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# THE DETERMINANTS AND ACCEPTANCE OF CLIMATE SMART AGRICULTURE PRACTICES IN SOUTH AFRICA

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## ABSTRACT

Weather variations have posed enormous barriers to water resources, availability of food, human health, infrastructure, and natural environment. These phenomena underscore the need for climate smart practices in South Africa. The study examined in context, the socio-economic determinants, and acceptance of climate smart agriculture practices in Mzinti, Nkomazi Local Municipality South Africa. From a known population of 455 farmers, 212 samples were selected for the survey and considered realistic for the study. This survey comprised questions that were clear, unbiased, and relevant to the research questions. Enumerators were further briefed on the study objectives and the importance of consistent and ethical data collection. The team comprised of four primary data enumerators. A pilot survey with 20 randomly selected smallholder farmers was undertaken to identify and address any questionnaire that may be ambiguous. Based on this pilot, minor revisions were made to improve the questionnaire and ensure accurate reflection of intended variables, thus enhancing the reliability of the data collection instrument. A randomized sampling method was employed to select respondents who participated in the study. This allowed every participant to have a fair chance of being chosen. The study used the structured questionnaire, and the field survey was done between the month of April 2023 and July 2023. Descriptive statistics: frequency count, tables, and percentages, were used to explain the socio-economic determinants for acceptance of climate smart agriculture practices. The hypothesized variables were assessed using the binary logistic regression to determine the correlation between the socio-demographic characteristics and dependent variables. The result revealed that age ($p< 0.007$), crop yield ($p<0.001$), farm income ($p<0.047$) farm size (p<0.020, and food shortages (p<0.001) were correlated and statistically significant in determining the acceptance of climate smart agriculture practices. The study concluded that climate smart agriculture practices enhance farmer productivity, and it is influenced by factors such as age, farm size, and scarcity of food, crop yield, and farm income. The adoption of climate smart agriculture enables farmers to have increased crop yields, have access to food, increased income of the farm. Thus, it can be concluded that CSA practices effectively enhance the productivity of vegetable farming and food security.

**Key words**: Climate, acceptance, smart practices, determinants, environment, farmers, agriculture, education

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## INTRODUCTION

Africa is considered one of the continents with food insecurity primarily due to its reliance on agriculture for sustenance [1]. As a result, many governments emphasize the need to adapt to climate change and recognize agriculture's pivotal role in ensuring food security, employment opportunities, and overall wellbeing. It is increasingly clear that numerous African nations grappling with food insecurity are devising various strategies to address the issue [2]. Most (16.30%) households in South Africa are situated in rural areas, directly or indirectly relying on farming activities for their livelihoods. Smallholder farming is crucial for rural development and household stability in South Africa because it is a means of living for the famers [1].

Vegetable production holds significant importance in South Africa, providing fresh nutritious food and aiding rural communities. However, the nation's food security and vegetable production face challenges from increasing instances of extreme weather, water scarcity, and shifting climate patterns [1]. The concept of climate-smart agriculture is gaining traction as a potential solution to these issues [1]. The efficiency of agricultural systems in African countries is essential for their economic development. However, the rapid pace of climate change, with its global consequences, severely impacts these agricultural systems [3].

The impact of climate change and increasing food demand poses a threat to global food security. Small-scale farmers in developing countries face heightening challenges due to the impacts of climate change that undermine efforts towards sustainable development in many African nations [3]. With the adoption of the 2030 agenda for sustainable development, countries are taking climate action, including mitigating and adaptation strategies and actions to address the issue [1]. The potential of agriculture to lift millions of disadvantaged rural families out of poverty is in jeopardy. Small-scale farmers, lacking sufficient economic, technical, and political resources, are the most vulnerable group to climate change. Furthermore, without access to information, technology, markets, financing, institutional support, and decision-making opportunities, small-scale farmers are unable to address climate-related challenges effectively [4].

In this context, the introduction of the concept of Climate-Smart Agriculture (CSA) is of essence. Developed by the Food and Agricultural Organisation (FAO), climate-smart agriculture aims to establish the technical, policy, and financial frameworks necessary for sustainable agricultural development to ensure food security amid climate change [5]. It involves access to agricultural technologies such as resilient crop and livestock breeds, innovative water management techniques, and practices like agro-forestry, intercropping, diversified farming, crop rotation, integrated crop-livestock systems, mulching, and improved grazing aimed at enhancing soil carbon and water retention [6].

Climate-Smart Agriculture (CSA) is a coordinated approach aimed at addressing the various challenges encountered by agricultural systems [7]. The acceptance of CSA strategies results from local imperatives to address food security issues intensified by the realities of climate change [3]. The concept of CSA began to take shape around 2010 [8]. The initial definition of CSA adopted by FAO outlines three objectives related to landscapes and food systems: enhancing resilience to climate change at various scales (from farm to national level), promoting sustainable increase in agricultural productivity to support equitable income growth, and mitigating greenhouse gas emissions from agricultural activities across landscapes, livestock, and fishers [6].

Given the varying performance of different technologies across the objectives of CSA, they are often promoted as a package to optimize their advantage and enhance their synergy [9]. Farmers seldom accept entire technological bundles due to their specific needs and preferences; rather, they opt for individual technologies [9]. These technologies can be utilised independently or in conjunction with others. For example, farmers may choose to utilize manure, retain agricultural waste, or employ both practices. The effectiveness of these approaches directly impacts the well-being of farmers [1]. The impact of climate change on vegetable production is severe, leading to crop failures, reduced yields, diminished quality, and increased pest and diseases pressures. These changes render vegetable farming unprofitable and raise concerns about the availability of essential nutrients in the human diet [10]. Water shortages resulting from erratic rainfall patterns contribute to below-average crop yields, affecting both rain fed and irrigated vegetable production [11]. Drought, exacerbated by limited water availability, merges as the primary stressor for vegetable production, disrupting farming systems [7]. Over the next century, climate change is projected to be the leading cause of biodiversity loss, altering phenology, species distribution, and ecological interactions [7]. Climate variations adversely affect vegetable quality, leading to significant losses and compromising food safety during storage [12].

As a result, farmers experience decreased yields, high production costs, and reduced profits, leading to food insecurity and poverty. To address these challenges, there is a need for sustainable agricultural methods such as CSA, which can enhance vegetable farming while bolstering resilience to climate change [10]. Climate-smart agriculture aims to address these issues by promoting sustainable agricultural practices that reduce greenhouse gas emission, enhance climate change resilience, and improve food security [13]. The ongoing question of how effectively CSA policies can enhance vegetable farming among farmers [3]. Various factors including farmer's socio-demographic characteristics, limited availability and high cost of CSA inputs, and lack of awareness among farmers about the benefits of CSA methods, may hinder the effectiveness in enhancing vegetable production [14]. It, therefore, is of paramount importance to evaluate the efficacy of CSA in improving vegetable production and food security and identify any barriers to CSA acceptance. Hence, this paper aims to examine in context, the socio-economic determinants, and acceptance of climate smart agriculture practices in Mzinti, Nkomazi Local Municipality South Africa

## MATERIALS AND METHOD

### Study site

The study was carried out at Mzinti village as shown in figure 1 below, located in the east of Ehlanzeni District Municipality, which is situated between east of Mozambique and north of Swaziland, in the Mpumalanga province of South Africa [15]. The village occupies an area of 4 787km², and the main towns are Malelane, Marloth park, Komatipoort, and Louw's Creek [15]. The area comprises of 393 030 residents, whereby Africans are 97.70%, whites 1.60%, and the other race of the population takes a share of 0.40%. The dominant racial group is mainly dependent on agriculture and natural based activities for their livelihoods. This is evident as Nkomazi Local Municipality is known of its robust agricultural activities in the production of sugarcane, maize, cotton, mangoes, citrus, sugar beans, and vegetable crops such as cabbages, tomatoes, onions, spinach, sweet potatoes, butternuts and pumpkins, beetroot, lettuce and paprika (peppers) [16].

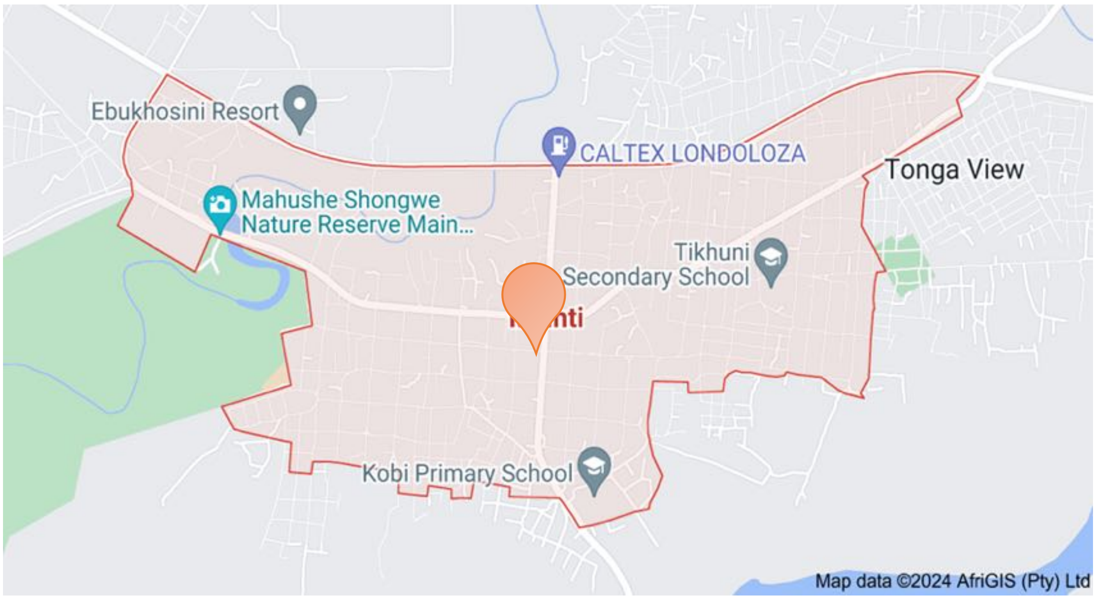


**Figure 1: Map of Mzinti, Nkomazi Local Municipality**

Source: World Atlas: Maps of Area around 25° 31' 56" S, 31° 31' 29" E. Available: http://www.maphill.com/atlas/25s30-31e30/ *Accessed 12 September 2023*

**Sampling method and sample size**

A random sampling method was employed to select participants who participated in the study. This allowed every participant to have a fair chance of being chosen. Smallholder farmers in Mzinti that are registered are 455 [17]. The sample size for this study consisted of 212 farmers, determined using the Slovin formula, thus n=N/(1+N (e )$^2$)) whereby n = anticipated sample size, N = the populace size, and e = margin of error (5%).

$$n = N/1+N(e)^2$$

$$= \frac{455}{1 + 455(0.05)^2}$$

$$=212.86$$

$$=212 \text{ farmers}$$

**Method of data collection**

To obtain primary data, structured questionnaires were utilized. This survey comprised questions that were clear, unbiased, and relevant to the research questions [18]. Enumerators, all possessing at least a secondary education level, underwent training in data collection procedures, ethics, and survey administration, completed within a day. The team, comprised of four primary data collectors, conducted a pilot survey with 20 randomly selected smallholder farmers to identify and address any questionnaire ambiguities or issues. Based on this pilot, minor revisions were made to improve question clarity and ensure accurate reflection of intended variables, thus enhancing the reliability of the data collection instrument.

**Data analysis**

The data gathered from the study area was analysed using the Statistical Package for the Social Sciences (SPSS) version 28.0, after undergoing data cleaning procedures to ensure data quality and consistency. Data cleaning included addressing missing values, handling outliers, and reconciling discrepancies in units of measurement. Subsequently, the cleaned data set was inputted into SPSS for statistical analysis. Categorical variables were converted into numerical ones for easier data entry. A detailed code book was created to document coding, coding schemes, variable definitions, and data sources, serving as a reference for the research and ensuring transparency and reproducibility of the study. To address the aim of the study and achieve the study's objective, binary logistic regression and descriptive statistics were employed. The binary logistic regression was used to determine the acceptance of smallholder farmers towards the use of climate smart agriculture and descriptive statistics were used to determine the socio-economic characteristics of the respondents in the study area.

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### The model of the study

The study utilized a logistic regression model, which is a statistical method for predicting the relationship between independent and dependent variables, with the dependent variable being binary. This model helps estimate the probability of events based on a set of independent variables hypothesized to influence an outcome. While the logistic regression categorizes individuals into groups based on predictor variables, it does not assume any specific distribution for these predictor variables, which can be continuous. Empirical studies commonly employ logistic regression to identify factors influencing smallholder farmers' acceptance decisions. Following the approach of Fullerton and Xu 2016, the dichotomous variable Y represents whether smallholder farmers accept climate-smart agriculture in vegetable production (equal to 1) or not (equal to 0). Table 1 outlines the predictor variables, their descriptions, measurements, and expected effects [19].

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \ldots + \beta 11X_{11}\mu.$$

Where:

Y = willingness to accept climate-smart agriculture strategies (farmers accept-1, 0=otherwise)

$X_1$ - $X_{11}$ = independent variables as shown below:

$X_1$= Age (years)

$X_2$ = Gender (Male = 1, Female = 2)

$X_3$= Marital status (Single=1, Married=2, Divorced=3, Widow=4, Widower=5)

$X_4$ = Educational level (No school =1, Primary school = 2, Secondary = 3, Tertiary = 4, ABET=5)

$X_5$ = Farming experience (years)

$X_6$ = Farm size (acres)

$X_7$ =Farming income (Rands)

$X_8$ = Source of water (Dam=1, Canal=2, Tap water=3, Borehole=4, other=5)

$X_9$ = experienced food shortage (Yes = 1, No= 2)

$X_{10}$ = Crop yield (Very high=1, High=2, Neutral=3, Low=4, Very low=5)

$X_{11}$= Impact of CSA on farm income (Very high=1, High=2, Neutral=3, Low=4, Very low=5)

$\beta 0$ = constant

$\beta_1$- $\beta_{11}$ = standardized partial regression coefficients of each explanatory variable

$\mu$ = error term

## RESULTS AND DISCUSSION

### Socio-demographic traits of smallholder farmers at the Study area

Contained in this section as presented in Table 2 are the socio-demographic traits of smallholder farmers at the study area. The findings of the study indicate that

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70.75% farmers were female farmers while the outstanding 29.25% were male farmers. This result implies that more females are engaged in farming activities as males tend to find jobs in other sectors of the South African economy. Having more females in the farming sector is a common feature in South Africa and highlights the gender disparities in the farming sector [20].

With respect to the age of farmers in the study area, 29.72% were between the ages of 41-50 years, while 21.23% were between 51-60 years. Farmers who were 61 years and above constituted 20.28% of the farmers at the study area, while those between the ages of 21-30 were 14.62%. Farmers who were between 31-40 years accounted for 14.15% of the study sample. The findings suggest that there is a lack of participation by the youth than the older farmers. The findings are supported by White [21], who posted that young people are not interested in agricultural activities since they consider that agriculture is for older people, which indicates that there is a need to encourage the youth in rural areas to participate in agricultural activities [21].

The marital statuses of the respondents in the study area (Table 1) shows that most (50.00%) of the respondents were single, while 36.30% were married, and (10.80%) were widowers. The other 2.40% were widows, and 0.50% were divorced. In sustainable agriculture it is very important to consider the marital status of the farmers because it specifies the necessity for farming in the household since most female headed families are dependent on agriculture [22]. Marital status is not a significant factor for climate smart agriculture acceptance [23]. On the distribution of the educational attainment level by farmers in the study area, the results show that 20,00% of the respondents had no formal education. Most of the respondents had a secondary level of education (46.70%), while 12.74% were educated up to a primary school level. Those who had tertiary education and ABET made up 11.32% and 8.96% respectively. This finding indicates that experienced and educated farmers have more access to information and knowledge on climate adaptation measures that helps in mitigating climate change effects. Employment and education are significant factors that influence the decision to adapt to climate-smart practices [24]. Moreover, Maddison [24], argues that exposure to the formal education system enhances the farmers' information processing abilities and improves the creativity of farmers.

Household size plays an important role in the acceptance of CSA practices. As a result, 48.10% of the respondents at the study area had 4-6 members while 28.30% had a household size of 7-9 members. The additional 15.10% of respondents were in household sizes of 1-3 members, while 6.10% of the respondents had 10-12 members and 2.40% of the respondents had more than 13 members in their household. The result implies that a sizeable number of households have sufficient household members as household size can also act as a labour supply that can be assigned to labour-intensive farm tasks. Hence, having more family members will make CSA acceptance easier, especially for labour-intensive practices [26].

Table 2 indicates the employment status of the respondents in the study area. The results indicate that 53.77% of the respondents are unemployed, while 29.25% of the respondents are employed, and only 16.98% were self-employed. Households that rely on farm income are more dedicated to farming than those who have further engagements in off-farm income sources activities [27]. Access to other sources of income may boost a household's capability to accept new behaviours or technologies since they may have better access to information and means to fund expenditures. However, work outside of farming may result in less time and effort being put into farming, which could result in a decrease in labour endowment and investments in the acceptance of new practices.

The farm experience of farmers in the study area shows that most (40.09%) of the respondents recorded more than 13 years farming experience (Table 1), while 20.28% had 7-9 years of experience. To add, farmers who had 10-12 years and 4-6 years of experience were 16.51% and 16.04% respectively. The lowest percentage was 7.08% which included farmers who had 1-3 years of farming experience. Farmers who have many years of farming experience have a better understanding of related information and can make enhanced quality decisions [28].

The distribution of farm size as presented in table 2 shows that 43.30% of the respondents had a farm size of between 1-3 acres. The result demonstrates that most (45.30%) of the respondents had 1-3 acres of land, while 36.80% of the respondents had 4-6 acres of land. Additionally, 9.00% of the respondents had 7-9 acres of land, and 5.70% had 10-12 acres of land. Only 3.30% of the respondents had more than 13 acres of land. The result indicates that most of the respondents have a small portion of land in the study area which implies that farm size has an impact on the decision to implement CSA methods. A study by Sithole [16], postulated that there is an increase in the likelihood that farmers will accept CSA practices if farm size increased.

The study findings on farming income (per annum) distribution among farmers in the study area as presented in Table 2, demonstrate that most (75.00%) of the farmers earn R1000-R3000 from selling their produce. Moreover, 16.50% of farmers had earned R4000-R6000 while 7.10% of farmers earned R7000-R9000 with 0.90% making R10000-R12000. The remaining 0.50% had a farm income over R13000. The findings indicate that most of the farmers have a low farm income which can limit their ability to spend on new technology or implement costly CSA practices. Therefore, as Pola [29] asserts that limited access to credit and low farm income is


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a factor that is affecting the acceptance of CSA practices and must be prioritised to promote sustainable agricultural practices.

**Challenges by farmers in using Climate Smart Agriculture**

The challenges faced by the respondents using CSA practices was investigated (table 3). The results are expressed as means and standard deviations. As indicated in the table, the challenge that was most cited by the respondents was insufficient financial resources to implement CSA (M=4.75; SD=0.523), lack of awareness and knowledge about CSA practices (M=4.54; SD=0.744), lack of technical skills and knowledge to implement CSA (M=4.53; SD=0.718) and limited access to climate information and forecast (M=4.26; SD=1.005). The challenge that was least cited was the institutional and policy barriers (M=3.55; SD=0.930). The results indicate that the major challenges in CSA acceptance among vegetable farmers were insufficient financial resources for CSA, lack of awareness and knowledge about CSA practices, lack of technical skills and knowledge, and limited access to climate information and forecasts. These findings support those of Alare [30], whose study showed that most farmers did not accept some practices because of financial constraints. The findings also stated that 20% of their respondents were having inadequate information about CSA practices. Farmers with financial constraints find it difficult to pay for labour, agricultural inputs, building boreholes, and building storage for their gravest and manure.

However, a study by Stoeva [31], on the challenges associated with the development of vegetable production in Bulgaria after the EU Enlargement, found that the most common challenge that vegetable farmers face is the inability of the farmers production to compete with other vegetable farmers from other countries, the insignificant financial support by the state, the relationship that is not effective between the market and the producers, lack of skilled and well trained labourers and also destroyed and outdated irrigation systems. The lack of cooperation and organisation between traders and producers, obstructs the access to market and decreases the effectiveness of the vegetable production that is marketed [31].

A study by Dinesh [3] found that female vegetable farmers are faced with difficulty accessing credit, which makes it very difficult for them to accept new technologies. As stated in the findings of this that that the least by vegetable farmers is institutional and policy barriers. In support of these results, a study by Pola [29], Stated that, for CSA implementation, low institutional capacity is a difficulty. The governmental policies and support that is misdirected is a barrier to the acceptance of CSA because their policies do not align with the environmental policies. Furthermore, the study stated that, another difficulty in accepting CSA is the language barrier that is used by scientists to disseminate information at the local level resulting in farmers not being completely aware of the benefits of CSA practices.


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Similarly, Ubisi [4], found that the lack of the following factors were extremely serious in terms of CSA practices: access to high-quality breed, access to improved crop varieties, access to education, access to credit, social interaction, cost of input, cost of labour, awareness of climate smart agricultural practices, time to practice climate smart agriculture, awareness of climate smart agricultural practices, demonstration of climate smart agricultural techniques, social interaction, and that of cost of input.

**The empirical findings of the study**

The study hypothesised that the socio-demographic factors of farmers do not affect the acceptance of climate-smart agriculture in improving food security among farmers. To test this hypothesis, the study utilized a logistic regression model, which is a statistical method for predicting the relationship between independent and dependent variables, with the dependent variable being binary. This model helps estimate the probability of events based on a set of independent variables hypothesized to influence an outcome. The examination of this model employed for the study gave the values of Nagelkerke *R* Square as 0.487, Cox & Snell R Square 0.361, which shows that the considered model fit the data at a suitable level as per Allison [32].

With reference to table 4, age was significant with a *P*-value = 0.007 and positively related to the acceptance of CSA with a coefficient of 0.855. This finding suggests that an increase in the age of smallholder farmers will result in the increase in the rate of acceptance of CSA, provided that all variables remain constant. A similar study by Onyeneke [33], on climate change and smallholder farmers in rice production in Ebonyi State, Nigeria, also found that age affects acceptance. Similarly, a study by Fernandez [34], about the local indicators of climate change: the contribution of local knowledge to climate research, suggested that farmers who are old, and who lived alone frequently desire to be independent and do things by themselves. This implies that such farmers are required to learn innovative technologies on their own and not rely on others.

Farm size was significant with a P-value of 0.020 (Table 3) and positively related to the decision to accept CSA practices with a coefficient of 0.702. This result suggests that for every unit increase in farm size, there is a 0.702 increase in the probability of acceptance of CSA provided that all variables are held constant. This result is consistent with Gailhard [35], who, in their study on acceptance of Agri-Environmental Measures by Organic Farmers, found that farmers who owned bigger farmland, adopted environmental measures put in place than farmers who had smaller farmland. Furthermore, a study on Climate smart agriculture practices in semi-arid Northern Ghana: Implications for sustainable livelihoods by Alare [30], indicates that the farm size is related to the acceptance of crop rotation practice suggesting that an increase in farm size increases the likelihood of the acceptance of CSA practices. A study by Morepje [36] also found that most smallholder farmers have access to enough farmland that can be utilised to test new technology and perform various activities.

The experience of food shortages over the past 12 months was found significant with a p-value of 0.001 and negatively associated with the acceptance of CSA practices with a coefficient of 1.680. The result in table 4 suggests that for every unit increase in food, there is a 1.680 decrease in the probability of acceptance of CSA provided that all variables remain constant. A similar study on acceptance of climate smart agriculture among female smallholder farmers in Malawi, also found that farmers experience food shortages, because food stored from the previous season depletes because of usage due to late rainfalls [32]. This results in high food insecurity, high expenditure on food and affects all in the household. Therefore, farmers accept CSA practices to increase their farm production and crop yields and deal with food insecurity. Additionally, a study by Lipper [37], on climate smart agriculture for food security, found that policy makers use CSA technology to mitigate the influence of climate change and shortage of food security.

The variable crop yield was significant with a p-value of 0.001 and positively related to the acceptance of CSA practices with a coefficient of 1.536. The study finding in table 3 suggests that for every unit increase in crop yield, there is a 1.536 increase in the probability of acceptance of CSA provided that all variables are held constant. This result is consistent with Van den berg [38], in the study on socio-economic factors affecting adoption of improved agricultural practices by small-scale farmers in South Africa, who found that a practice of crop management which results in increased crop yield, increases the likelihood of acceptance to improved crop production and protection practices. Additionally, a study by Branca [39], on a synthesis of empirical evidence of food security and mitigation benefits from improved crop land, established that farmers are accepting mulching practices because it increases the crop yield.

From the results presented in table 4, the variable farm income was found significant with a p-value of 0.047 and positively related to the decision to accept CSA practices with a coefficient of 0.683. This result suggests that an additional increase in the farm income of smallholder farmers will result in the increase in the rate of CSA acceptance, provided that all variables are held constant. This result agrees with Abegunde [26] who, in their study on the determinants of the acceptance of climate-smart agricultural practices by small-scale farming households, found that farm income was determined to derive the acceptance of CSA practices in a positive direction. It increases the ability of farmers to accept technologies or practices and has the advantage of exposure to new information. To successfully implement various agricultural practices or advances, farmers must be financially capable. To successfully mainstream CSA acceptance into the small-scale farming system, financial empowerment is essential [40].

## CONCLUSION AND RECOMMENDATIONS FOR DEVELOPMENT

The utilization of Climate-Smart Agriculture techniques in the research is primarily influenced by factors like age, farm size, food scarcity, crop yield, and farm income. These factors, whether positive or negative, significantly impact the acceptance of CSA practices. Thus, it can be concluded that CSA practices effectively enhance the productivity of vegetable farming and contribute to food security. Addressing barriers to CSA acceptance would enable farmers to reap the benefits of these practices, leading to improved crop yields, enhanced food security, and increased farm income.

Recommendations raised from the study's findings, which focused on assessing the efficacy of climate-smart agriculture and food security among vegetable farmers in Mzinti, South Africa. Conducting further research to pinpoint the cause of food insecurity among farmers who have accepted CSA practices will be valuable. Such research could shed light on the effectiveness of CSA practices in addressing food security and why vegetable farmers may be hesitant to accept them. Additionally, future studies on CSA technology acceptance rates should explore large-scale initiatives, providing insights into the perspectives of project organisations on the low acceptance rates among smallholder vegetable growers in Mpumalanga.

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### Conflict of interest
The authors declare no conflict of interests.

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**Table 1: Summary of independent variables hypothesized with their operational description, measurement, and expected signs**

| Variable and code | Operational description | Measurement unit | Expected sign |
|---|---|---|---|
| Gender (GND) | Male or female | 1= male 0 = female | +/- |
| Age (AGE) | Total years lived by participants | (20 – 30years) = 1, (31 – 40years) = 2, (41 – 50years) = 3, (51 – 60years) = 4, >61 = 5 | – |
| Educational level (EDUCL) | Educational level achieved | No school = 1, primary school = 2, secondary = 3, tertiary = 4, ABET=5 | + |
| Farming Experience (FRMEXP) | Number of years in farming | (< 4years) = 1, (5 – 10years) = 2, (11-14years) = 3, (15 – 20years) = 4 (> 20years) = 5 | + |
| Land size (LANSZ) | Size of arable land | (< 1ha) = 1, (1 -2ha) = 2, (3 – 4ha) = 3, (5 – 6ha) = 4, (> 6ha) = 5 | + |
| Farm ownership (FRMOWN) | Ownership of land by respondents | Leasehold = 1, family land = 2, communal land = 3, own land = 4 | + |
| Off-farm employment (OFFEMP) | Off-farm Employment status of the participant | Unemployed=1, employed=2 | +/- |
| Information on CSA (INFCSA) | Information about climate-smart agriculture practices | Poor=1, fair=2, good=3 | + |
| Extension access (EXTACES) | Household's access to extension services | 1 = yes, 0 = no | + |

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**Table 2: The distribution of farmers' socio-demographic traits**

| Socio-demographic traits | Variables | N=212 | Percentage (%) |
|---|---|---|---|
| Gender | Male | 62 | 29.25 |
| | Female | 150 | 70.75 |
| | Total | 212 | 100 |
| Age | 21-30 years | 31 | 14.62 |
| | 31-40 years | 30 | 14.15 |
| | 41-50 years | 63 | 29.72 |
| | 51-60 Ears | 45 | 21.23 |
| | ≥ 61 years | 43 | 20.28 |
| | Total | 212 | 100 |
| Marital status | Single | 106 | 50.00 |
| | Married | 77 | 36.30 |
| | Divorced | 1 | 0.50 |
| | Widow | 5 | 2.40 |
| | Widower | 23 | 10.8 |
| | Total | 212 | 100 |
| Educational level | No school | 43 | 20.28 |
| | Adult-based education (ABET) | 19 | 8.96 |
| | Primary school education | 27 | 12.74 |
| | Secondary school education | 99 | 46.70 |
| | Tertiary education | 24 | 11.32 |
| | Total | 212 | 100 |
| Household size | 1-3 members | 32 | 15.10 |
| | 4-6 members | 102 | 48.10 |
| | 7-9 members | 60 | 28.30 |
| | 10-12 members | 13 | 6.10 |
| | ≥ 13 members | 5 | 2.40 |
| | Total | 212 | 100 |
| Employment status | Employed | 62 | 29.25 |
| | Unemployed | 114 | 53.77 |
| | Self-employed | 36 | 16.98 |
| | Total | 212 | 100 |
| Farming experience | 1-3 years | 15 | 7.08 |
| | 4-6 years | 34 | 16.04 |
| | 7-9 years | 43 | 20.28 |
| | 10-12 years | 35 | 16.51 |
| | ≥ 13 years | 85 | 40.09 |
| | Total | 212 | 100 |
| Farm size | 1-3 acres | 96 | 45.30 |
| | 4-6 acres | 78 | 36.80 |
| | 7-9 acres | 19 | 9.00 |
| | 10-12 acres | 12 | 5.70 |
| | ≥ 13 acres | 7 | 3.30 |
| | Total | 212 | 100 |


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| | | | |
|---|---|---|---|
| Farming income (ZAR) | R1 000-R3 000 | 159 | 75.00 |
| | R4 000-R6 000 | 35 | 16.50 |
| | R7 000-R9 000 | 15 | 7.10 |
| | R10 000-R12 000 | 2 | 0.90 |
| | ≥ R13 000 | 1 | 0.50 |
| | Total | 212 | 100 |

**Table 3: The challenges faced when accepting CSA for vegetable production**

| **Challenges** | **1-Not a challenge %** | **2-Slight challenge %** | **3-Moderate challenge %** | **4-Severe challenge %** | **5-Very severe challenge %** | **Mean** | **Std deviation** |
|---|---|---|---|---|---|---|---|
| Lack of awareness and knowledge of CSA | 0.50 | 1.40 | 8.00 | 24.10 | 66.00 | 4.54 | 0.744 |
| Limited access to climate information | 2.40 | 4.70 | 12.30 | 25.50 | 55.20 | 4.26 | 1.005 |
| Insufficient financial resources | 0.00 | 0.90 | 1.40 | 19.30 | 78.30 | 4.75 | 0.523 |
| Lack of technical skills and knowledge | 0.90 | 1.40 | 3.30 | 32.10 | 62.30 | 4.53 | 0.718 |
| **Institutional or policy barriers** | 1.40 | 10.80 | 34.40 | 37.70 | 15.60 | 3.55 | 0.930 |

**Table 4: Determinants of acceptance of Climate Smart Agriculture Practices**

| **Independent variables** | **B** | **S.E.** | **Wald** | **Df** | **Sig.** | **Exp(β)** | **95% C.I. For EXP(β)** | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | **Lower** | **Upper** |
| Age | .855 | .319 | 7.202 | 1 | .007** | 2.352 | 1.259 | 4.392 |
| Gender | .157 | .425 | .137 | 1 | .712 | 1.170 | .509 | 2.690 |
| Marital status | .284 | .204 | 1.932 | 1 | .164 | 1.328 | .890 | 1.982 |
| Educational level | -.210 | .240 | .770 | 1 | .380 | .810 | .507 | 1.296 |
| Farming experience | .093 | .215 | .187 | 1 | .665 | 1.098 | .720 | 1.674 |
| Farm size | -.702 | .301 | 5.443 | 1 | .020* | .496 | .275 | .894 |
| Farming income | .421 | .455 | .854 | 1 | .355 | 1.523 | .624 | 3.718 |
| Source of water | -.362 | .239 | 2.301 | 1 | .129 | .696 | .436 | 1.112 |
| Experienced any food shortages | -1.680 | .526 | 10.212 | 1 | .001** | .186 | .067 | .522 |
| Crop yield | 1.536 | .413 | 13.813 | 1 | .001** | 4.644 | 2.066 | 10.437 |
| Farm income | .683 | .344 | 3.936 | 1 | .047* | 1.980 | 1.008 | 3.888 |
| Constant | -4.892 | 2.869 | 2.907 | 1 | .088 | .008 | | |
| -2 log likelihood | 190.711[a] | | | | | | | |
| Nagelkerke R square | .487 | | | | | | | |
| Cox & Snell R square | .361 | | | | | | | |
| *Significant level set at 0.05 and 0.01.* | | | | | | | | |

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