responsibly, with no unpaid debit orders or unauthorised overdrawn accounts. This variable was found to be significant at the 1% level. Bad account conduct was strongly associated with defaulting on debt; therefore, the odds of accessing credit decreased by over 83% for a poorly conducted bank account. The results are aligned with those of [46], which highlighted that a bad credit record, a history of defaults, and bad account conduct are contributors to an automatic credit application refusal.

The frequency with which the farmer has previously applied for credit, as well as the number of years the farmer has held a business bank account, was not found to be significant in determining whether the farmer would apply for credit. This is in contradiction with the results of [46], which highlighted that the longer the business has been operating with a bank account, the less likely it is to default on credit. Additionally, the question of whether the farmer had ever defaulted on credit was omitted from the model, as it determined a perfect failure to apply for credit.

The size of the farm was found to be statistically significant at the 1% level, indicating that an increase in farm size (in hectares) increased the odds of having credit access by 1.2 times. In addition, farm ownership was significant at the 10% level, showing that not

owning a farm decreased the odds of credit access by 41%. These results are in line with those of [47].

Table 5. Factors considered for credit application/accessibility.

	Odds Ratio	Standard Error	*p*-Value
Personal Attributes (Prob > Chi2 = 0.00; Pseudo R^2 = 0.1324)			
Age	0.970	0.014	0.04 **
Gender	2.314	0.803	0.02 **
Education level	12.685	10.511	0.00 *
Farming experience	2.828	1.944	0.13 ***
Credit Background (Prob > Chi2 = 0.00; Pseudo R^2 = 0.3710)			
Account standing	0.017	0.009	0.000 *
Years of banking account	0.427	0.352	0.302
Number of times applied	0.541	0.468	0.477
Farm attributes (Prob > Chi2 = 0.00; Pseudo R^2 = 0.2071)			
Size of farm	1.234	0.699	0.000 *
Farm ownership	0.587	0.166	0.062 ***
Loan features (Prob > Chi2 = 0.00; Pseudo R^2 = 0.4563)			
Amount requested	1.000	6.42×10^{-7}	0.042 **
Purpose of loan	0.082	0.073	0.005 *
Repayment period	0.993	0.020	0.704
Financial information (Prob > Chi2 = 0.00; Pseudo R^2 = 0.3376)			
Farm income	1.000	3.54×10^{-6}	0.000 *
Farm asset	1.000	1.52×10^{-6}	0.062 ***
Climatic resilience (Prob. > Chi2 = 0.00; Pseudo R^2 = 0.1588)			
Irrigation	2.842	1.574	0.06 ***
Fence	0.351	0.150	0.02 **
Water tank	1.746	0.753	0.20
Chicken house	0.478	0.201	0.09 ***
Tractor	11.495	14.371	0.05 **
Harrow	5.824	5.625	0.07 ***
Plough	0.073	0.108	0.08 ***
Sprayer	0.464	0.375	0.34
Vehicle	3.395	1.469	0.01 *
Generator	1.567	0.102	0.39

Notes: *, **, and *** means significant at the 1%, 5%, and 10% levels, respectively. Source: Survey, (2023).

Farmer's climate change resilience was assessed and measured by having assets that help adapt to various changing climate conditions. The assets considered in the study were irrigation systems, fences, water tanks, chicken houses, farming equipment, tractors, vehicles, and generators. The expected results had a positive effect on the decision of applying for credit at a commercial bank. South Africa is viewed as a scarce country; therefore, investing in irrigation systems helps smallholder farmers save water in an area that is prone to having droughts and assists in improving crop yields [48]. The logistic

regression model showed significance at the level of 10%, with the odds of having access to credit increasing by 2.8 times. Water management is likely to enhance a farmer's credit access, as highlighted by [49].

Assets such as fences and chicken houses were expected to have a positive relationship with credit access, as fences can protect the covered land from erosion by serving as a barrier. Chicken houses help protect chickens from harsh weather conditions; in addition, a well-built chicken house can even serve as collateral to the bank when the borrower approaches the bank. These variables were significant at the 5% and 10% significance levels, respectively, showing that the odds of having access to finance decreased by 64.9% and 52.2%, respectively.

Water harvesting has been an area of interest for various researchers, and it was a surprise that having a water tank was statistically insignificant when determining the decision to apply for a credit facility. Assets such as tractors, farm implements, and vehicles further assisted farmers in being resilient to climatic change by improving planting efficiency and moving produce to the market sooner when affected by bad weather conditions. Teye and Quarshie [44] emphasised that access to credit enables farmers to invest in these technologies so as to improve productivity.

5. Conclusions and Recommendations

This study mainly assessed factors affecting credit access by smallholder farmers in two rural provinces of South Africa. Findings from the descriptive statistics showed that the farming population in these areas is ageing and less educated. The majority of farmers were female, which is in line with smallholder farmers globally. Additionally, the study found that these smallholder farmers operated mostly in communal lands where there were no title deeds. This made it difficult for farmers to approach banks for credit assistance, as there was no collateral. The lack of business accounts also played a major role in banks not being able to keep track of income for farm produce. Where farmers received assistance, this study found that a small percentage of farmers received finance for irrigation equipment, yet these farmers were vulnerable to climatic change. The results from the logistic regression model showed that the five Cs of credits were significant in determining the decision to apply for a credit facility at the bank. The model further showed a positive relationship between climate-resilient technologies/assets and credit accessibility. Currently, financial institutions have a complex seven-step climate change integration tool for credit assessment. It is recommended that these institutions design simplified means tailored to smallholder farming when assessing the climate change resilience of these farmers, that is, assessing the ownership of assets that aid climate change adaptation. These assets include those addressing means of water harvesting to assist with irrigation; in cases where there is water readily available, it should be assessed if farmers use water-saving irrigation methods. Fences were also identified as a means of protecting crops. Smallholder farmers have a less complex farming structure than large-scale farmers; therefore, the means of assessing credit should be different.

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