

Determinants of climate change awareness among emerging commercial maize farmers in Limpopo province, South Africa

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ABSTRACT

Farmers' awareness of climate change is a crucial starting point for developing effective adaptation strategies and environmental management. A low level of awareness can delay the implementation of adaptation measures, increasing farmers' vulnerability to the adverse effects of climate change. This study employed a deductive approach and a quantitative method to analyze factors associated with climate change awareness among emerging commercial maize farmers in the Limpopo province of South Africa. Primary data were collected from 288 randomly selected farmers using a semi-structured questionnaire. The data were analyzed using a Binary Logistic Regression model in SPSS version 28. The results indicated that education (coef. = 0.347; sig. = 0.060), discussion of climate change within farming organizations (coef. = 1.994; sig. = 0.011), farmers' belief that climate change negatively impacts farming (coef. = 0.790; sig. = 0.005), and social media usage (coef. = 5.026; sig. = 0.000) were statistically significant factors. The study recommends enhancing climate change education, utilizing social media to disseminate information, and encouraging discussions about climate change among farmers. Additionally, policymakers and the government should allocate sufficient budgets for farmers' training workshops focused on climate change awareness, adaptation strategies, and environmental management.

Contribution/Originality: This study contributes to the existing literature on the level of climate change awareness among smallholder farmers. Most studies did not focus on the level of awareness among farmers. Specifically, studies regarding the levels of awareness of climate change among smallholder farmers have not been conducted in the study area.

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1. INTRODUCTION

Climate change is a result of shifting precipitation patterns and increasing temperatures that will progressively pose challenges to farmers worldwide (Ortiz-Bobea, 2018). The season of precipitation is expected to start late, and there are also signs that precipitation will decline in many areas of southern Africa (Antle, Homann-KeeTui, Descheemaeker, Masikati, & Valdivia, 2018). Werndl (2016) noted that there is climate change when there are different distributions for succeeding periods. Africa is one of the continents of the world that is susceptible to climate change because the majority of its people's livelihoods depend on rainfed agriculture (Jayne, Sitko, Mason, & Skole, 2018). It is

predicted that climate change will reduce the production of the main crops in sub-Saharan Africa. Overall, the impact of the changing climate on food security and the welfare of smallholder farmers is significant (Nkonya, Koo, Kato, & Johnson, 2018). Mereu et al. (2018) noted that the effect of climate change needs to be well thought out during the planning of water storage and development of irrigation infrastructure to avoid inadequate water loadings.

Agriculture is a risky business, and it is the only enterprise that turns out to be riskier under changing climate conditions (Mullins, Zivin, Cattaneo, Paolantonio, & Cavatassi, 2018). Climate change awareness helps agricultural producers in planning farming activities and reducing the risks that are connected to agriculture (Adebayo, Onu, Adebayo, & Anyanwu, 2012). Ansari, Joshi, and Raghuvanshi (2018) noted that climate change awareness shapes farmers' perceptions regarding climate change. Acquah (2011) emphasised that the provision of free climate change awareness and information is key to address climate-related complications. Being aware of climate change is one of the important aspects when building the resilience of society to handle climate change and thereby ensuring that strategies are sustainable (Iturriza, Hernantes, Abdelgawad, & Labaka, 2020). Ansari et al. (2018) noted that climate change awareness shapes the perceptions of farmers regarding climate change. Mulenga, Wineman, and Sitko (2017) and Mengistu (2011) noted that climate change awareness and accessibility to information are prerequisites for adapting to the adverse impact of climate change. First and foremost, climate change awareness needs to be created among the people through mass media followed by individual communication procedures by qualified extension agents (Sarkar & Padaria, 2016).

The objectives of the study were to analyze the levels of climate change awareness among emerging maize commercial farmers in the study area; the study also analyzed factors associated with climate change awareness among emerging commercial maize farmers in Limpopo Province, South Africa.

Climate change is a threat to maize production and other field crops that depend on the availability of water (Mulungu & Ng'ombe, 2019). Most of the studies were conducted regarding climate change awareness. However, they did not focus on the level of awareness among farmers. This study aims to address that gap by assessing the level of awareness among farmers. In this study, farmers were asked whether they were aware of climate change or not. The determinants were analyzed using binary logistic regression. The respondents also defined climate change to assess their level of awareness. The objective was analyzed using descriptive analysis.

2. LITERATURE REVIEW

Shrestha, Kadel, Shakya, Nyachhyon, and Mishra (2025) noted that climate change is a global phenomenon that harms socio-economic, ecological, and environmental sustainability. Therefore, farmers and society at large must be aware of climate change. Grechyna (2025) noted that experience in extreme weather events influences climate change awareness because individuals who are aware of global warming can spread the news. According to Ricart, Gandolfi, and Castelletti (2025) knowledge of climate change helps assess the occurrence and severity of its impacts and also increases farmers' ability to adapt and respond to climate change. Climate change awareness is becoming increasingly important since the country is focusing on environmental management (Nasir, Khan, Iqbal, & Ahmad, 2025). Humans' actions may have a negative impact on the climate and environment. Açıkalin, Sarı, and Erçetin (2024) highlighted that to fight climate change, which is caused by human activities, it is imperative to involve humans. The society's behaviour change is important in addressing the impact of climate change (Shrestha et al., 2025). Due to a lack of knowledge, some farmers still burn crop residue on their farms. The nations that understand the issue of climate change shift their behaviour towards sustainability (Hakimi, Safi, & Momand, 2024). The primary reason for raising awareness about climate change is to promote climate change adaptation and environmental management.

2.1. Levels of Climate Change Awareness Among Developing Farmers

Levels of climate change awareness among farmers differ among developing countries. For instance, Pakistan's level of climate change awareness is low compared to other developing countries, which may be due to insufficient campaigning on climate change among farmers (Mustafa, Alotaibi, & Nayak, 2023). According to Akano, Modirwa, Oluwasemire, and Oladele (2023) farmers in the agroecological zones of Southwest Nigeria have a higher awareness level of climate change. Kom, Nethengwe, Mpandeli, and Chikoore (2022) reported that one-third of farmers in the Vhembe district of South Africa had a very high level of climate change knowledge, and 50% high level of knowledge. The knowledge assists the farmers in addressing the issue of climate change. Ado, Leshan, Savadogo, Bo, and Shah (2019) also reported that the level of climate change awareness among the Fulani farmers in Niger was satisfactory, with 92% of the farmers.

2.2. Factors Associated with Climate Change Awareness Among Developing Farmers

Mustafa et al. (2023) reported that off-farm income has a good relationship with farmers' climate change awareness. Ricart, Gandolfi, and Castelletti (2023) highlighted that the majority of regression tests revealed that the farming experience had a positive association with climate change awareness. The extent to which farmers participate in community discussions of climate change in Thailand significantly and positively affects farmers' awareness of climate change (Thamsuwan, 2024). Farmer's educational level, farming experience, and access to climate information were the factors that influenced climate change awareness in Niger (Ado et al., 2019). Gudina and Alemu (2024) reported that agro-climate consulting services have a positive impact on climate change awareness. Recommendations for improvement in climate change awareness include targeted interventions to provide farmers with enhanced climate knowledge and support; extension services, collaborative efforts such as fostering collaboration between academics,

extension services, and farmers are essential for sharing knowledge and developing appropriate adaptation strategies; and investment in information systems is necessary to build climate-resilient societies.

3. MATERIALS AND METHODS

3.1. Study Area

The study was carried out in the Limpopo province (Figure 1) of South Africa. The province comprises five district municipalities: Mopani, Vhembe, Capricorn, Sekhukhune, and Waterberg. The five district municipalities in the province are divided into twenty-two local municipalities. It is situated in the northern part of South Africa and is named after the Limpopo River. The province borders the North West, Gauteng, and Mpumalanga provinces and the countries of Botswana, Zimbabwe, and Mozambique. Rainfall in the province varies significantly, and this affects the rural population depending on agriculture (EcoAfrica, 2016). Limpopo Province highlighted that there is an urgent need to address the challenges of climate change (Limpopo Provincial Government, 2024).

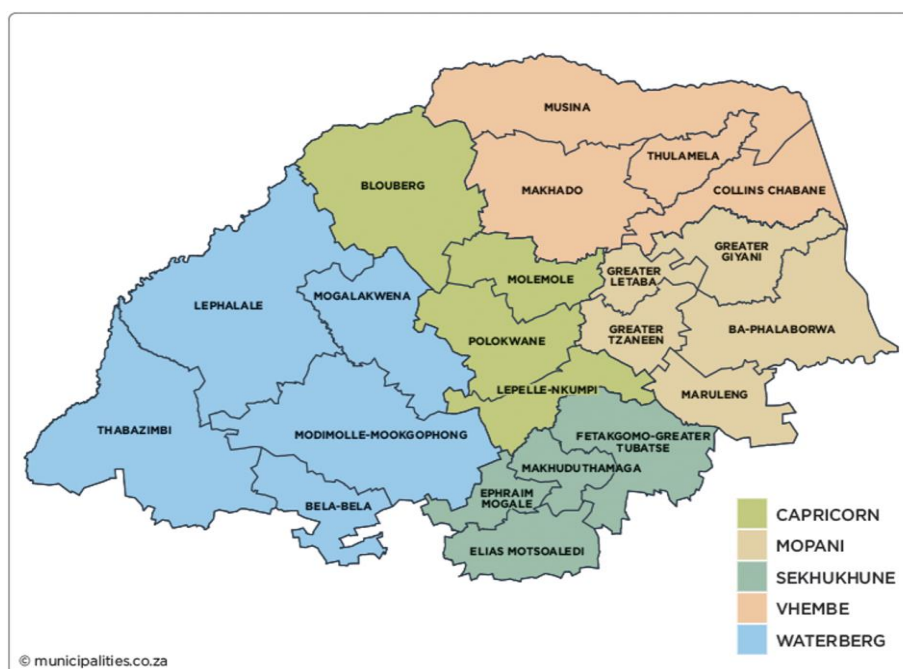


Figure 1. Map of Limpopo province in South Africa.

Source: <https://municipalities.co.za/provinces/view/5/Limpopo> (Accessed: 13 September 2024).

3.2. Sample Size and Sampling Technique

The list of emerging commercial maize farmers was obtained from the Department of Agriculture of the Limpopo Province Krejcie and Morgan (1970). A formula was employed to determine a sample size of 288 for the study since the target population is finite at 354. Table 1 indicates the population and sampling procedure. The population of the target farmers was 354. The random stratified sampling technique was used to select the samples for the respective districts, which constituted a total of 288.

Table 1. Sampling procedure according to the districts in the province.

	District Municipality	Number of emerging commercial maize farmers per district (A)	Sample per district proportionately. $\frac{A \times n}{N}$
1	Vhembe	135	102
2	Mopani	100	81
3	Sekhukhune	83	70
4	Waterberg	23	22
5	Capricorn	13	13
	Total	N=354	n=288

Source: Data from the study.

3.3. Ethics Considerations

The study obtained ethical approval from the Human Research Ethics Committee for the College of Agriculture and Environmental Sciences at the University of South Africa before the research was conducted. The participants were informed about the purpose of the study. The participants were treated as anonymous, and their responses were kept confidential. Consent from participants was obtained before completing the questionnaires. Interviews with participants were conducted by appointment at a convenient time and place for the farmers. Data for the study will be

used solely for the purpose of the study. All emerging maize commercial farmers on the list obtained from the Department of Agriculture in the province were over 18 years of age and actively farming.

3.4. Data Collection and Analysis

The data in this study were collected from primary sources using a semi-structured questionnaire. The questions in the questionnaire were informed by the objectives of the study. The collected data from the fully completed questionnaires were captured in Excel, cleaned, and transferred to the Statistical Package for Social Sciences (SPSS) version 28. The data for the study were analyzed using Binary Logistic Regression. Descriptive statistics were also used to summarize the results of the analyses.

3.5. The Binary Logistic Model Specification and Estimation

The logistic function is employed in logistic regression to model the dependent variable (Ostovar, Davari, & Dzikuć, 2025). The dependent variable in this study was dichotomous, i.e., $Y = 0$ or 1 . The value of 1 represented farmers who were aware of climate change, and 0 represented farmers who were not aware of climate change. The study used binary logistic regression, which was introduced by Cox, while different forms of logistic regression, such as multinomial and ordinal, are available (Saran & Nar, 2025).

The assumptions of the Binary Logistic Regression Model are that; the outcome variable is binary, observations are independent, explanatory variables should not experience multicollinearity, and there should be a linear relationship between continuous predictors and the log-odds of the outcome, not a direct linear relationship with the outcome itself.

The model is specified as:

$$P(Y = 1) = e^{\beta x} / 1 + e^{\beta x} \quad (1)$$

$$P(Y = 0) = 1 - e^{\beta x} / 1 + e^{\beta x} = 1 / 1 + e^{\beta x} \quad (2)$$

P is the probability that $Y = 1$. Equation 1 presents the probability that farmers were aware of climate change, Equation 2 presents the probability that farmers were not aware of climate change. Both Equations 1 and 2 present the result of the model. An alternative equation to present the binary logistic results is:

$$\text{Logit}[\theta(X)] = \log[\theta(X) / 1 - \theta(X)] = b_0 + b_1X_{1+} + b_2X_{2+} + b_3X_{3+} + \dots + b_kX_k \quad (3)$$

Where:

θ = Logit transformation.

b_0 = Is the constant.

b_i = Regression coefficient.

x_i = Independent variables.

The model is estimated by maximum likelihood estimation, thus it finds the parameters that maximize the likelihood of observing the actual data.

$$Y_i = b_0 + b_1X_{1+} + b_2X_{2+} + b_3X_{3+} + \dots + b_kX_k \quad (4)$$

Explanatory variables used in the study and their expected effect are presented in Table 2.

Table 2. Explanatory variables used for the analysis of the determinants of climate change awareness.

Independent variables	Variable label	Expected indicator
X_1	Age of farmer	Positive
X_2	Gender (Male=1, Female=0)	Positive
X_3	Household size (Number of people in the family)	Positive
X_4	Marital status (Married=1, if not married=0)	Positive
X_5	Educational level (No formal education=1, Primary education=2, Secondary education without matric=3, Matric=4, Tertiary=5)	Positive
X_6	Discussion of climate change in the farming organisation (Yes=1, No=0)	Positive
X_7	Extension officers visit the farm (Yes=1, No=0)	Positive
X_8	Considering maize as a staple food (Yes=1, No=0)	Positive
X_9	Believing that climate change has a negative impact (Yes=1, No=0)	Positive
X_{10}	Perception of temperature (Increased temperature=1, Decreased temperature=2, Still the same=3)	Positive
X_{11}	Perception on rainfall (Increased rainfall=1, Decreased rainfall=2, It rains late=3, None of above/ It rains normal=4)	Positive
X_{12}	Drought experienced (Yes=1, No=0)	Positive
X_{13}	Maize farming experience (Number of years in maize farming)	Positive
X_{14}	Knew climate change from media (Yes=1, No=0)	Positive

4. RESULTS AND DISCUSSION

4.1. Demographic Characteristics of the Farmers Participated In Study

Table 3 indicates that 56% of the participants were male, while 44% were female. In terms of age, 6% of the participants were between 18 and 35 years, 18% were between 36 and 50 years, 30% were between 51 and 60 years, and 46% were over 60 years of age. The results further indicate that 7% of the participants had fewer than three people in their households, 39% had household sizes of between three and five persons, 46% had a household size of six to ten

persons, and 8% of the farmers had more than ten people in their households. The results show that 71% of the farmers were married, and 29% were single. About 16% of the participants had no formal education, 25% had primary education, 26% had secondary education without matric, 16% had matriculated, and 17% of the participants had tertiary education. Baiardi (2023) noted that demographic characteristics such as gender, age, and education are significant for understanding climate change, its impact, and the need for adaptation strategies.

Table 3. Demographic characteristics of farmers (n=288).

Gender	Frequency	Percentage
Male	161	56
Female	127	44
Total	288	100
Age group	Frequency	Percentage
18- 35 Years	18	6
36-50 Years	52	18
51- 60 Years	87	30
>60 Years	131	46
Total	288	100
Household size	Frequency	Percentage
<3	21	7
3-5	112	39
6-10	132	46
>10	23	8
Total	288	100
Marital status	Frequency	Percentage
Married	204	71
Single	84	29
Total	288	100
Educational level	Frequency	Percentage
No formal education	46	16
Primary education	72	25
Secondary education without matric	75	26
Matric	45	16
Tertiary	50	17
Total	288	100

4.2. Socio-Economic Characteristics and Perceptions of Farmers

The results in Table 4 indicate that 78% of the participants were aware of climate change, whereas 22% were not yet aware of climate change. The knowledge about climate change awareness is growing compared to a decade ago. Mandleni and Anim (2011) reported that 57% of farmers were more aware of climate change while 43% were not aware at that time. The results in Table 4 also indicate that 51% of the participants knew about climate change from the media, while 49% of the participants did not know about climate change from the media. According to Rahimi (2020), climate change awareness can be successfully achieved if climate change becomes a social epidemic like the outbreak of a viral infection such as COVID-19, and then the awareness can be achieved within a short space of time. The findings also indicate that 20% of the participants were discussing the issue of climate change in their farming cooperatives, whereas 80% were not. The agricultural extension service is a fundamental platform where farmers can receive information about climate change. Table 4 indicates that 87% of the participants were receiving agricultural extension services from the government, while 13% were not receiving agricultural extension services. About 8% of the participants had one to three year(s)' experience in maize production, 27% of the participants had four to ten years' experience of maize farming, 32% of the participants had 11 to 20 years' experience of maize farming, 15% of the participants had 21 to 30 years' experience of maize production, while 18% of the participants had more than 30 years' experience in maize farming activities. The study by Sarkar and Padaria (2016) noted that farmers with farming experience were expected to realise that there are changes in weather conditions. Akano et al. (2023) reported that farming experience had a positive impact on the farmers' understanding of climate change.

Almost all study participants (99.7%) considered maize a staple food, and only one participant (0.3%) did not; his staple food was sorghum. The result is consistent with the review by Mulungu and Ng'ombe (2019), who highlighted that maize is a staple food and provides food security in most countries of sub-Saharan Africa.

Table 4 indicates that 93% of the participants believed that climate change has a negative impact on farming activities, while 7% of the participants did not believe that climate change poses problems to the farming process. Niles and Mueller (2016) reported that farmers who believe that climate change is taking place and that it is caused by human behavior are expected to believe that temperature is increasing, while those who do not believe that climate change is happening and is caused by people's behavior will not believe that the temperature is rising. The results in Table 4 indicate that 98% of the participants noticed that the temperature has increased nowadays, 1% of the participants had noticed that the temperature is still the same, and 1% of the participants noticed that the temperature has decreased.

Similarly, Mengistu (2011) found that only less than 5% of the farmers did not see a slight change in temperature. Sahu and Mishra (2013) also reported that 98% of farmers who were aware of climate change noticed a rise in temperature as well.

The results further indicate that 93% of the participants noticed that rainfall had decreased, 5% of the participants noticed an increase in rainfall, 1% of the participants observed that the rains come very late, and another 1% noticed that the rainfall remains the same as in the past decade. About 95% of the participants experienced drought in the last ten years, while 15% did not experience drought during that period.

Table 4. Socio-economic characteristics and perceptions of farmers in the study area (n=288).

Climate change awareness	Frequency	Percentage
Yes	224	78
No	64	22
Knew climate change from media	Frequency	Percentage
Yes	146	51
No	142	49
Discuss climate change in the cooperatives	Frequency	Percentage
Yes	57	20
No	231	80
Extension visits	Frequency	Percentage
Yes	250	87
No	38	13
Maize farming experience (years)	Frequency	Percentage
1-3 year(s)	23	8
4-10 years	79	27
11-20 years	92	32
21- 30 years	43	15
More than 30 years	51	18
Considering maize as a staple food	Frequency	Percentage
Yes	287	99.7
No	1	0.3
Believing that climate change has a negative impact	Frequency	Percentage
Yes	267	93
No	21	7
Perception of temperature	Frequency	Percentage
Increased temperature	283	90
Still the same	4	1.4
Decreased temperature	1	0.3
Perception of rainfall	Frequency	Percentage
Decreased rainfall	268	93
Increased rainfall	14	5
It rains late	3	1
Still the same	3	1
Drought experienced in the last ten years	Frequency	Percentage
Yes	273	95
No	15	5

Source: Data from the study.

4.3. Level of Climate Change Awareness Among Farmers

Participants of the study explained how they understood climate change. The explanations were grouped as high, moderate, and low understanding (awareness). Criteria followed when rating the level of farmers' awareness of climate change:

- High level: Providing definitions, causes, and impacts of climate change in their explanation. For instance, "Unusual reactions of the climate caused by pollution, high population, and human behavior. Currently, there is a shortage of rain, and temperatures are very high."
- Moderate level: Indicating the shifting of seasons, low rainfall, and high temperatures in their explanation. For instance, "the temperature is higher than we used to know. The rainy season has changed. There are a lot of pests."
- Low level: Confusing climate change with weather forecasts in their explanation. For instance: "There is a change in the weather and temperature. Our area is hot."

The result in Table 5 indicates that 10% of the participants had a high level of climate change awareness. The majority (66%) of the participants had a moderate understanding of climate change, while very few (2%) of the participants had a low level of understanding. Acquah (2011) highlighted that farmers only define climate change as

changes in weather. Sarkar and Padaria (2016) noted that most community members do not have detailed information about climate change.

Table 5. Rating the level of farmers' awareness of climate change.

Level	Frequency	Percentage
High	28	10
Moderate	189	66
Low	7	2
Unaware of climate change	64	22
Total	288	100

Source: Data from the study.

4.4. Binary Logistic Analyses for Factors Influencing Climate Change Awareness Among the Emerging Commercial Maize Farmers

The results in Table 6 from the Binary Logistic Regression model had four coefficients, which were statistically significant at the levels of 10%, 5%, and 1%. The significant variables were education, discussion of climate change in the farming organisation/cooperative, farmers' belief that climate change has a negative impact on maize farming, and access to media.

The results in Table 6 indicate that the estimate for education is positive (.347) and statistically significant ($p < 0.10$), which means that climate change awareness increases when the level of education improves, with other factors held constant. This might be because literate people are likely to access different sources of information where climate change is discussed.

Similarly, the study conducted in Kathmandu Valley, Nepal, by Shrestha et al. (2025) reported that education has a significant positive relationship with the level of climate change awareness. Consistently, Baiardi and Morana (2021) found that education had a positive impact on the formation of environmental attitudes. Filho, Aina, Dinis, Purcell, and Nagy (2023) highlighted that higher education is critical to the global effort to address climate change. Indeed, climate change is an important factor in raising awareness about climate issues.

The coefficient associated with the discussion of climate change in the farming organisation of the farmers had a positive (1.994) impact on climate change awareness and is statistically significant ($p < 0.05$), indicating that the level of climate change awareness increased when farmers are frequently discussing the issue of climate change in their organisations.

The reason might be that the discussion of climate change in the farmer organisation helps to enlighten the farmers about the impact, mitigating, and adaptation strategies of climate change.

The coefficient associated with the farmers' belief that climate change has a negative impact on farming positively (2.210) influences climate change awareness and is statistically significant ($p < 0.01$). This indicates that when the number of farmers who believe that climate change has a negative impact on maize farming or farming at large increases, climate change awareness also increases. The reason might be that those who believe in the impact of climate change can spread the information to those who are unaware of climate change. The result supports (Niles & Mueller, 2016), who reported that 66% of the farmers in Marlborough and 52% in Hawke's Bay believed that climate change exists and is caused by the behaviour of human beings. According to Hyland, Jones, Parkhill, Barnes, and Williams (2016) climate change awareness is independent from the belief that the alteration of climatic conditions negatively affects farming processes.

Access to media had a positive (5.026) and significant ($p < 0.01$) influence on climate change awareness among farmers. This means that the increase in media usage in climate change awareness raises awareness among farmers. The reason might be that information from the media reaches a large number of people in different locations within a short period of time. Supporting this finding, Das and Ghosh (2020) reported that mass media exposure had a positive and significant effect on the knowledge of farmers about climate change in India. Nasir et al. (2025) reported that the media influences public awareness of climate change.

The goodness of fit for the model is indicated in Table 6, -2 log-likelihood value is 170.133. The value of the -2 log-likelihood in these results shows that the model fits the dataset. The value of chi-square is 134.978, which still indicates a better fit of the model to the dataset. The values of -2 log-likelihood and chi-square indicate a better fit (Starkweather & Moske, 2011).

The value of Cox & Snell R Square is .374, while Nagelkerke R Square is .573. The R-squared value still supports that the model fits the dataset. Gelman, Goodrich, Gabry, and Vehtari (2019) reported that the value for R Square is acceptable when it is between 0 and 1.

Multicollinearity was tested to check the problem between independent variables. The multicollinearity test (Table 7) indicates that all tolerance values are greater than 0.2, indicating that there was no multicollinearity problem between the independent variables.

The multicollinearity test further shows that variance inflation factors are less than 10, confirming that no multicollinearity problem occurred among the independent variables used during data analysis.

Table 6. Results of binary logistic regression model on climate change awareness.

Independent variables	Coefficient	S.E.	Sig.
Age	-0.030	0.021	0.154
Gender	0.561	0.412	0.174
Household size	0.033	0.057	0.566
Marital status	-0.065	0.446	0.885
Education	0.347	0.184	0.060*
Discussion of climate change in the organisation	1.994	0.788	0.011**
Extension visits	0.884	0.541	0.102
Considering maize as staple food	-14.736	40192.923	1.000
Perception of temperature	-0.403	1.290	0.755
Perception of rainfall	0.787	0.687	0.252
Drought experienced	1.418	1.405	0.313
Maize farming experience	0.021	0.018	0.245
Believe that climate change has a negative impact	2.210	0.790	0.005***
Media	5.026	1.060	0.000***
Constant	9.416	40192.923	1.000
Number of observations	288		
Chi-square	134.978		
-2 Log likelihood	170.133a		
Cox & Snell R Square	0.374		
Nagelkerke R Square	.573		

Note: Significance: *** if $p < 0.01$; ** if $p < 0.05$; * if $p < 0.10$.

Source: Data from the study.

Table 7. Multicollinearity test for independent variables on climate change awareness analysis.

Variables	Collinearity statistics	
	Tolerance	VIF
Age	0.597	1.674
Gender	0.857	1.168
Household size	0.940	1.063
Marital status	0.854	1.172
Education	0.680	1.471
Discussion of climate change in the organisation	0.917	1.090
Extension visit	0.936	1.068
Considering maize as staple food	0.932	1.073
Belief that climate change has a negative impact	0.929	1.076
Perception of temperature	0.801	1.248
Perception of rainfall	0.837	1.195
Drought experienced	0.786	1.272
Maize farming experience	0.697	1.434
Media	0.928	1.078

Source: Data from the study.

5. CONCLUSION

This study found that most farmers were aware of climate change. However, the level of understanding of climate change among farmers was not equal. Some farmers had a high level of understanding of climate change, others had a moderate understanding, and others had a low understanding of climate change.

The binary logistic regression model in SPSS has been employed to analyze the factors that influenced the awareness of climate change among farmers.

The findings of the study have implications for education, the discussion of climate change, and the use of social media among farmers. The study recommends climate change education. The study also recommends the discussion of climate change among farmers because the discussions could enlighten the farmers about the impact, mitigation, and adaptation strategies of climate change. The recommendation is also directed at policymakers and the government to have a budget for farmers' training workshops on climate change awareness.

5.1. Future Studies

Future studies need to focus on identifying the best climate change adaptation strategies to lessen the severity of climate change impacts on food production, especially among smallholder and emerging farmers. Environmental management should also be given attention.

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Institutional Review Board Statement: The Ethical Committee of the College of Agriculture and Environmental Science, University of South Africa, South Africa has granted approval for this study on 1 November 2018 (Ref. No.2018/CAES/145).

Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.

Competing Interests: The authors declare that they have no competing interests.

Authors' Contributions: Both authors contributed equally to the conception and design of the study. Both authors have read and agreed to the published version of the manuscript.

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