S. Afr. J. Agric. Ext. Isaac & Zenda
Vol. 54 No. 1, 2026: 103-127
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The Impact of Climate Change on the Livelihoods of Small-Scale Crop Farmers in Lepelle Nkumpi District, Limpopo Province, South Africa

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ABSTRACT

This study aimed to evaluate the effects of climate change and extreme weather events on the livelihoods of small-scale farmers, as well as to determine the adaptation strategies employed by households affected by climate change in the Lepelle Nkumpi region of Limpopo. A comprehensive survey was conducted using a stratified sampling method, with individual questionnaires administered to a total of 40 participants. Additionally, two focus group discussions were explicitly held with farmers. Findings reveal that farmers perceive climate change as a real phenomenon, citing rising temperatures, erratic rainfall, and an increase in more frequent droughts and floods. These changes have led to reduced agricultural production and financial losses. In response to the challenges posed by climate change, small-scale farmers are implementing various adaptive strategies, including crop diversification, adjusting planting schedules, utilising irrigation, and applying fertilisers. However, their adaptation efforts are hindered by limited financial resources, restricted access to finance, lack of skills, and inadequate access to agricultural inputs and technologies. The study emphasises the importance of providing enhanced support to small-scale farmers, including agricultural extension services, local early warning systems, diversified livelihoods, climate-sensitive farming techniques, and increased awareness of climate change.

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Vol. 54 No. 1, 2026: 103-127
10.17159/2413-3221/2026/v54n1a18959

Keywords: Small-Scale Farmers, Climate Change, Impacts, Adaptation, Lepelle Nkumpi.

1. INTRODUCTION

According to Ziervogel and Taylor (2020), South Africa exhibits climatic variability over many temporal scales. Pasquini *et al*. (2019) assert that the present global climate change models indicate substantial climate change effects in South Africa. Ziervogel *et al*. (2017) emphasise the importance of climate change as a significant issue in South Africa. They note that the country has experienced a notable rise in mean annual temperatures, surpassing the observed global average of 0.65°C by a factor of at least 1.5 over the past five decades. Additionally, the frequency of extreme rainfall events has also shown an upward trend. According to Fitchett *et al*. (2020), the impact of climate change on various aspects of South Africa, including water resources, food security, health, infrastructure, ecosystem services, and biodiversity, is of considerable concern.

Bellprat *et al*. (2019) have documented that historical records indicate fluctuations in South Africa's climate, characterised by alternating wet and dry phases that correspond to occurrences of floods and droughts. These climatic variations are notably influenced by El Niño or Southern Oscillation events, which are projected to increase in frequency due to the effects of climate change. Moreover, the examination of historical records reveals notable escalations in the magnitude of extreme precipitation occurrences and rising atmospheric temperatures. The potential impacts of shifting precipitation and temperature patterns encompass various aspects, including soil erosion rates and water availability (Mastrorillo *et al*., 2018). Additionally, these changes pose risks for waterborne diseases and can have indirect health consequences (Ndlovu & Zenda, 2024). Furthermore, alterations in rainfall patterns can influence the occurrence and severity of drought events (Edossa *et al*., 2019). Moreover, these climatic shifts can have implications for crop yields, food security, rural livelihoods, biodiversity, and ecosystem services (Midgley & Bond, 2015; Ndlovu & Zenda, 2024).

The negative effects of climate change significantly impact farmers' ability to sustain their livelihoods, particularly in agrarian regions such as Limpopo Province. As the majority of the population in this province relies on agriculture, they are highly vulnerable to climate variability and extreme weather events. The Intergovernmental Panel on Climate Change (IPCC, 2021) emphasises that changes in weather patterns and climate conditions have a direct

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impact on the livelihoods of thousands of small-scale farmers, thereby exacerbating poverty and food insecurity.

These adverse effects have led to a range of socioeconomic challenges, including low agricultural productivity, unemployment, reduced household incomes, and insufficient food production (Shayegh *et al*., 2020). Despite growing recognition of these challenges, a critical gap remains in research on integrating climate adaptation strategies, interventions, and sustainable agricultural practices to enhance rural livelihoods. At the national level, there is a lack of comprehensive studies providing actionable insights for strengthening the resilience of small-scale farmers to climate shocks.

This study seeks to address this gap by examining the impact of climate change on rural livelihoods in the Lepelle Nkumpi District of Limpopo Province. It aims to contribute to existing knowledge by developing recommendations, promoting climate-resilient agricultural practices, and proposing strategies for improving rural livelihoods. Given the urgency of the climate crisis, research on the adaptation strategies employed by small-scale farmers and their effectiveness is crucial for informing both policy and practice.

2. METHODOLOGY

2.1. Study Area

The research was conducted in Limpopo Province, which is recognised as the fifth-largest province among South Africa's nine provinces (South African Government, 2013). The province under consideration comprises six districts, specifically Greater Sekhukhune, Mopani, Capricorn, Waterberg, and Vhembe, as shown in Figure 1 (LDA, 2012). Nevertheless, the primary focus of this study was directed towards the district of Lepelle Nkumpi.

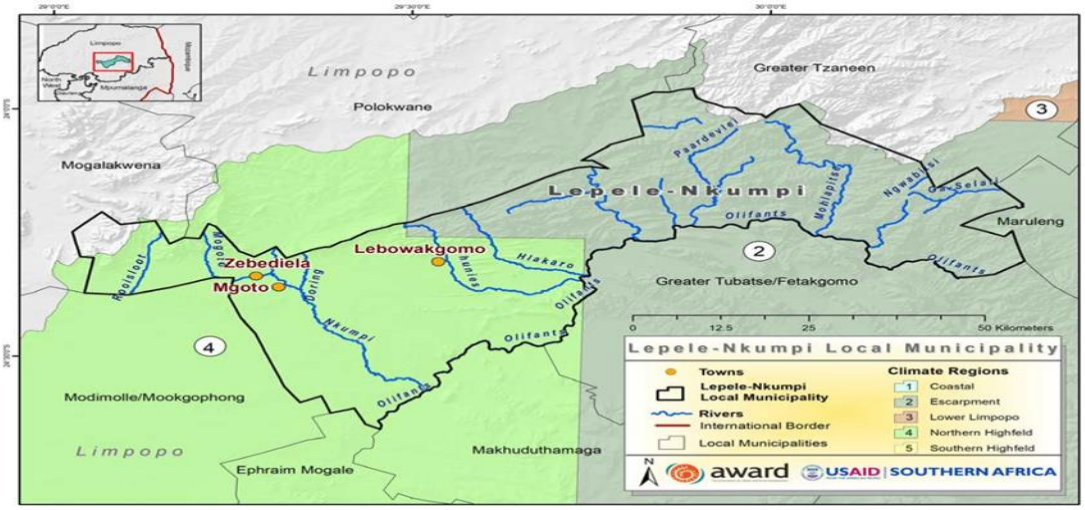

FIGURE 1: The Five Distinct Climate Regions of the Olifants River Catchment (Source: South African Government, 2013)

According to Oni *et al*. (2012), the province's total land area is 12.46 million hectares, representing approximately 10.2% of South Africa's total land area. The province being examined displays three distinct climate regions: The low veld, characterised by arid and semi-arid conditions; the Middle Veld and High Veld, which are semi-arid regions; and the Escarpment region, which has a sub-humid climate and receives an annual rainfall of 700mm (LDA, 2012). The agricultural sector in the province of Limpopo has a capacity for cultivating a wide range of agricultural commodities, including tropical fruits, cereals, and vegetables. This ability can be attributed to the prevailing climatic variations within the region.

The geographical coordinates of the Municipality of Capricorn are 23.6123 °S and 29.2321 °E, as shown in Figure 1. This municipality spans an approximate area of 3,484 km^2 within the Lepelle Nkumpi District, as reported by the South African Government in 2013. Lepelle Nkumpi District is situated in the southeastern region of Limpopo Province. The parish in question is the smallest among the four parishes in the district, accounting for approximately 16% of the district's total geographic area (LDA, 2012). A rural setting characterises the majority of the town. The region is geographically partitioned into a total of 29 administrative districts, with one of them being the municipality known as Lebowakgomo.

Additionally, within the Capricorn District, there exists a growth point that comprises one of these districts. The district under consideration exhibits a notable feature of diminished precipitation levels, typically falling within the range of 450 to 500 mm per year. Consequently,

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the region faces a scarcity of water resources, which manifests in the form of acute water shortages and recurring droughts.

According to the South African Weather Service (SAWS, 2020), there has been a notable fluctuation in the precipitation coefficient, with a recorded variance of 30.78%. This suggests a discernible trend of decreasing precipitation levels over successive years. According to the Environmental Study (2009) and the South African Weather Service (SAWS, 2020), the municipality of Lepelle-Nkumpi experiences an average yearly temperature of around 20°C. The average temperature during the summer months is roughly 23°C, while during the winter months it remains around 20°C (Lepelle-Nkumpi Agricultural Hub, Environmental Analysis, 2019).

2.2. Data Collection

Data were collected from smallholder farmers using a mixed-methods approach, incorporating both questionnaires and focus group discussions. Quantitative data were obtained through structured questionnaires administered to farmers in Capricorn villages, located in the Lepelle Nkumpi area of Limpopo. These questionnaires were designed to capture measurable aspects of agricultural practices, climate change impacts, and the adaptive strategies employed by farmers.

The questions were carefully crafted to ensure clarity and relevance, avoiding technical jargon to accommodate varying literacy levels among respondents. To enhance the validity and reliability of the instrument, the questionnaires underwent a comprehensive pretesting phase. This involved conducting pilot tests with a small group of farmers from the target population to identify and rectify potential issues in question wording, order, and overall design. Feedback from these pretests led to necessary revisions, ensuring that the final version effectively captured the intended information and was easily understood by the respondents. This rigorous pretesting process is essential in survey research, as it helps identify and address problems that could affect data quality and the overall success of the study.

To complement the quantitative data, focus group discussions were conducted with individuals actively engaged in agricultural production as members of various farming groups. These discussions provided a platform for participants to share their perspectives, experiences, and beliefs regarding climate change and its effects on their livelihoods. The focus group method

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was selected for its cost-effectiveness, interactive nature, and ability to facilitate in-depth exploration of complex issues through dialogue and collective reflection.

Focus group discussions were conducted with members of various farming groups to explore their perspectives on climate change and its impact on their livelihoods. Each group consisted of 20 participants, totalling 40 participants across all groups. This size facilitates in-depth interaction and ensures diverse viewpoints. The discussions were guided by a semi-structured set of open-ended questions designed to elicit detailed responses and encourage dialogue among participants. To capture the richness of the conversations, all sessions were audio-recorded with participants' consent, and a trained observer took comprehensive notes. The recorded discussions were transcribed verbatim, and the data were analysed using thematic analysis to identify recurring themes and patterns. This approach allowed for a nuanced understanding of the participants' experiences and beliefs regarding climate change.

Additionally, field observations were carried out to collect qualitative data. Farmers were observed in their natural environment while engaging in routine agricultural activities. This approach allowed the research team to document firsthand the farming practices and adaptive responses employed in real-world settings. By integrating structured questionnaires, focus group discussions, and direct observations, this study ensured a comprehensive and holistic understanding of the challenges faced by smallholder farmers in the region.

2.3. Sampling

A stratified sampling method was employed to choose 40 small-scale crop farmers from the Lepelle Nkumpi region of Limpopo. A stratified sample was selected from household heads who agreed to take part in the study. Stratified sampling involves dividing the population into subgroups or strata based on specific criteria before selecting samples from each stratum. Afterwards, a space is selected from every subgroup. In this scenario, the population was divided into strata, or groups, based on two key factors: the number of small-scale crop farmers and their level of involvement in crop production. This stratification likely aimed to organise the population for analysis or decision-making purposes within the crop farming sector.

A small sample of 40 small-scale crop farmers was used due to practical constraints such as time, resources, and accessibility, which often limit the feasibility of large-scale data collection. Stratified sampling ensures that even with a small sample size, the study captures key variations

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within the population by selecting representative subgroups. This approach enhances the validity and reliability of findings while maintaining efficiency in data collection and analysis. Additionally, in studies focused on specific farming communities, smaller samples can still provide meaningful insights, especially when qualitative depth and targeted analysis are prioritised over large-scale statistical generalisations.

2.4. Data Analysis and Interpretation

Qualitative data were analysed using content analysis, a systematic and rigorous qualitative research method that facilitates the identification, interpretation, and contextualisation of patterns, themes, and meanings within textual or qualitative data. Content analysis enables an in-depth examination of the language, concepts, and relationships embedded within the data, allowing researchers to derive nuanced insights beyond mere word frequency (Özkan & Gezer, 2024). This approach involves categorising and coding data to discern recurring themes, contextual meanings, and relational patterns, thereby enhancing the interpretive depth of qualitative research. Content analysis is particularly valuable in social sciences, communication studies, and interdisciplinary research, as it provides a structured yet flexible framework for analysing diverse sources, including interviews, policy documents, reports, and media content. The method ensures both transparency and replicability, supporting rigorous qualitative inquiry while accommodating the complexity of human expressions and interactions. Its systematic nature allows researchers to mitigate bias by establishing clear coding frameworks, thereby enhancing the validity and reliability of the findings. Consequently, content analysis was chosen for this study due to its ability to provide an empirical and theoretically grounded understanding of the data while preserving the richness and contextual depth of qualitative information.

The descriptive analysis was conducted using the Statistical Package for the Social Sciences (SPSS) version 22 software to determine the means, modes, and frequencies of the variables.
Ethical approval for this study was obtained from the University of the Free State, ensuring that all research activities adhered to the institution's ethical guidelines and principles. In compliance with ethical research standards, informed consent was obtained from all participating farmers prior to the commencement of data collection. Participants were thoroughly briefed on the study's purpose, procedures, potential risks, and benefits, enabling them to make informed decisions about their involvement. To uphold confidentiality and

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protect the identities of all participants, strict anonymity measures were implemented, including the use of pseudonyms and secure data storage protocols. Additionally, all collected information was handled with the highest level of integrity, ensuring that participants' rights, privacy, and dignity were safeguarded throughout the research process.

3. RESULTS AND DISCUSSION

3.1. Demographic Characteristics of Participants

3.1.1. Gender of Participants

A total of 40 respondents were sampled from nine villages in Lepelle Nkumpi in Limpopo Province. As illustrated in Table 1, both groups of respondents consisted of an equal number of participants, with 20 individuals identifying as male (50%) and 20 individuals identifying as female (50%). Throughout history, the agricultural sector has always been associated with male labour. However, there is an increasing demographic of women who are actively participating in the agricultural sector. According to the Farming Portal (2019), the proportion of women farmers in sub-Saharan Africa who engage in smallholder farming ranges from 60% to 80%.

However, the percentage of women who own land in this region is considerably lower, estimated to be between 15% and 20%. The age distribution among both groups differed, and this will be further elaborated upon in the subsequent section. This study was also conducted to examine the involvement of women in agriculture, as it has traditionally been perceived as a male-dominated field, especially in this district. This is the reason the number of respondents, regardless of gender, is equal. The data presented in Table 1 illustrate the even distribution of male and female participants in the research conducted.

TABLE 1: Summary Statistics of a Survey Carried Out in Lepelle Nkumpi District (n=40)

Gender distribution	Percentage
Male	50%
Female	50%
Age (Years)	
18-25	48%
26-35	20%
36-45	15%

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46-55	8%
56-65	8%
66-75	15%
Farm size	
0 to 0.5 ha	55%
0.6 to 1 ha	25%
More than 1 ha	20%

3.1.2. Age of Participants

The age group with the highest percentage of registered farmers was individuals aged 18 to 25 years, constituting 48% of the overall population (Table 1). The demographic group generally known as "youth", which includes those aged 18 to 35 years, constituted 6.5% of the overall population of registered farmers (Stats South Africa, 2021). The findings of this study demonstrate a greater proportion of individuals engaged in agricultural activities among the youth demographic (18–35 years old) in comparison to the older demographic (36–70 years old). A considerable proportion of young farmers have indicated that their choice to pursue farming is primarily influenced by the prevailing circumstances, characterised by elevated levels of unemployment and poverty. The results of the census data are consistent with the survey results, indicating that 48% (n = 17) of the respondents belong to the 18- to 35-year age group, which qualifies them to be classified as "youth" according to the defined criteria. The remaining individuals were categorised into the following age groups: 36–45 years (n = 8; 15%), 46–55 years (n = 6; 8%), 56–65 years (n = 3; 8%), and over 65 years (n = 6; 15%) (Table 1).

3.1.3. Farm Size

The majority of farmers participating in this survey engage in agricultural activities on communal property, with only 2% operating on privately owned farms (Table 1). In South Africa, tribal organisations manage and own the majority of communal land, which is primarily rural property. Communal tenure can be defined as a circumstance when a collective entity possesses secure and exclusive rights to own, manage, and/or utilise land and natural resources, sometimes referred to as common pool resources (Communal Land Rights Act 11 of 2004).

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These resources encompass a wide range of land types, including agricultural lands, grazing areas, forests, and trees, as well as aquatic resources such as fisheries, wetlands, and irrigation waters (Communal Land Rights Act 11 of 2004). When land ownership is mostly communal, there are little incentives to practise sustainable land management efficiently (Zenda & Malan, 2021). This is because communal land tenure often lacks clear individual property rights, leading to a situation where land resources are used collectively without direct accountability for degradation or overexploitation.

During the interview, several farmers emphasised the advantages of engaging in farming activities on communal land, primarily due to the exemption from monthly levies. However, a notable challenge they encountered was the difficulty in managing the presence of other individuals' livestock in the vicinity, which resulted in crop damage. The survey findings indicate that a significant proportion of farmers, including 55% (n = 22), possess land holdings ranging from 0 to 0.5 hectares. Additionally, 25% (n = 10) of farmers reported farming on land between 0.6 and 1 hectare. It is essential to note that these farmers do not own any land; instead, the land is held under the community land tenure system. Among the surveyed population of farmers, it was observed that a significant majority, specifically 55%, possessed at least one hectare of land. However, it is worth noting that only a mere 25% of farmers actually owned the land they cultivated. This finding was based on n = 8, or 20% of the total population.

3.1.4. Education Level of Participation

Since the 1970s, there has been a consistent upward trend in the unemployment rate among the youth population in South Africa (Kanbur, 2009). Presently, South Africa is positioned as the fourth nation globally in terms of its proportion of unemployed young people. According to data from 2014, the unemployment rate among individuals aged 15–24 who were actively seeking employment was 52.6% (Stats SA, 2021). According to Statistics South Africa's Quarterly Labour Force Survey for the fourth quarter of 2022, it is evident that Limpopo Province has the third-highest expanded unemployment rate at 49.9%. This ranking places Limpopo behind the Eastern Cape Province, which holds the highest expanded unemployment rate at 53%. As of the initial quarter of 2023, a significant proportion of the unemployed population in South Africa had an educational attainment level below matriculation, which corresponds to Grade 12. Approximately 41% of the unemployed population consists of

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individuals who have completed their matriculation year, while graduates constitute nearly 3% of the overall unemployed demographic.

According to the survey findings, it was observed that 43% (n = 17) of the participants possess a tertiary qualification, while 10% have completed their matriculation (Table 2). The remaining participants lack educational qualifications. A total of nine individuals, accounting for 23% of the sample, reported not having attended any formal educational institution. Additionally, ten participants, representing 25% of the sample, indicated that they completed their education from Grade 1 to Grade 12 (Table 2).

TABLE 2: Educational Qualifications of Participants

Highest education level	**Number of participants**	**Percent**
Matriculated	4	10%
Grade 1 to Grade 12	10	25%
Tertiary qualification	17	43%
Never been to school	09	23%
Grand Total	**40**	**100%**

3.1.5. Type of Crops Produced by Participants

According to Molele (2016), Limpopo Province in South Africa is renowned for its significant agricultural contributions, earning it the title of the "Bread and Fruit Basket" of the country. The province is responsible for producing approximately 60% of various agricultural products, including fruits, vegetables, maize meal, wheat, and cotton (Drysdale *et al*., 2019). The fertile soils of the Limpopo region support the cultivation of various crops, including maize, coffee, peaches, litchis, papayas, tomatoes, potatoes, and tea plantations. The cultivation of maize, alongside other crops, is essential for food security in the area, as it provides a staple food source for the local population (Mukwada *et al*., 2021). The study reveals that a significant proportion of small-scale farmers in this particular location prioritise the cultivation of vegetables over field crops. As illustrated in Figure 2, the predominant crop among the farmers surveyed was tomatoes, accounting for 28% of the total number of participants (n = 11). Following closely behind were spinach and cabbage, which were produced by 18% of the farmers (n=7). A larger proportion of the participants engaged in vegetable farming. Out of the

total sample size of farmers (n = 5), 13% were engaged in the cultivation of green peppers, whereas just one farmer (n = 1; 2%) was involved in the production of okra. There was a limited number of farmers involved in the production of field crops, specifically yellow maize farmers (n = 5; 13%) and soybean farmers (n = 3; 8%).

Overall, the study underscores the strategic significance of vegetable farming in Limpopo Province, highlighting its crucial role in sustaining local livelihoods, ensuring food security, and promoting economic development. Given the province's vast agricultural potential, targeted interventions such as improved access to markets, value-chain development, and climate-smart agricultural practices could further enhance productivity and sustainability among small-scale farmers in the region.

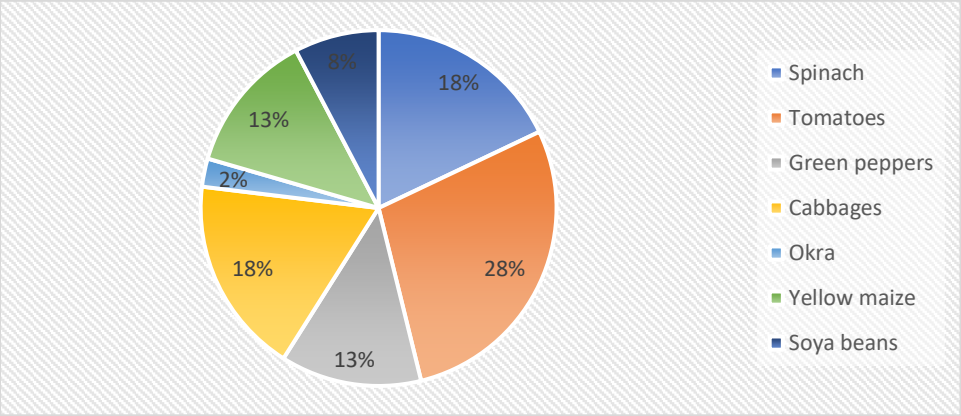

FIGURE 2: **Type of Crops Produced by Participants**

3.1.6. Number of Years in Farming of Participants

The data collected from the study reveal that a greater proportion of farmer respondents (50%) had engaged in agricultural practices for a duration of 2 to 5 years (Figure 3). The study's findings align with statistical data from South Africa's farmer register, which indicates that the high unemployment rate has led to an increase in the number of young individuals engaging in farming activities since 2019 (Cowling, 2021). Most of the farmers in this study started farming in 2018. A small proportion of respondents, specifically 8% (n = 3), have reported having engaged in farming for a duration of 6 to 12 years. Similarly, 5% (n = 2) of respondents have indicated a farming experience of 13 years or more. Additionally, there is a subset of farmers who have engaged in farming for a duration of 1 to 5 months (n = 5; 13%) and another subset who have been involved in farming for a duration of 6 months to 1 year (n = 10; 25%).

The diversity in farming experience among respondents highlights the dynamic nature of the agricultural sector, characterised by a continuous influx of new farmers alongside a smaller proportion of more experienced individuals. This distribution has important implications for agricultural extension services, training programmes, and policy interventions. The presence of a significant number of relatively new farmers highlights the need for targeted support, including access to credit, technical assistance, and knowledge-sharing platforms. Moreover, the relatively small number of long-term farmers suggests the need for mechanisms to retain experienced farmers and leverage their expertise for the benefit of the broader farming community.

Overall, the findings indicate a growing engagement in farming, driven by economic conditions and evolving livelihood strategies. The increasing number of young and new farmers presents opportunities for innovation, the adoption of climate-smart agricultural practices, and the strengthening of sustainable farming systems. However, ensuring their long-term success will require comprehensive support structures, including access to resources, training, and market linkages.

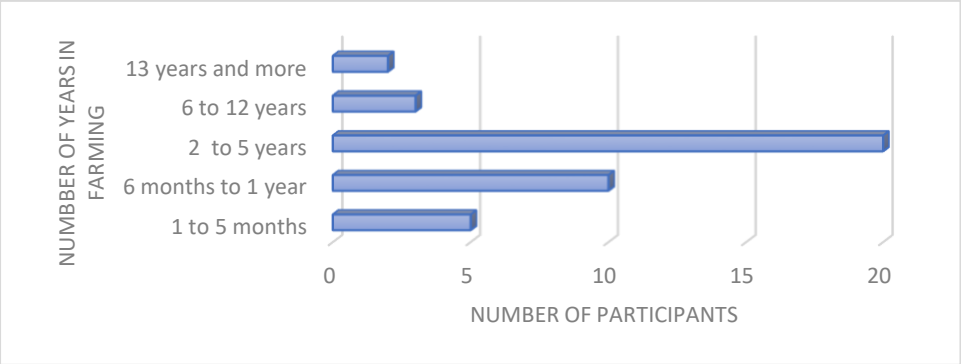

FIGURE 3: **Number of Years in Farming of Participants**

3.1.7. Race of Participants

Numerous ethnic groups, differing from one another in terms of cultural practices, linguistic variations, and racial characteristics, comprise Limpopo's demographic makeup. According to 2021 statistics, the demographic composition of the population is as follows: 97.3% of individuals identify as Black, 2.4% identify as White, 0.2% identify as Coloured, and 0.1% identify as Indian or Asian (Stats SA, 2021). The province exhibits the lowest proportion and second-lowest aggregate count of white South Africans within the nation. Additionally, it exhibits the highest proportion of individuals identifying as black among all the provinces. The

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survey findings align with those reported by Stats South Africa, as all respondents (n = 40; 100%) identified as belonging to the black racial group. This indicates that the majority of individuals residing in this particular region (Lepelle Nkumpi) are of Black ethnicity. The demographic pattern can be attributed to historical factors, migration trends, and socioeconomic dynamics that have shaped settlement patterns in Limpopo.

4. THE EFFECT OF CLIMATE CHANGE ON CROP PRODUCTION

4.1. Poor Quality Fruits

Elevated temperatures have significant implications for crop yield, primarily manifesting in two distinct ways: impeding vegetative growth and reducing fruit set. The combination of excessive transpiration and elevated temperatures imposes constraints on fruit crops that are susceptible to significant transpiration losses (Little, 2019). These farmers experienced a significant decline in the quality of their tomato crops, cabbage heads, and spinach. The dynamic nature of the environment is simultaneously giving rise to pronounced instances of drought and flooding. These alterations render fruit trees vulnerable to adverse growing conditions, infestations by pests, fungal infections, and other related challenges (Agnolucci, 2020).

In the previous year, the Intergovernmental Panel on Climate Change (IPCC, 2021) delineated five prospective global warming scenarios that encompassed varying degrees of fossil fuel utilisation and emissions. The analysis incorporated various climate scenarios, all of which consistently indicated significant alterations in tomato production within the next three to four decades. In general, the study revealed a projected decrease of approximately six percent in tomato production worldwide by 2050, compared to the baseline period of 1980–2009 (IPCC, 2021). This decline is attributed to the anticipated rise in air temperature. Furthermore, the analysis indicates that the five alternative future scenarios exhibit minimal variation in their impact on tomato production.

4.2. Increase in Diseases and Pests

According to Maponya (2012), the research findings indicate that the prevailing climatic conditions in Limpopo Province are primarily characterised by a prolonged period of drought. Consequently, this severe drought has led to a diminished availability of grazing land, water resources for livestock, and irrigation facilities, thereby exerting a substantial influence on

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agricultural livelihoods and contributing to food scarcity. According to farmers, there has been an observed rise in the prevalence of diseases such as verticillium wilt, which is a soil-borne disease. Certain farmers decided to transition from cultivating tomatoes to spinach due to their difficulties in effectively managing a rapidly escalating disease outbreak.

The escalating threat to food security and the environment is attributed to the exacerbation of plant pests that inflict significant damage on economically vital crops, a phenomenon primarily driven by the consequences of climate change (FAO, 2021). The responders have reported the emergence of new pest and disease incursions as a result of the irregular rainfall and fluctuating temperature variations. The farmers emphasised the significance of "aphid attacks" on cabbage as a notable pest issue. The agricultural practitioners have also observed these incursions throughout the summer months, particularly in periods characterised by high temperatures. The farmers have also noted the occurrence of these incursions throughout the summer, particularly during times of high temperatures. The findings of the Intergovernmental Panel on Climate Change (IPCC, 2022) also indicate that the production systems of smallholder farmers face immediate challenges due to rising temperatures, which lead to heat stress on plants, less water availability, decreased overall productivity, and the emergence of novel pests and diseases.

4.3. The Effect of Climate Change on Farmers' Livelihoods

The adverse repercussions of climate change and variability have had a detrimental effect on the well-being of the majority of rural smallholder farmers. Rural regions have witnessed a decline in agricultural production, crop failures, the emergence of human diseases, pest and disease infestations, inadequate water supplies, a scarcity of agriculture-based food products at the household level, and food insecurity (Mutekwa *et al*., 2019). The aforementioned impacts have presented a significant challenge to global food security and the livelihoods of farmers worldwide, thereby jeopardising the overall well-being of smallholder farmers in rural areas. This is primarily due to the heavy reliance of rural smallholder farmers on natural resources, such as agriculture, that are sensitive to climatic conditions, for their sustenance (Debela *et al*., 2015). The next section elucidates the impact of climate change on individuals' means of subsistence.

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4.4. Socioeconomic Effect on Agricultural Production

During the focused group conversations conducted, the farmers confirmed the exacerbation of climate fluctuations on an annual basis. They expressed that they had received less precipitation since the beginning of January in the current year, and the dry spells were observed to be intensifying, thereby harming their overall welfare. According to smallholder farmers, climate change has led to extended periods of drought, decreased precipitation, and increased temperatures, resulting in a decline in agricultural productivity. The farmers expressed that the insufficiency of water for irrigation posed a significant obstacle, as the adverse alterations in precipitation patterns detrimentally impacted their means of subsistence. Consequently, they were compelled to postpone their planting activities in anticipation of rain, only to find themselves unable to plant due to the late season. The aforementioned findings support Bellprat *et al*.'s (2019) claim that the province of Limpopo has experienced severe droughts, heatwaves, and reduced precipitation. The adverse climatic impacts have a detrimental influence on the livelihoods of farmers, leading to a scarcity of food resources.

Based on the participants' feedback, it was evident that climate change had a negative impact on the food security of their households. This was largely attributed to the occurrence of crop losses over a two-year period. The study revealed that a significant majority of farmers (90%) exhibited heightened vulnerability, as they reported enduring substantial agricultural losses in terms of food production throughout the preceding two-year period. In its 2007 report, the Intergovernmental Panel on Climate Change (IPCC) predicts a reduction in agricultural production in sub-Saharan Africa from 21% to 9% by 2080 as a consequence of climate change. According to the paper, it is anticipated that the increase in temperatures during precipitation events will have a detrimental impact on the production of staple foods, potentially leading to a decrease of up to 50%.

The findings underscore the need for policymakers, researchers, and agricultural stakeholders to develop targeted interventions that support vulnerable farming communities. Enhancing access to climate-resilient farming techniques, promoting agroecological approaches, and integrating indigenous knowledge systems into climate adaptation strategies could help mitigate the risks posed by climate change and safeguard food security in sub-Saharan Africa.

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4.5. Emotional Effect on Farmers' Livelihoods

The emotional well-being of farmers has been observed to be adversely impacted by the negative consequences of climate change (Table 3). The protracted droughts led to a loss of optimism among certain farmers, as they experienced significant losses in the preceding year and faced ongoing challenges in recovering from these losses. The farmers emphasised their recognition of their susceptibility to climate-related risks, particularly the adverse effects of climate change, such as less rainfall leading to drought. The farmers expressed a heightened level of confusion and worry as they struggled with the uncertainty of whether to persist with their agricultural activities in the face of diminished rainfall resulting from prolonged drought conditions.

Despite being directly impacted by climate change, some farmers remain unaware of its causes and long-term consequences. This lack of awareness can often be attributed to limited access to reliable information and inadequate education on climate-related issues. In many rural areas, farmers may lack exposure to formal climate change education or receive information in a form that is inaccessible or not tailored to their specific contexts. Additionally, there is often a gap between scientific knowledge and local, practical knowledge.

In some cases, farmers might attribute weather anomalies to natural variability, relying on traditional explanations rather than recognising them as symptoms of broader climatic changes. Socioeconomic factors, such as illiteracy, limited access to technology, and low income, can also restrict farmers' ability to access and process information related to climate change. Furthermore, the urgency of immediate agricultural needs may overshadow longer-term concerns, such as climate change, leaving limited space for farmers to engage with environmental issues, even if they are experiencing their effects. This creates a significant challenge in fostering effective climate change adaptation strategies, as understanding the issue is the first step toward proactive and informed action.

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TABLE 3: **Effect of Climate Change on Farmers' Livelihoods**

Type of effects	Concepts	Quotes from farmers
Socioeconomic effects	Declining crop yields increased.	"Our crop yields have gone down, so we don't have enough food." Lower profits
	Increased water scarcity	"It hasn't rained, so there's no water and no crops."
	Increased new pest & disease invasions	"We keep losing crops in our fields because of new pests, like aphids."
Emotional effects	Loss of hope	"We keep on losing our crops."
	Fearful	"If these prolonged droughts persist and there's no rain, we are afraid we will struggle of hunger and food insecurity."
	Helpless	"The issue of climate change is beyond our control, there's nothing we can do."

The primary concern of these farmers revolves around the agricultural sector, which serves as the foundation of their overall livelihood. They expressed distress due to the adverse impact of unfavourable weather conditions on their food security and the subsequent constraints it imposes on their livelihood opportunities. Rural residents expressed a strong desire to make progress and implement methods aimed at mitigating the impacts of climate-related pressures and risks. Nevertheless, individuals perceived the current circumstances as being outside of their sphere of influence, resulting in a sense of helplessness. This sentiment arises from the perception that their indigenous knowledge, which is both cost-effective and readily available, appears to be obsolete. Furthermore, there is a lack of sufficient support mechanisms available to address the challenges posed by climatic threats.

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5. ADAPTATION AND MITIGATION STRATEGIES UTILISED BY FARMERS ON CLIMATE CHANGE

5.1. The Utilisation of Several Cultivars

The United Nations' Food and Agriculture Organisation (FAO) recommends the use of modified crops and varieties, encompassing both herbaceous and tree crops, as a climate-smart approach to mitigate risks, preserve soil and water resources, and enhance water efficiency. The utilisation of modified crops and varieties, whether annual or perennial, serves to mitigate the adverse effects of climate change on agricultural systems while simultaneously ensuring consistent agricultural productivity.

The survey findings suggest that a significant proportion of the smallholder farmers examined (60%, n = 40) utilise a strategy characterised by the diversity of crop kinds and varieties as their primary approach. To mitigate the effects of climate change, some farmers (n = 14, 35%) have adopted alternative varieties of crops or modified the crops they plant. According to the FGDs, smallholder farmers were occasionally compelled to adopt new crops or abandon old ones due to the effects of climate change.

The introduction of novel crops or varieties, as well as the revival of traditional crops, contributes to the diversification of agricultural production. This diversification has a positive impact on biodiversity and ecosystem services, especially when these crops are cultivated in conjunction with conservation agriculture practices. These practices include minimising soil disturbance, maintaining permanent soil organic cover, and diversifying crop species. Based on the survey findings, a small proportion of farmers (n = 2, 4%) have adopted the cultivation of drought-resistant varieties as a strategy to alleviate the adverse effects of recurrent droughts in the region. These droughts have become more prevalent as a consequence of climate change. It is worth noting that farmers who have adopted this approach primarily cultivate maize and soybean crops. One instance of a drought-tolerant crop that has been widely embraced by a majority of farmers, as evidenced by the findings from the focus group discussions (FGDs), is the indigenous short maize variety and wild cherry tomato.

The findings suggest that while some farmers are gradually integrating drought-resistant varieties, there is a need for further extension services, knowledge dissemination, and policy support to encourage broader adoption. Investments in seed distribution programmes, farmer training initiatives, and climate-smart agriculture incentives can play a pivotal role in scaling

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up the cultivation of resilient crop varieties. Furthermore, integrating indigenous knowledge with modern agricultural techniques can offer holistic solutions that enhance productivity while maintaining ecological balance.

5.2. Changing the Time of Planting

According to the survey findings, it can be inferred that a significant proportion of the studied population, specifically 90% (n = 30), has made adjustments to their planting schedules and fertiliser usage as a means of mitigating the potential risks associated with the considerable fluctuations in rainfall patterns observed in the region. Farmers in South Africa are implementing several adaptation measures to mitigate production risk. These tactics encompass the cultivation of crop types with shorter growing periods, adjusting planting schedules based on rainfall patterns, adopting water collection techniques in furrows adjacent to plants, and augmenting the utilisation of irrigation methods. According to the FAO (2018), it is observed that natural fluctuations in climatic factors, such as precipitation and temperature, can prompt small-scale farmers to adapt their planting and harvesting schedules as a means of coping. To mitigate crop production risks, smallholder farmers employ staggered planting techniques. For instance, some farmers opt for dry land planting before the arrival of rainfall, while others choose to plant right after the commencement of the first significant rains.

These findings highlight the dynamic nature of smallholder farming in the face of climate change and underscore the importance of continuous innovation, knowledge-sharing, and support to strengthen farmers' adaptive capacity. Strengthening access to climate information services, improving extension support, and investing in sustainable water management technologies will be essential in ensuring the long-term resilience of South Africa's smallholder agricultural sector.

5.3. Mixed Farming

Farmers have embraced the practice of mixed farming as a means to mitigate risks and adapt to the challenges posed by climate change. The individuals engage in livestock husbandry, specifically raising cattle and goats, while cultivating a diverse range of crops, including maize, tomatoes, cabbage, and soybeans (Conradie, 2020). The practice of mixed farming is crucial in the context of climate change adaptation, as it serves to mitigate the risks associated with over-dependence on a singular agricultural production system. According to Issahaku *et al*. (2019),

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the integration of livestock and agricultural production is recognised as a strategy for enhancing farm diversification and improving farmers' adaptive capacity. As climate change continues to impact agricultural production, extension services should encourage and support the adoption of mixed farming systems to ensure long-term food security and environmental sustainability.

6. CONCLUSION AND RECOMMENDATIONS

To enhance the resilience of farmer livelihoods amid the fluctuations brought about by climate change, it is imperative for the Department of Agriculture to actively participate in this endeavour. This is particularly crucial given that a significant proportion of those impacted by these changes are impoverished and reside in rural regions. The Department of Agriculture, Land Reform, and Rural Development should provide targeted subsidies to farmers by supplying high-quality, climate-resilient seed cultivars with strong resistance to pests. Additionally, the government should invest in the establishment and maintenance of efficient irrigation infrastructure to enhance water security for agricultural production.

To improve climate change awareness, the department should mandate Agricultural Advisors to conduct regular, structured information sessions in rural areas. These sessions should include practical demonstrations, farmer training workshops, and knowledge-sharing platforms to ensure that rural communities understand climate risks and adopt adaptive farming practices. Furthermore, it is advisable to extend invitations to all stakeholders in order to enhance the knowledge and capabilities of farmers.

Climate change has been observed to have differential impacts on individuals based on their gender. Further research is warranted to assess the gendered aspects of climate change's impact on small-scale farmers and their corresponding adaptation strategies.

REFERENCES

AGNOLUCCI, P., RAPTI, C., ALEXANDER, P., DE LIPSIS, V., HOLLAND, R., EIGENBROD, F. & EKINS, P., 2020. Impacts of rising temperatures and farm management practices on global yields of 18 crops. *Nature Food.*, 1(9): 562–571.

BELLPRAT, O., LOTT, F.C., GULIZIA, C., PARKER, H.R., PAMPUCH, L.A., PINTO, I., CIAVARELLA, A. & STOTT, P.A., 2019. Unusual past dry and wet rainy seasons

over Southern Africa and South America from a climate perspective. *Weather Clim. Extrem.*, 9: 36-46.

CONRADIE, B. & GENIS, A., 2020. Efficiency of a mixed farming system in a marginal winter rainfall area of the Overberg, South Africa, with implications for thinking about sustainability. *Agrekon.*, *59*(4): 387-400.

COWLING, D.N., 2021. *Households involved in agricultural activities in South Africa in 2021.* Available from https://www.statista.com/statistics/1116075/share-of-agricultural-households-in-south-africa-by-province

DEBELA, N., MOHAMMED, C., BRIDLE, K., CORKREY, R. & MCNEIL, D., 2015. Perceptions of climate change and its impacts by smallholder farmers in pastoral/agropastoral systems of Borana, South Ethopia. *Springer Open Journal.,* 4: 236.

DRYSDALE, R.E., MOSHABELA, M. & BOB, U., 2019. Food security in the district of iLembe, KwaZulu-Natal: A comparison of coping strategies between urban and rural households. *Ecol. Food Nutr.*, 58: 379–396.

EDOSSA, D.C., WOYESSA, Y.E. & WELDERUFAEL, W.A., 2019. Spatiotemporal analysis of droughts using self-calibrating Palmer's Drought Severity Index in the Central Region of South Africa. *Theor. Appl. Climatol.,* 126: 643–657.

FARMING PORTAL., 2019. Available from: https://agriculturereportal.co.za/index.php/farming-news/downloads?start=5.

FAO., 2018. *Climate change, energy and food: Climate-related transboundary pests and diseases*. Rome: FAO.

FAO., 2021. *Desert local upsurge. Progress report on the response in Greater Horn of Africa and Yemen.* Available from https://openknowledge.fao.org/server/api/core/bitstreams/ef5b3577-2033-4087-aa7d-3bdf9253d1f1/content

FITCHETT, J.M., GRANT, B., HOOGENDOORN, G. & FITCHETT, J., 2020. Climate change threats to two low-lying South African coastal towns: Risks and perceptions. *S. Afr. J. Sci.,* 112(5/6): 1-9.

IPCC., 2021. *Managing the risks of extreme events and disasters to advance climate change adaptation.* A special report of working groups I and II of the Intergovernmental Panel on Climate Change. Cambridge, UK and New York, NY: Cambridge University Press.

ISSAHAKU, G. & ABDULAI, A., 2019. Can farm households improve food and nutrition security 2 through adoption of climate-smart practices? Empirical evidence from Northern Ghana. *Appl. Econ. Perspect. Policy.,* 0(0): 1-22.

KANBUR, S. & RAVI, J., 2009. *Labor Markets and Economic Development.* Abingdon, Oxon: Routledge.

LDA., 2012. *The mapping of agricultural commodity production in the Limpopo province, South Africa.*

LITTLE, A., 2019. *Climate change is likely to devastate the global food supply. But there's still reason to be hopeful*. Available from https://www.potatonewstoday.com/2019/08/31/climate-change-is-likely-to-devastate-the-global-food-supply-but-theres-still-reason-to-be-hopeful/

MASTRORILLO, M., LICKER, R., BOHRA-MISHRA, P., FAGIOLO, G., ESTES, L.D. & OPPENHEIMER, M., 2018. The influence of climate variability on internal migration flows in South Africa. *Glob. Environ. Change.,* 39: 155-169.

MAPONYA, P. & MPANDELI, S., 2012. Coping with climate change variability in Limpopo province, South Africa. *Peak J. Agric. Sci.*, 4: 54-64.

MOLELE, C., 2016. *Cultivating agri-business in Limpopo*. Mail & Guardian. Available from https://mg.co.za/article/2016-11-25-00-cultivating-agri-business-in-limpopo/

MIDGLEY, G.F. & BOND, W.J., 2015. Future of African terrestrial biodiversity and ecosystems under anthropogenic climate change. *Nat. Clim. Chang.,* 5(9): 823-829.

MUKWADA, G., MAZIBUKO, S.M., MOELETSI, M. E. & ROBINSON, G.M., 2021. Can famine be averted? A spatiotemporal assessment of the impact of climate change on food security in the Luvuvhu river catchment of South Africa. *Land.,* 10(5): 527.

MUTEKWA, V.T., 2009. Climate change impacts and adaptation in the agricultural sector: The case of smallholder farmers in Zimbabwe. *J. Sustain. Dev. Afri.,* 11: 237-256.

NDLOVU, N. & ZENDA, M., 2024. The impact of climate change on food security and natural resource management in smallholder crop farming systems at Mthonjaneni Local Municipality, KwaZulu-Natal, South Africa. *S. Afr. J. Agric. Ext.*, *52*(2): 159-177.

ONI, S.A., NESAMVUNI, A.E., ODHIAMBO J.J. & DAGADA D.C., 2012. *Executive summary of a study of agricultural industry of Limpopo Province.* South Africa: Centre for Rural Development: Department of Soil Science.

ÖZKAN, G. & GEZER, U., 2024. Investigation of activities related to specific days and weeks in life science course in the context of classroom teachers' opinions. *QIETP.*, 2(1): 23-41.

PASQUINI, L., COWLING, R.M. & ZIERVOGEL, G., 2019. Facing the heat: Barriers to mainstreaming climate change adaptation in local government in the Western Cape Province, South Africa. *Habitat Int.,* 40: 225-232.

SHAYEGH, S., MANOUSSI, V. & DASGUPTA, S., 2020. Climate change and development in South Africa: The impact of rising temperatures on economic productivity and labour availability. *Clim. Dev.,* 13(8): 725-735.

SOUTH AFRICAN WEATHER SERVICES (SAWS)., 2020. *Lepelle nkumpi district summary climatical data.*

STATS SA., 2021. Available from https://www.statssa.gov.za/?s=limpopo&sitem=publications

ZENDA, M. & MALAN, P., 2021. The sustainability of small-scale sheep farming systems in the Northern Cape (Hantam Karoo), South Africa. *S. Afr. J. Agric. Ext.*, 49(1): 105-121.

10.17159/2413-3221/2026/v54n1a18959

ZIERVOGEL, G., NEW, M., VAN GARDEREN, E.A., MIDGLEY, G., TAYLOR, A., HAMANN, R., STUART-HILL, S., MYERS, J. & WARBURTON, M., 2017. Climate change impacts and adaptation in South Africa. *WIREs Clim Change,* 5: 605-620.

ZIERVOGEL, G. & TAYLOR, A., 2020. Feeling stressed integrating climate adaptation with other priorities in South Africa. *Environ.,* 50(2): 32-41.