S. Afr. J. Agric. Ext. Dingiswayo, Khapayi & Majola
Vol. 54 No. 4, 2026: 47-69
10.17159/2413-3221/2026/v54n4a18698 (License: CC BY 4.0)

Perceptions of Small-Scale Vegetable Farmers Regarding Drought Mitigation Strategies in the Amathole District Municipality, Eastern Cape Province

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ABSTRACT

The research explored the views of small-scale vegetable farmers on drought mitigation in the Amathole District Municipality, an area known for its tough landscapes in the Eastern Cape Province of South Africa. The study covered several local municipalities, including Mbashe, Mnquma, Amahlathi, and Great Kei. It involved 44 small-scale vegetable farmers, chosen because they participate in government social support programs and are officially registered with the Department of Rural Development and Agrarian Reform. These farmers are vital in fighting food insecurity and boosting local economies. Additionally, insights were collected from 13 agricultural extension officers experienced in supporting small-scale farmers. Data collection used two self-administered questionnaires and a mixed-methods approach, combining qualitative and quantitative analysis. The qualitative data were analysed thematically using inductive coding, while the quantitative data were analysed using SPSSX version 25.0 and STATA version 9. The results showed that drought is a major challenge across the listed local municipalities, impacting agricultural output and farmers' financial stability. There is a notable lack of access to information and training on effective drought strategies, as well as insufficient adaptive techniques and timely government support. This gap threatens farmers' livelihoods and the wider agricultural sector. The study suggests improvements in infrastructure, affordability, and access to training for better drought management. It also

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Vol. 54 No. 4, 2026: 47-69
10.17159/2413-3221/2026/v54n4a18698 (License: CC BY 4.0)

highlights the need for collaboration among government, NGOs, and the private sector to promote sustainable agricultural practices in response to climate change.

Keywords: Perceptions, Small-Scale Vegetable Farmers, Drought Mitigation Strategies, Amathole District Municipality.

1. INTRODUCTION

In many developing countries, the livelihoods of people living in poverty are closely tied to subsistence crop farming (Serote, Mokgehle, Du Plooy, Mpandeli & Senyolo, 2023). These individuals, often known as small-scale farmers (SCFs), play a crucial role in agriculture, especially in rural, semi-rural, and urban areas where farming is the primary means of combating poverty (Mango, Makate, Tamene, Mponela & Ndengu, 2018). Kamara and Conteh (2019) estimate that about 500 million small-scale farmers worldwide, indicating that more than two billion people depend on their work for daily food and economic stability. In South Africa, small-scale farmers are important in reviving rural economies, supporting their families, and providing local markets by working small plots of land, usually less than three hectares (Mwangi & Kariuki, 2015). However, despite their vital role in rural economic growth, many of these small farms face major challenges, especially across Africa. They struggle with low crop yields, rising food insecurity, and persistent rural poverty. These problems are made worse by water shortages, unpredictable weather, and irregular rainfall—factors that can seriously affect crop production and people's livelihoods (Sinyolo, 2019). George, Hameed, and Baskar (2022) emphasise that vegetable production, especially in small-scale farming, is crucial for addressing food security, nutrition, livelihoods, and environmental sustainability. As the global population grows and concerns about health and nutrition increase, the role of vegetable production in building a sustainable and resilient food system becomes even more vital (George, Hameed & Baskar, 2022). In particular, small-scale vegetable farming—primarily practised by farmers in semi-rural and urban areas such as the Amathole District Municipality—is essential for meeting the diverse needs of local communities and supporting sustainable food systems (Mukaila, Falola, Akanbi & Egwue, 2022). This farming approach involves growing a variety of vegetables on relatively small plots of land, often using traditional or low-input methods that help increase resilience against economic and environmental challenges (Mukaila et al., 2022).

Despite their modest scale, these small-scale vegetable farms make substantial contributions to multiple crucial sectors. The significance of small-scale vegetable farming extends beyond mere economic metrics; it is fundamentally linked to nutritional security (Mukaila *et al*., 2022). Vegetables are a rich source of essential vitamins, minerals, and dietary fibre—critical components of a well-balanced diet (Jamali & Asif, 2014). By providing a diverse selection of fresh vegetables, small-scale farmers enhance both the availability and accessibility of nutritious food options, particularly in regions where fresh produce is sparse or unaffordable (Dong, Han & Liang, 2023). Moreover, small-scale vegetable farming is a vital source of income and livelihoods for millions of people worldwide, particularly in rural and urban communities. These agricultural enterprises create employment opportunities at multiple stages of the value chain, from cultivation and harvesting to processing and marketing (Mazibuko, 2018). The primary aim of this study was to (a) explore the adaptive strategies employed by small-scale vegetable farmers to navigate the challenges posed by drought conditions, and (b) devise community-based communication methods to educate stakeholders and disseminate effective mitigation strategies. These strategies can ultimately influence policy discussions surrounding climate change. An informed society that understands drought and has early warning systems—whether through traditional knowledge or modern communication technologies—is markedly less vulnerable to its impacts. Therefore, implementing an effective disaster risk mitigation plan is essential, as it helps gauge community response to disasters and enhances preparedness through early warning systems. These systems are crucial for minimising the disruptions caused by drought and ensuring that communities are better equipped to cope with adverse conditions.

1.1. Theoretical Framework: Political Ecology and Vulnerability Nexus

This research is grounded in the political ecology framework (PEF), which provides a comprehensive lens for analysing the interplay among political, economic, and environmental factors influencing food security. The study investigates how rural, semi-rural, and urban households access food and sustain their food systems amidst persistent drought conditions and the broader impacts of climate variability. Understanding this intricate relationship is critical, as the ability of communities to secure sustainable food sources is not merely a matter of geography or availability; rather, it is deeply intertwined with the political and socioeconomic contexts that shape exposure to and vulnerability from climatic risks. The research specifically explores the differential vulnerabilities faced by households across varying residential

classifications—rural, semi-rural, and urban—underscoring that the challenges inherent in accessing sustainable food systems cannot be fully addressed within isolated frameworks. Instead, these challenges are interwoven with existing political and economic structures that exacerbate the effects of environmental hazards and shape individuals' capacity to cope and adapt. For instance, Ajibade and McBean (2014) and Dinko et al. (2018) highlight how these vulnerabilities manifest in tangible ways.

Dinko *et al*. (2018) provide a compelling case study from northeastern Ghana, where the political landscape is characterised by chieftaincy rule. Their research reveals why certain households—particularly those categorised as emigrants, despite their national identity—struggle to secure agricultural land near critical resources, such as community dams, for irrigation during dry seasons. Their findings indicate that these households are often neglected in farmland distribution processes overseen by local chiefs, who prioritise those deemed true Ghanaian nationals or closely aligned with the political elite. Furthermore, the study identifies that female-headed households, particularly those with numerous dependents and uncooperative absentee husbands engaged in off-farm jobs, face heightened water insecurity. This demographic exemplifies the intersection of gender and economic vulnerability; without support or adequate means to transport water, these women are disproportionately affected by climate change, particularly during droughts, when water scarcity becomes a pressing concern (Dinko *et al*., 2018).

Similarly, Ajibade and McBean (2014) illustrate the detrimental effects of divisive community politics in urban settings like Lagos and Baida. Their research emphasises how political favouritism and exclusion during the 2008 local government elections exacerbated household vulnerability to flooding. Residents of Baida were particularly marginalised, as infrastructure projects that could have mitigated flood risks were sidelined in favour of rewarding political loyalists. The research indicates that these conditions left many residents reliant on inadequate housing—wooden structures lacking resilience against flooding—due to tenure insecurity and the chronic poverty that pervades the community. The culmination of these conditions became painfully evident during the 2011 heavy rainstorm, which unleashed unprecedented rainfall and wreaked havoc on health, property, and livelihoods (Ajibade & McBean, 2014). In light of these findings, employing a political ecology analysis is essential. It reveals the varied characteristics and circumstances within communities that can amplify vulnerability to climate change and exacerbate existing inequalities. The PEF enables a deeper understanding of the

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power dynamics that prevent certain households from accessing critical resources necessary for climate adaptation. Consequently, this research leverages the PEF to elucidate the complex barriers that small-scale vegetable farmers in the Amathole District Municipality encounter when seeking mitigation strategies to cope with adverse drought conditions. Through this analysis, the research aims to lay the groundwork for developing equitable solutions that address the disproportionate vulnerabilities present within these communities.

2. METHODS USED

A mixed-methods approach was used to enhance research quality by addressing biases associated with qualitative or quantitative methods. This approach provided a nuanced understanding of the topic. For qualitative analysis, thematic content analysis was performed using Atlas.ti software to identify patterns in the textual data, employing inductive coding to generate new insights. Simultaneously, statistical software was used to analyse numerical data collected through structured, self-administered questionnaires with both open- and closed-ended questions. Face-to-face data collection methods explored the study problem in depth and observed nonverbal cues, capturing diverse perspectives alongside quantifiable data. The study targeted small-scale vegetable farmers in the Amathole District Municipality, specifically in Mbashe, Mnquma, Amahlathi, and Great Kei, who are vital to local food systems and engaged in initiatives to combat food insecurity. The researcher utilised a three-stage sampling process to identify study participants. The first stage involved selecting municipalities known for their agricultural potential in localised rain-fed agriculture. Consultations with extension officers provided insights into local practices and helped select participants. Many small-scale vegetable farmers were found to be organised into cooperatives, and a detailed list of these groups was compiled with the help of government officers. Despite efforts to engage all farmers, many declined to participate for various reasons, such as other business commitments or part-time farming. The focus thus shifted to full-time vegetable farmers who rely on farming for their livelihood. Criteria for participant selection included availability, willingness to cooperate, and achieving data saturation, resulting in a final sample size of forty-four willing participants.

The study was conducted with the approval of the Research Ethics Committee—Humanities at Nelson Mandela University. The application outlined strict ethical protocols, assuring that participant identities would remain confidential and that any information collected would not

be used against them. Throughout the research process, ethical principles were prioritised, ensuring the anonymity and confidentiality of all participants. The researcher emphasised that the study was solely for academic purposes and clarified that participants would not receive employment or remuneration for their involvement. In exchange, the results would be presented to relevant authorities engaged in subsistence agriculture development, and a training workshop would be conducted to educate small-scale vegetable farmers on effective climate change mitigation strategies based on the study's findings. Data collected from the questionnaires were meticulously coded by assigning numerical values to facilitate the management of the results in SPSSX (version 25.0). Initially, the data were entered into a Microsoft Excel 2022 spreadsheet, which was subjected to thorough filtering and error-checking before subsequent analysis using both SPSSX and STATA V9. To ensure accuracy, any data discrepancies were rectified by continually cross-referencing the survey instruments with field notes and photographic evidence. Face-to-face data collection with respondents was conducted on their farms by appointment, allowing them to allocate sufficient time for an uninterrupted discussion. This approach not only ensured thoughtful and comprehensive responses but also provided the researcher with an opportunity to observe the farming environment firsthand, thereby triangulating and verifying the collected data. Conducting on-site data collection provided an additional layer of detail, enabling the researcher to confirm that all questions were adequately addressed without intimidating participants.

3. RESULTS AND DISCUSSION

The demographic characteristics of small-scale vegetable farmers are crucial for understanding their agricultural decisions and responses to challenges such as climate change. Often, the household head—the individual responsible for coordinating household activities and generating income—significantly influences these decisions. Therefore, integrating demographic attributes into research on small-scale farmers is essential to accurately assess how these factors affect their climate change mitigation strategies. In this study, 86% of respondents were aged 46 or older, while only 14% were aged 21 to 45. This demographic trend suggests a predominance of older individuals among small-scale vegetable farmers in the region. While these experienced farmers benefit from a wealth of knowledge accumulated over years of practising traditional and indigenous farming methods, their age also imposes certain limitations. Specifically, older farmers may be more reluctant to adopt innovative practices and often exhibit greater risk aversion, which can hinder their adaptability to drought and changing

climatic patterns. The perception of farming as an unfashionable career among young people may explain the lower level of youth involvement in agriculture (Tokozwayo et al., 2022). These findings align with the research conducted by Sumberg et al. (2012), as well as Myeni, Moeletsi, Thavhana, Randela, and Mokoena (2019), and the European Commission (2017), which noted that many small-scale farmers are over the age of 55, and that the low level of agricultural engagement among African youth may be attributed to their migration to cities in search of better opportunities.

Education plays a crucial role in shaping individuals' farming decisions. Those with higher educational attainment typically possess a greater ability to interpret agricultural information and apply it effectively in their practices. Education enhances skills in planning, informed decision-making, resilience in the face of new challenges, risk management, and the use of modern technology. Regrettably, the educational levels of the surveyed farmers were notably low: only 12% had not completed Grade 8, while 32% had finished Grade 8; 18% had completed Grade 9; 16% achieved Grade 10; 18% reached Grade 11; and merely 4% had attained Grade 12. This data reveals that 62% of the farmers did not progress beyond Grade 10, and no household head had completed a tertiary education. Supporting these findings, it has been frequently noted that rural small-scale farmers in South Africa have limited access to educational opportunities (Thamaga-Chitja & Morojele, 2014). Low-income households often exhibit cyclical educational attainment, with children from these families more likely to drop out of school due to financial constraints that limit their ability to spend on education, as noted by the South African Department of Cooperative Governance and Traditional Affairs (2020). In contrast, commercial farmers in South Africa are often characterised by having higher educational levels, including tertiary education (Khapayi & Celliers, 2016).

Furthermore, only 22% of the surveyed farmers reported participating in agricultural short courses before embarking on their farming careers, leaving 78% without such training. The primary obstacle to accessing these valuable educational opportunities is the high cost of the courses, which many farmers cannot afford. Typically, only those with personal connections to agricultural institutions can enrol in workshops or skills-transfer sessions, revealing a critical gap in access to essential agricultural education and resources. Betek and Jumbam (2015) highlight that one of the challenges small-scale farmers face in vegetable cultivation is the lack of appropriate hands-on training. According to Muthelo, Owusu-Sekyere, and Ogundeji

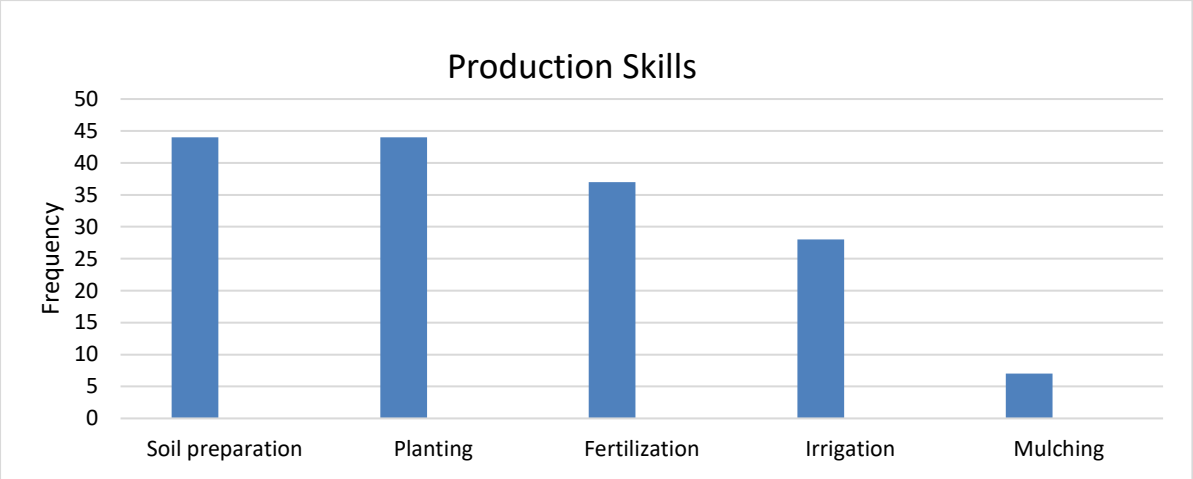
(2019), farmers who can predict rainfall at the start of the farming season generally possess a tertiary or at least a secondary level of education or have undergone training in specific skills.

TABLE 1: Various Vegetables Grown by Small-Scale Farmers

Vegetable types grown	Frequency	Percent
Beetroot	27	61.4
Butternut/pumpkin	13	29.5
Cabbage	35	79.5
Carrots	18	40.9
Cauliflower	3	6.8
Lettuce	3	6.8
Onions	17	38.6
Potatoes	31	70.5
Spinach	34	77.3
Tomatoes	4	9.1
Peppers	8	18.2
Other	4	9.1

The findings indicate that cabbage, spinach, potatoes, and beetroot are the primary vegetables cultivated in the area. Carrots, onions, and butternut/pumpkin are grown on a moderate scale, while peppers, tomatoes, cauliflower, and lettuce are the least cultivated vegetables, with only a few small-scale farmers producing them. Additionally, approximately 9.1% of the farmers grow other crops such as maize, sweet potatoes, or beans. The research primarily focused on the commonly cultivated vegetables grown by small-scale farmers in rural areas, but was not restricted to specific types. These vegetables are mainly chosen for their resilience to drought conditions and are commonly used in household dairy dishes. These results align with Kibirige's (2013) findings, which indicate that in the Eastern Cape province, small-scale and subsistence farmers typically plant cabbage, potatoes, spinach, butternuts, and carrots during the summer months to ensure household food security and generate income. Small-scale farmers cultivate these vegetables because of their high value, enabling them to supplement government social assistance and remittances (Kibirige, 2013).

FIGURE 1: Production Skills of Respondents



The data presented in Figure 1 indicate that 100% (all 44) of the respondents engage in soil preparation before planting. This practice is vital for farmers as it creates an optimal environment for crop growth, promotes germination and root development, and contributes to overall plant health. Furthermore, all respondents (100%, or 44) are actively involved in planting, as shown by the results. Additionally, 84.1% (37) of respondents have adopted effective fertilisation strategies, using fertilisers at appropriate times and in appropriate quantities. Fertilisers play an essential role in crop production, with the type of fertiliser used distinguishing between conventional and organic farming (Beharielal, Thamaga-Chitja & Schmidt, 2022). Small-scale farming typically relies on animal manure as fertiliser, whereas commercial farming relies on synthetic fertilisers (Pires, Milner, Baron & Jay-Russell, 2018). Due to limited resources, small-scale farmers' use of animal manure is associated with a higher prevalence of pathogenic microorganisms in agricultural soils than in soils that primarily use synthetic fertilisers (Gu et al., 2013). An irrigation programme is followed by 63.6% (28) of the respondents. However, irrigation is a major challenge due to the ongoing drought in the area. Most farmers in the study area rely on rainfall for irrigation; some are planting under irrigation schemes and have access to irrigation water year-round. These farmers lack the necessary resources to adopt irrigation infrastructure; hence, a large number of small-scale vegetable farmers rely on rainfall as their primary irrigation method.

In South Africa, irrigation water is vital for the production of fresh produce. However, the increasing difficulty in providing safe, high-quality water has resulted in lower production yields (Decol et al., 2017; Stats SA, 2019). Historically, South African fresh produce farmers have relied on water sourced from dams, streams, or rivers for irrigation (Jongman & Korsten,

2017). According to Kamwamba-Mtethiwa, Weatherhead, and Knox (2016), small-scale farming often employs basic irrigation technology, influenced by the educational backgrounds of these farmers. Worldwide, including in South Africa, a significant number of small-scale farmers also use rainwater for irrigation (Hamilton et al., 2019). However, only 15.9% (7) of surveyed individuals are aware of the benefits of mulching for production and have incorporated this practice into their farming systems. This indicates that, due to drought, reduced yields, and limited climate resilience, accessing mulching materials can be challenging, and some farmers remain uninformed about their advantages. There is also a noticeable lack of training and awareness programs to equip farmers with the necessary skills.

TABLE 2: Challenges in Small-Scale Vegetable Production

Challenges respondents face	Frequency	Percent
Infrastructure	13	29.5
Production inputs	22	50.0
Farming skills	10	22.7
Soil degradation	0	0.0
Climate change	3	6.8
Water scarcity	43	97.7
Drought	43	97.7
Strong winds	6	13.6
Market	3	6.8
Pests and diseases	2	4.5

Farming, particularly subsistence farming, faces numerous challenges, including access to credit, innovations, climate change, land ownership issues, and both natural and personal obstacles. Small-scale vegetable farmers in the Amathole district were surveyed to determine the challenges they encounter in small-scale farming. The results, shown in Table 2, indicate various challenges identified by the participants, some of which lead to significant production problems. The data revealed that drought (97.7% or 43 respondents) and water scarcity (97.7% or 43 respondents) are viewed as the most severe challenges. Most respondents are experienced farmers who are nonetheless affected by these issues. Production inputs negatively affect 50% (22 respondents) of participants, while infrastructure affects 29.5% (13), and farming skills

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affect 22.7% (10). Other challenges include strong winds (13.6% or 6 respondents), climate change (6.8% or 3), marketing (6.8% or 3), and pests and diseases (4.5% or 2), which have the least impact on respondents. Notably, no respondents reported being affected by soil degradation on their farms, resulting in a zero percent figure for this issue. Among the major difficulties these farmers face are naturally occurring challenges, such as sudden changes in weather patterns and drought, which lead to critical water scarcity. Drought and water scarcity are particularly pressing issues because they significantly impact production. Without adequate water, most farmers are unable to irrigate their crops since they primarily rely on rainfall for their water supply. Challenges such as pests, diseases, and marketing do not appear to pose significant threats to small-scale farming. The 0% figure for soil degradation indicates either a lack of awareness or poor monitoring of soil conditions, given that soil degradation is a significant problem in South Africa. According to Akapalu (2005), rural farmers and those with limited resources are especially vulnerable to drought and water scarcity. Research by Mdoda, Mushunje, Olajide, and Lesala (2020), as well as by Madamombe et al. (2024), confirms that drought is the most common extreme weather event negatively affecting agricultural productivity. These findings align with those of this study.

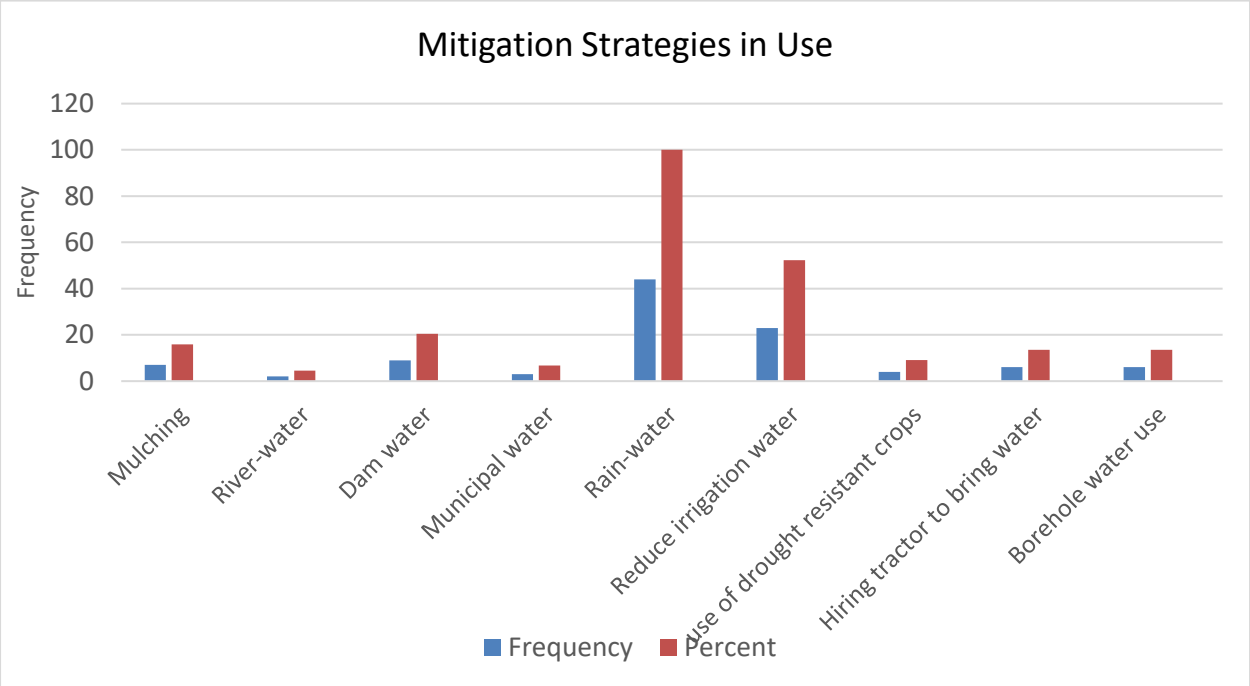

FIGURE 2: Mitigation Strategies Implemented by Respondents

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All respondents benefit from rainwater (100% or 44 respondents) for irrigation. Since rainwater is only available during the rainy season, some respondents indicated storing it for the dry seasons. Slightly above half (52.3% or 23) of respondents practice reducing the amount of irrigation water used to have water for a longer period of time, and tend to irrigate only once every second day to save water. However, reducing irrigation reduces vegetable production, as crops wilt without sufficient water. The use of dam water was employed by 20.5% (9) of respondents. This method, however, involves fuel costs, as generators must pump water from the dam to the field. The use of river water was practised by 4.5% (2) of respondents, but it also involves fuel costs to run a generator. The use of river and dam water becomes problematic during droughts, as dam and river levels drop or run dry altogether. A further 13.6% (6) of respondents reported hiring a tractor to transport water from dams or rivers. However, this approach can be quite costly, as it involves paying for tractor use to obtain water. Municipal water was utilised by 6.8% (3) of the respondents, but relying on it for irrigation is prohibitively expensive for farmers. Another strategy employed by 13.6% (6) of the respondents was the installation of drilled boreholes on their farms, from which borehole water is used to irrigate crops during periods of drought.

As previously mentioned, only 15.9% (7) of the respondents practice mulching in their fields. Mulching helps cover the soil, shielding it from direct sunlight, aiding moisture retention and consequently reducing the amount of water needed for irrigation. Additionally, cultivating drought-resistant crops is a strategy used by only 9.1% (4) of the farmer respondents. These crops can survive drought and require minimal water. The findings of this study align with those of Ncube (2017) and Vilakazi (2017), who noted that small-scale farmers rarely utilised drip irrigation, no-till farming, mulching, limited production, or rainwater collection. Instead, farmers tended to adopt drip irrigation, harvest rainwater, and limit production when faced with water scarcity. However, rainwater harvesting poses challenges for some small-scale farmers due to inadequate storage facilities, such as tanks.

TABLE 3: Determinants in the Choice of Existing Drought Coping Strategies Provided to Small-Scale Vegetable Farmers

Impact of drought	Coping strategies	Adaptation strategies
• Water shortage • Loss of vegetable yields • Lack of food availability	• Sustainable water management • Shade netting • Mulching to conserve moisture • Planting various vegetable varieties • Planting small areas • Irrigating small areas	• Drilling boreholes for a reliable supply of irrigation water • Rainwater harvesting • Mulching to conserve moisture • Government programmes support

Table 3 outlines the coping and adaptation strategies that extension officers present to small-scale vegetable farmers. These officers collaborate closely with farmers to address the challenges they face. Among the coping strategies provided to sustain productivity during drought periods are sustainable management practices, shade netting, mulching, intercropping, reducing the area planted, and using less water for irrigation. While these strategies serve as short-term solutions, the adaptation strategies offered are designed for long-term implementation, although farmers often find them difficult to adopt. These findings align with those of Atube et al. (2021), who found that small-scale farmers are significantly more likely to implement drought adaptation strategies when they have access to agricultural extension services. Such services equip farmers with the technical skills needed to improve their resilience to climate change and drought. The increasing frequency of droughts in recent years has enhanced farmers' understanding of their circumstances and informed their adaptation decisions.

4. CONCLUSION AND RECOMMENDATIONS

The empirical data gathered from surveyed farmers indicate a distinct absence of drought mitigation strategies; instead, farmers primarily use drought coping mechanisms. Small-scale vegetable farmers in the surveyed areas have adopted several coping strategies, including cultivating drought-tolerant crops, using zero-tillage practices, mulching, reducing irrigation

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use, and adjusting planting times, either earlier or later than usual. While these strategies are prevalent among some respondents, awareness and understanding of these coping mechanisms are not universal among all farmers. Additionally, the data reveal that farmers are inadequately informed about drought and climate change mitigation strategies and do not receive specialised training on these topics. As a result, farmers are relying on available drought coping mechanisms without the necessary adaptive strategies or sufficient state intervention to build long-term resilience. Many small-scale producers, constrained by limited resources, depend heavily on natural resources, particularly water for irrigation. The crops respondents identified as drought-tolerant include cabbage, spinach, potatoes, and sweet potatoes, which are known for their resilience to drought and shorter growth periods. The practice of zero-tillage is considered beneficial as it preserves soil structure and moisture retention. Mulching is another strategy respondents use to suppress weed growth and prevent soil moisture loss. However, the availability of mulching materials can be a barrier, as not all farmers have access to what they need. The study further highlights a lack of resources, training, and involvement from extension services, which has led farmers to rely on their existing drought coping mechanisms while seeking to adapt their production methods.

Information sharing: To improve rural livelihoods and enhance productivity, it is recommended that information-sharing sessions be initiated. These sessions can facilitate skill development and provide small-scale vegetable farmers with up-to-date agricultural information. Regular meetings, facilitated by agricultural extension officers, can foster collaboration, enabling farmers to share strategies and best practices to address climate change.
Youth engagement and innovation: Importantly, the lack of youth engagement in farming poses challenges for the adoption of modern conservation techniques and innovative farming systems necessary to mitigate climate change impacts and revitalise rural areas, such as Amathole. Promoting education on drought, advanced drought-coping mechanisms, and adaptive strategies is essential for fostering a blend of traditional and contemporary agricultural knowledge. Infrastructure development within rural communities is crucial for improving farming operations and systems. Initiatives aimed at building capacity and enhancing digital literacy among farmers can promote effective utilisation of IT solutions.

Education: Workshops focused on IT applications and climate-smart agricultural practices can empower farmers to embrace new technologies. Nonetheless, challenges such as infrastructure limitations, poor internet connectivity, and limited access to technology can obstruct the

adoption of these solutions. It is essential to ensure affordability to enable widespread access for small-scale farmers. Addressing infrastructure limitations, ensuring affordability, and providing adequate training are critical for the successful adoption of these solutions. Collaborative efforts involving government, NGOs, and the private sector will be vital for promoting sustainable agricultural practices amid climate change.

5. ACKNOWLEDGEMENTS

The financial support from the TATA Africa Scholarship, the Dormehl-Cunningham Scholarship, the Nelson Mandela University Post-Graduate Research Scholarship (PGRS) and the FoodBev SETA Bursary. All the scholarships and bursaries stated above are acknowledged for the support of this research study. The author would like to thank the editors for their thoughtful and insightful suggestions in this study.

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