Research on World Agricultural Economy
https://journals.nasspublishing.com/index.php/rwae

RESEARCH ARTICLE

The Impact of Climate Change on Agricultural Risks in Southern Africa: A Case Study of Mutoko District, Zimbabwe

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ABSTRACT

Agricultural production in rural Zimbabwe is severely constrained by climate change. This paper investigates the impact of climate change on agricultural risks in rural Zimbabwe, focusing specifically on changes in temperature and precipitation patterns as well as increased frequency of extreme weather events. This study utilized a qualitative methodology to discern the understanding of local farmers concerning climate change adaptation on agricultural risks. The study employed in-depth interviews and focus group discussions as data collection instruments. Purposive sampling was employed to select twenty (20) small-scale farmers and ten (10) key informants, namely agricultural specialists, agronomy experts, and local leadership in particular leaders from crops-related committees based on ward structures within the agriculture and rural development sectors of Mutoko district. The study found that agriculture risks in the district are exacerbated due to factors such as decreased crop yields and increased pest or disease incidence that worsen food insecurity. The study concludes that due to insufficient institutional support for rural communities in Zimbabwe, adaptation efforts towards climate change impacts on agriculture tend not to yield anticipated outcomes. The paper recommends adaptive approaches to reduce agricultural risks and increase agricultural resiliency in the district.

Keywords: Agricultural Risks; Climate Change; Rural Zimbabwe; Southern Africa; Food Security

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ARTICLE INFO
Received: 10 August 2024 | Revised: 13 September 2024 | Accepted: 18 September 2024 | Published Online: 27 March 2025
DOI: https://doi.org/10.36956/rwae.v6i2.1232

CITATION
Mugambiwa, S.S., 2025. The Impact of Climate Change on Agricultural Risks in Southern Africa: A Case Study of Mutoko District, Zimbabwe. Research on World Agricultural Economy. 6(2): 111–122. DOI: https://doi.org/10.36956/rwae.v6i2.1232

1. Introduction

Climate change has severe effects on local communities that rely entirely on agriculture [1]. Shifting climatic conditions in the region as a result of climate change have left Zimbabwe grappling with exacerbated challenges. Agricultural activities in rural Zimbabwe are heavily dependent on rainfall [2], which exposes them to the vagaries of climate change as is increasingly being experienced. A majority of rural Zimbabweans depend on subsistence farming for livelihood with agriculture being the backbone of the country's economy [3]. This increasing trend of climate change is triggering challenges like transforming agricultural systems and intensifying existing vulnerabilities [3]. Southern Africa is characterized as a region highly sensitive to the adverse effects of climate change owing mainly to their dependence on agricultural practices which are largely rain-fed [4].

The region has undergone marked climatic changes over the last few decades where there have been temperature increases, shifts in rainfall patterns to more erratic weather events such as floods and/or drought [2, 5]. Zimbabwe has multiple climatic zones, including semi-arid and humid regions. Even so, rural areas depend heavily on subsistence farming such that maize, alongside other staple crops which are fundamental for survival as well as economic viability. The concomitant rise in temperature and shifts in the pattern of precipitation has had severe implications on agriculture that can overshadow other threats such as food poverty aggravating, harvest production decreases astronomically [6]. The consequences of climate change vary from general to intricate and have disturbing impacts on indigenous agriculture practices resulting in reduction of crops, decreased yields and other socio-economic vulnerability [2, 4]. Also, they deepen existing social and economic vulnerabilities, including poverty and inadequate access to agricultural resources. Consequently, farmers in rural Zimbabwe are more food insecure and economically vulnerable as a result [7]. This study aimed to assess the potential impacts of climate change on agricultural risks in the Mutoko district of Zimbabwe. The study sought to provide guidance on how to build breakthroughs and ensure food security in an increasingly uncertain world.

1.1. Literature Review

1.1.1. Climate Change and Agriculture

Agricultural systems and practices in Africa have increasingly been affected by the incidence of climate change due to the frequency and severity of extreme weather events that lead to a shift in precipitation [3]. Such changes generally result in decreased agricultural productivity, and a higher frequency of parasite and disease outbreaks [5, 7]. Global agriculture is deeply affected by climate change which causes extensive implications for environmental sustainability, livelihood, and food security [2, 5]. A study conducted by Sango [8] in the Makonde Communal Lands of Zimbabwe discovered that climate change directly affects the biophysical environment and the conditions of the biophysical environment significantly affect the productivity and availability of ecosystem services. The relationship between climate dynamics and agricultural systems is increasingly clear as extreme weather events intensify, global temperatures rise further, and precipitation patterns are altered [2].

The aforementioned changes in the trend of rainfall in Africa negatively affect the yield of agricultural products. Climate change sometimes leads to an increased amount of unexpected rain as is the case for some regions that receive prolonged periods of drought [2, 9]. The fluctuation of seasons due to climate change significantly affects farming practices like planting and harvesting and the availability of water to be used in irrigation [5, 6]. Mugambiwa [2] opines that due to the unpredictability of rainfall, countries that rely on rain, especially for farming will experience crop failure and increased food insecurity. Global climate change has caused increased occurrence of climate-related calamities, for instance, droughts, flooding, and cyclones [10]. The aforementioned occurrences are capable of destroying infrastructures and crops instantly causing a huge loss to farmers. For instance, droughts would cause low crop yields and long-term water scarcity while floods are likely to make the soil less fertile and lack nutrients.

Further, climate change has serious implications for the incidence and prevalence of agriculture pests and diseases. High temperatures and a shifting pattern of hu-

midity pose risks regarding the aggravation of pest and disease transmission, and hence increased pressures on crops and livestock [11]. The control of pests and diseases might at some point be difficult because new pests and diseases might emerge in zones hitherto not affected by these diseases [2, 5]. This change may lead to an aggravation of the environmental consequences that result in a decrease in agricultural productivity. To address these issues, the producers and policymakers have to come up with resilient strategies that enhance the production capacity of farms in the face of climate change. These measures may include undertaking conservation agriculture practices enhanced water management, and the use of more resilient crops.

1.1.2. Agricultural Risks in Southern Africa

The challenges that come with climate change are felt hard in Southern Africa due to the compound socioeconomic challenges, water scarcity, and rain-fed agriculture in the region [2, 11]. Earlier works highlighted the distinct climatic challenges in the region, including the frequent occurrence of droughts, irregularity in the rains, and rising temperatures [2, 5, 6, 12]. The major analysis indicates that agriculture in Southern Africa faces mainly four core issues which include; heavy reliance on rain-fed agriculture, water scarcity, and temperate climate change vulnerability [7]. The region has experienced accentuation of variability of rain amount and intensity specifically, intensive rain and frequent occurrence of dry season. These changes disrupt old modalities of cultivation and lead to reduced yields, and an increased susceptibility to famine [2]. Hassan [13] conducted a study on the potential implications of climate change on agriculture in 11 African countries, revealing that global warming adversely affects crop output; however, the detrimental effects are less significant for crops sustained through irrigation. Hassan [13] also discovered that cattle output appears to be jeopardised due to global warming. This indicates that climate change impacts various forms of production, including crop cultivation and livestock management.

Furthermore, the agriculture industry in Southern Africa experiences other risks due to the more often occurrence of intense weather events such as cyclones and storms [6, 14]. A study by Gbetibouo [15] in the Limpopo province, South Africa demonstrated that rainfall was characterized by enormous inter-annual variability and approximately half of the farmers in the study attested that their farming methods in order to deal with climate change effects. Catastrophes such as cyclones and storms threaten crops and facilities, aggravate the existing issues, and complicate the destiny of the affected communities to unmanageable levels. Increased pest and disease incidence, water rationing, and poor soil qualities among other factors stress the agricultural systems in the region as modified by climate change [14, 16]. So, to ensure the increase in resilience and permanency of food security, it is high time to apply a complex approach that meets these challenges. This plan should include the promotion of sustainable agricultural practices, development of structures of infrastructure, and enhancement of adaptive capacity.

This is revealed in the case of rural Zimbabwe since climate change has an influence on the farmers most of whom in the area practice farming which mostly depends on rain [5, 6]. These regions of the country experience less rain, which is not very reliable, and the farmers cultivate their fields based on the calendars and depend on the rainfall for their staple crops like maize and for boosting the economy [6]. Due to the untimely distribution and nature of rainfall with delayed onset disasters, there has been a negative impact on agricultural production and increased crop losses in Zimbabwe [14]. Seasonal rains have aggravated the water scarcity situation, thus adding pressure on the available water resources to the farmers. This has further deepened the vulnerability of households in rural areas to adaptive shock.

Also, the agricultural industry in rural Zimbabwe is subjected to more uncertainties due to the occurrence of severe weather conditions [17]. The effects of disastrous storms include soil erosion and nutrient depletion which limits future crop production and lowers the fertility of the soil. An elaboration of altered climate conditions reveals that there is frequent occurrence of parasites and diseases that are a big threat to agricultural productivity [2, 5, 16]. Rural smallholder farmers in Zimbabwe are in a very risky position due to the complexity

and dynamism of the existing setting and the assistance accorded to such farmers[17]. To address these issues, it is necessary to conduct particular approaches that enhance the capacity of adaptation, promote sustainable agriculture, and strengthen the frameworks to reduce the climate change effects on rural farming.

2. Materials and Methods

This study employed a qualitative method and exploratory design to explore the impacts that climate change has on agricultural risks in rural Zimbabwe. The study used semi-structured interviews, and focus group discussions as the main research instruments to gather data from smallholder farmers, agricultural experts, and the district leadership of Mutoko district. The focus of data collection for this study was to acquire a concrete understanding of participants' experiences, perceptions and coping mechanisms on climatic change. Focus group discussions supplement the data by encouraging the participants to discuss a range of issues with fellow farmers and to acknowledge the problems and solutions found based on group work. It was because of this methodology that the study was able to gain a better understanding of how climate change impacts certain areas and how rural communities are managing the effects currently in place. Snowball and purposive sampling approaches were used to reach out to small-scale farmers and key informants respectively. Ten (10) small-scale farmers from Mutoko district, five (5) key informants from NGOs, and five (5) agricultural specialists were involved in the study while data was analyzed by applying thematic content analysis as recommended by Braun and Clarke[18], who proposed steps to be examined in thematic analysis (TCA). The process consists of five phases, that are namely;

Phase 1: Familiarisation with the data

Acquainting oneself with data is the preliminary phase that entails meticulous examination of transcripts multiple times. At this stage, the researcher meticulously reviewed all texts in the data by listening to the recorded materials multiple times. This was significant as it enabled the researcher to engage deeply with the material and identify all pertinent themes and elements worthy of consideration.

Phase 2: Generating initial codes

The second stage involves generating initial codes to identify trends and patterns emerging from the data. Upon frequently analysing the recordings, the researcher identified trends and patterns, subsequently coding and categorising them into several classifications.

Phase 3: Searching and reviewing themes

The third phase involves the identification and evaluation of themes, employing a top-down strategy in which the researcher utilised pre-existing categories to identify relevant cases.

Phase 4: Searching, defining and naming themes

The third stage involved the identification, delineation, and designation of topics, which entailed converting notes into potential emergent themes. During this phase, the researcher discovered prevalent themes that arose from the data.

Phase 5: Analysing and consolidating data

Phase five, the concluding stage, allowed the researcher to consolidate interpretations into a written account.

3. Results

The phenomenon of climate change in rural Zimbabwe has significantly affected socio-economic and agricultural activities in the last few decades. From the findings of the study, enhanced average temperatures have been seen together with a rise in heat wave frequencies. This has led to conditions such as heat stress on crops as well as livestock. The ever-present situation of global warming not only reduces the time of the growing season in agriculture but also intensifies the problem of water shortage by increasing the rate of evaporation processes. Some of the views captured by the participants included;

> *...we are currently observing numerous changes, such as the fact that temperatures nowadays are significantly higher compared to the past. Summer temperatures have increased compared to the past, and if we expe-*

rience reduced rainfall, which is now a normal occurrence, our crops frequently face adverse consequences.

[Participant 1: In-depth interview]

…there is a significant difference in the temperatures, so much that we are overwhelmed by them. We are farmers here, and since farming is how we survive when the weather is hot and the rains are insufficient, there are moments when I worry about whether we will make it through this heat. I even question whether it's an indication that our forebears are abandoning us.

[Participant 2: In-depth interview]

The findings of the study have established that frequent extreme weather poses severe challenges to agriculture in the Mutoko district. The situation has been greatly aggravated by long dry periods hence less availability of water. The findings ascertained that climate change has made soils worse and diseases and pests are on the increase and they also are factors that contribute pressure on agriculture. Thus, the farmers in rural Zimbabwe are experiencing an unfavorable situation in being able to set up a stable food production system and controlling the shocks that arise from a changing climate.

The changing weather patterns are causing low agricultural output in the district. The rise in temperatures and altered precipitation habits have led to reduced yields of key crops such as maize that contribute to food security and income in the region. Too long dry spells and uncertain rainfall patterns disrupt the sowing seasons and growth cycles of plants resulting in poor crop stands and subsequently reduced yields. Moreover, increased temperatures worsen water scarcity thereby speeding up crop maturity that often reduces grain quality. These climate fluctuations are compounded by decades of farmers' failure to produce reliable and sustainable output in an increasingly variable atmosphere. Agricultural practices along with technologies that are capable of withstanding climate change impacts should be adopted to address these issues. This will help reduce the negative effects of farming productivity decline thus enhancing food security ultimately. Moreover, climate fluctuations have also resulted in early drying of rivers in the region wherein rivers that used to flow throughout the year would only dry earlier in the year. One participant had this to say;

…We used to have enough rain back in the 1980s and 90s. Then, in the early 2000s, our weather started to change to the point where we were no longer getting enough rain. The most of the changes we are observing have to do with the rivers. For example, we knew that by August the river would still be flowing, but these days it is sporadic. The river used to run until May or June of past years, after which it would dry up until July.

[Participant 3: In-depth interview]

Figure 1 depicts the condition of the Nyamuzizi River in July, a period during which many participants noted that the river should still have been flowing as it did in the past. The early drying of rivers has severe effects on the livelihoods of the community because they heavily depend on river water for most of their domestic activities. Rural areas of Zimbabwe have been affected by climate change and this has increased the incidence of pests and diseases thus posing serious challenges in farming. Temperature increases and humidity variations create an environment that is friendlier for the multiplication and spread of diseases and pests, thus allowing them to move into new regions. Higher temperatures speed up the life cycles of pests causing their numbers to grow. Similarly, changes in weather patterns may lead to an increase in pest species in this region. In addition, high humidity coupled with unstable weather conditions can also enhance the transmission of plant diseases, thus worsening the susceptibility of crops. These outbreaks not only cause immediate damage to plants but also make farmers more dependent on chemicals which are usually costly and harmful to the environment.

Figure 1. Nyamuzizi River (Mutoko district).

Source: Author (Fieldwork).

…The fragility of our crops stems from various broad factors, such as variations in meteorological conditions. A small number of dams and rivers remain, but not enough to sustain us through the following season. The majority of dams and rivers are drying up. We also confront health-related issues as a result of this circumstance. Imagine that we are scurrying around for water sources, most of which aren't too clean, but because they are the only ones we have, we have no choice but to use the water.

[Participant A: Focus Group Discussion]

The erosion of soil in Mutoko district is one of the major problems that have bad effects on agricultural productivity and sustainability. Climate change complicates this issue further. Soil erosion, depletion of organic materials, and diminishing fertility are also worsened by the intensification in number of extreme weather events like long droughts and heavy storms. This can lead to depletion of topsoil which is important for the growth of plants.

A growing number of people in rural Zimbabwe face food shortages as a result of climate change's negative consequences on agriculture. Reduced crop yields, soil degradation, and increased incidences of pests and diseases, are some challenges that hinder local farmers from meeting food demand. Erratic rainfall patterns and prolonged dry spells disrupt farming cycles making harvests unpredictable.

…Over the past ten or so years, there has been a pattern of insufficient rainfall in both our region and the entire nation. You would be aware that we engaged in a variety of activities, including gardening when we received enough rain. Additionally, there is no method for us to preserve our vegetables because we currently need to eat what we have. After all, there won't be enough for storage. Storage is thus totally disregarded.

[Participant B: Focus Group Discussion]

...We are now concentrating on drought-resistant crops like sorghum and millet because there haven't been enough rains. These are the kinds of crops that have a reputation for flourishing during droughts. We now only have one choice, which is to think about sorghum and millet, because we frequently face droughts or insufficient rainfall.

[Participant C: Focus Group Discussion]

Due to a shortage of food, there is a rising rate of hunger among rural families who rely on assistance and subsidies. That is why it is necessary to put in place comprehensive measures designed to address the problem of food insecurity. These measures should include optimizing food systems, increasing the flexibility of farming through climate-smart techniques, and helping local populations deal with environmental problems better.

3.1. Adaptive Capacity

The study results show that different factors limit local farmers' ability to adapt, such as insufficient knowledge, lack of resources, and the extent of institutional support. The scarcity of resources available to them greatly hampers the capacity of rural Zimbabwe's farmer population to respond to climate change challenges. This limits the ability of farmers in Zimbabwe to take up techniques that are resilient against climate change due to limited financial resources, modern agriculture technologies, and infrastructure. A large number of smallholder farmers lack money to invest in irrigation systems, new seed types, or soil conservation measures which are important when it comes to reducing the impact of unpredictable weather and hostile climatic conditions. This is compounded by their inability to access appropriate extension services and technical support that would provide them with the necessary information and tools essential for effectively managing agricultural activities. For rural communities to become adaptive, become more resilient, and help ensure that they can cope with ongoing impacts from climate change; some changes need to be made by overcoming resource constraints.

The provision of assistance programs by the government and other stakeholders is a vital approach to responding to the effects of climate change. **Figure 2** presents farmers in Chibeta village receiving government-subsidised maize and agricultural inputs for the upcoming agricultural season. The initiative was necessitated by climate change-induced challenges that local farmers are facing making it difficult for them to purchase inputs. Relief programs necessitate the use of two distinct categories of resources: social resources and institutional resources. Social resources encompass the social networks that bolster the capacity of communities to cooperate and adjust to the impacts of climate change. However, there are institutional resources available that include governmental, non-governmental, and community-based organisations that intervene to provide support to communities through a range of resilience and adaptation approaches. This paper argues that the government supports a specific type of aid to improve the overall well-being of the population. One of the major barriers to effective mitigation of climate change's impact on agriculture in rural Zimbabwe is lack of knowledge. Many farmers fail to completely understand the various climate-resilient practices including advanced soil conservation measures, pest control and water use optimization. For farmers to adapt better and develop more resilient agricultural systems for climate change, there needs to be a focus on these gaps of knowledge through targeted training, extension work, and participatory research.

Figure 2. Villagers receiving government-subsidized maize in Chibeta village.

Source: Author (Fieldwork).

Figure 3 illustrates excerpts taken from a manual used by a village headman to assist smallholder farmers in crop management. The guidebook has graphic illustrations that portray several pests that are prone to impact the cotton crop, along with the exact types of soil and fertilizers that should be employed for the most effective

cotton farming. This discovery has proven advantageous as farmers may improve their harvests by being aware of the conditions affecting the crop. The headman's role effectively complements the duties of agricultural extension officers in the district, since they aid farmers in implementing measures to improve their farming techniques. The headman plays a vital role in the administration of indigenous resources. The guidebook provides the village headman with the necessary knowledge to assist the farmers in attaining abundant harvests. This includes efficiently dealing with pest problems and making well-informed choices on soil quality and fertilizers for the cotton crop. Due to insufficient institutional support for rural communities in Zimbabwe, adaptation or mitigation efforts towards climate change impacts on agriculture tend not to yield much outcome. The current challenges faced by the farming community such as limited funding, poor infrastructure development as well as weak coordination among agencies of government and farmer organizations continue hindering comprehensive assistance provision from these bodies. All these make it difficult for them to help farmers comprehensively.

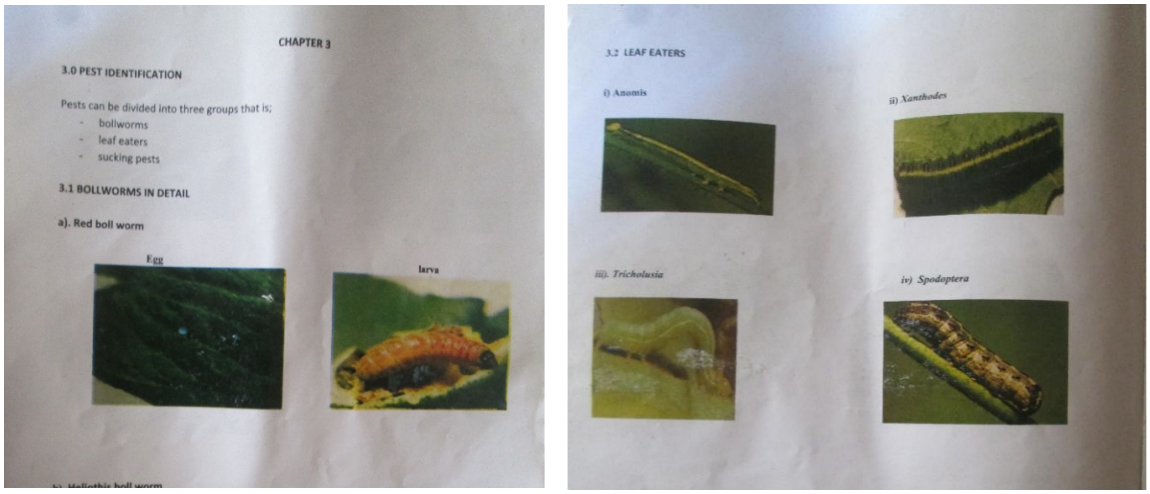

Figure 3. Images of extracts from the headman's manual for cotton farmers.

Source: Author (Fieldwork).

4. Discussion

4.1. Implications for Agricultural Policy

The present study shows that there is an urgent requirement for a comprehensive agriculture policy focusing specifically on the effect of climate change on agricultural risks. Agriculture involves a wide range of techniques designed to improve the adaptive capacity and sustainability of agricultural systems concerning changing climatic regimes [7, 10]. These practices include drought-resistant crop varieties, effective water management such as rainwater harvesting and drip irrigation as well as conservation tillage that enhances soil health and reduce erosion [3]. These actions represent only a few existing examples of climate change adaptation. It is also necessary for farmers to combine agroforestry with crop diversity to maintain stable yields and improve soil fertility [7]. However, there are ways in which farmers can build resilience in the face of extreme weather events, optimize resource use efficiency and achieve profitable agricultural systems [13, 15, 19]. Promoting widespread adoption of climate change resilient approaches is critical for increasing agricultural resilience and promoting sustainable food security within the region. The present study revealed that farmers in Mutoko district receive assistance from government programs such as subsidized agricultural inputs and food programs. Constant with this finding, Mandleni [20] presents a scheme for agricultural disaster insurance in the Eastern Cape province of South Africa. The scheme offers financial compensation to farmers for damages resulting from climate change-

related disasters and other general calamities in the area. This provides evidence for the efficacy of relief as a mechanism of adaptation. Mandleni [20] presents a drought and wind management system that includes relief operations designed to enhance the welfare of disadvantaged regions and individuals who lack the means to purchase disaster insurance. Adger et al. [15] argue that community-based assistance, along with other types of relief, enhances adaptive capacity by bolstering networks that are essential for dealing with catastrophic events.

Capacity building is, therefore, an essential process that should be undertaken so as to enhance rural agriculture resilience in Zimbabwe to climate change impacts. This process involves imparting relevant information and resources to farmers, agricultural extension workers and local groups for them to adapt to changing climatic conditions and practice productive agricultural techniques [21]. This includes training programs on Climate Smart Agriculture (CSA), soil management, pest control, and water conservation measures. Capacity building also means improving local organizations' skills to provide better support services, accessing financial resources more efficiently and developing infrastructure [5, 6]. The aim of capacity building is to create an open-minded farming society that can adjust according to climate variations thus sustaining food production for the lifetime. In doing this communities are given education, technical assistance as well as resource creation. Policy implementation gaps exist while financial assistance programs are lacking with limited technical support as well as extension services access for instance [22]. Consequently, they struggle to access the necessary tools and information that will enable them to adjust their cropping seasons and other practices according to weather alterations over time [20]. Institutional support can be enhanced through improved coordination mechanisms, increased funding of agricultural sector development and service delivery in order to augment resilience building programmes toward sustainable agricultural livelihoods within rural Zimbabwe.

The construction of infrastructure is important because it enhances agricultural resilience and adaptation to climate change effects among smallholder farmers. With respect to sustaining crop production under a rainfed agriculture system, one key area of focus is irrigation expansion [11]. These systems have the ability to mitigate the impact of erratic precipitation and aridity which are crucially important. Additionally, the improvement of transportation infrastructure including rural roads eases access to markets reducing post-harvest losses possibility while ensuring the timely delivery of inputs, and resources [11, 23]. Storehouses act as a way of minimizing spoilage/waste guaranteeing a steady food supply and effectively managing seasonal changes in crop availability. Financial sector input into farming practices in Zimbabwe's rural areas has proven vital towards successful coping strategies by farmers against climate change events [11]. For example, subsidies can be used to reduce the prices of vital inputs such as drought-tolerant seeds and fertilizers thus they become affordable [11, 24].

4.2. Community-Based Adaptation

The resilience of the community depends on community-based adaptation techniques. Farmer cooperatives in rural Zimbabwe play a crucial role in enhancing agricultural resilience and productivity through collaboration and collective action among farmers [11]. Through these groups, individuals can pool their resources together, exchange know-how, as well as benefit from services that may go beyond what individual smallholder farmers can offer [5, 7, 11]. For example, scale economies may be realized in purchasing inputs like seeds and fertilizers which will also help in marketing their produce. This can lead to better pricing and reduced transaction costs. Likewise, cooperatives often serve as platforms for accessing technical support, training, and financial services such as lending and insurance.

Indigenous knowledge remains an integral part of agriculture addressing issues related to climate change in the rural parts of Zimbabwe [11]. The indigenous knowledge passed across generations encompasses a deep understanding of local ecosystems including weather patterns and agricultural practices tailor-made for specific region's needs [12, 17]. Indigenous knowledge entails such practices as the use of traditional crop varieties management systems for land conservation over a long period that have shown effective outcomes. Ancient

wisdom when blended with current agricultural procedures plus scientific studies allows farmers to come up with more robust responses to changing climatic conditions and improved crop yields over time [11]. By acknowledging indigenous knowledge alongside modern farming methods and scientific research, farmers could develop better solutions suitable for dealing with variations in climate patterns while enhancing crop yield levels at different sites within a country. In so doing we show respect for cultural heritage besides ensuring adaption takes place while maintaining our creativity by being deeply rooted in customary norms of behaviour.

It is essential to involve local farmers, community members, and stakeholders in designing successful and sustainable agricultural plans in rural Zimbabwe. In this regard, participatory planning ensures that the strategies are well-informed and supported by the people directly affected by them [9, 24]. Participatory planning combines perspectives and insights of those who are directly impacted by climate change as well as challenges facing agriculture. With this approach, policies would be able to be crafted in a manner that responds specifically to local requirements and situations [11]. This inclusive strategy promotes a stronger sense of community involvement and dedication to implemented solutions, enhances the appropriateness and efficiency of interventions, and facilitates the exchange of knowledge and resources.

5. Conclusions

A comprehensive strategy is required to effectively tackle the effects of climate change on agriculture Mutoko district. This should cover financial assistance, infrastructure improvement, skills development as well as incorporation of indigenous wisdom. Problems experienced by rural populations such as reduced crop yields, increased pest attacks, soil erosion, and food insecurity underscore the urgent need to implement comprehensive measures that enhance resilience and sustainability among agricultural operations. The provision of financial aid is important in assisting farmers' adoption of climate-resilient technologies and practices. Stakeholders can offer subsidies credits or insurance which helps overcome obstacles faced by farmers that often prevent them from investing in necessary resources or infrastructures. Infrastructure development improves resilience by addressing critical needs such as irrigation systems, transportation networks or storage facilities. Better infrastructure makes farming operations more effective after harvesting while reducing further losses after harvests besides making it easier for sellers to reach their markets hence sustaining output under prevailing climatic conditions variations. Engaging farmers in the planning process is one way of ensuring that solutions take up a localized nature, are based on local situations, and are supported by more people resulting in long-lasting impacts. Moreover, indigenous knowledge integrated into climate adaptation measures offers valuable insights and practices that have been developed over many generations. The unification of this information together with present scientific strategies provides an all-inclusive basis for addressing agricultural challenges more effectively as well as increasing resilience. By implementing these approaches, local farmers can enhance food availability and access; and improve the capacity of agricultural systems to withstand and recover from shocks; thereby maintaining sustainability.

Funding

This research received no external funding.

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The data supporting the findings of this study are available but not in a format suitable for public sharing or publication at this time. Due to the need for further processing and refinement, the dataset is currently un-

available. However, researchers interested in accessing the data may contact the corresponding author for further discussion. Any data sharing will be subject to ethical considerations and institutional guidelines.

Acknowledgments

In this section, you can acknowledge any support given which is not covered by the author contribution or funding sections. This may include administrative and technical support, or donations in kind (e.g., materials used for experiments).

Conflict of Interest

The authors declare no conflict of interest.

References

[1] Adebayo, A.A., Mubi, A.M., Zemba, A.A., et al., 2013. Awareness of climate change impacts and adaptation in Adamawa State, Nigeria. International Journal of Environment, Ecology, Family and Urban Studies. 3(1), 11–18.

[2] Mugambiwa, S.S., Chitongo, L., 2023. The impact of climate change on agricultural risks among cotton farmers in the Mutoko District of Zimbabwe. Indonesian Journal of Social and Environmental Issues. 4(1), 25–35.

[3] Mugambiwa, S.S., 2021. Evoking the epistemology of climate governance through indigenous knowledge systems for sustainable development in rural Zimbabwe. Jàmbá: Journal of Disaster Risk Studies. 13(1), a1024. DOI: https://doi.org/10.4102/jamba.v13i1.1024

[4] Alfons4, G.P., Laruan, K.A., 2020. Climate change trends, impacts and adaptation of upland farmers in La Trinidad, Benguet, Philippines. International Journal Agronomy and Agricultural Researches. 17(1), 1–15.

[5] Nyahunda, L., Tirivangasi, H.M., 2020. Barriers to effective climate change management in Zimbabwe's rural communities. In: African Handbook of Climate Change Adaptation. Springer: Cham, Switzerland. pp. 2405–2431.

[6] Nyahunda, L., Tirivangasi, H.M., 2021. Harnessing of social capital as a determinant for climate change adaptation in Mazungunye communal lands in Bikita, Zimbabwe. Scientifica. 2021(1), 8416410. DOI: https://doi.org/10.1155/2021/8416410

[7] Brzoska, M., Frohlich, C., 2016. Climate change, migration and violent conflict: vulnerabilities, pathways and adaptation strategies. Migration and Development. 5 (2), 190–210. DOI: https://doi.org/10.1080/21632324.2015.1022973

[8] Sango, I., 2014. An investigation of communal farmer's livelihoods and climate change challenges and opportunities in Makonde rural district in Zimbabwe [Phd Thesis]. University of South Africa: Pretoria, South Africa. pp. 1-212.

[9] Berlemann, M., Steinhardt, M.F., 2017. Climate change, natural disasters, and migration - a survey of the empirical evidence. CESifo Economic Studies. 63 (4), 353–385. DOI: https://doi.org/10.1093/cesifo/ifx019

[10] Chandra, A., McNamara, K.E., Dargusch, P., et al., 2017. Gendered vulnerabilities of smallholder farmers to climate change in conflict-prone areas: A case study from Mindanao, Philippines. Journal of Rural Studies. 50(2017), 45–59. DOI: https://doi.org/10.1016/j.jrurstud.2016.12.011

[11] Mugambiwa, S.S., 2020. Climate governance through indigenous knowledge systems for sustainable development in Mutoko district of Mashonaland East province, Zimbabwe [Ph.D. thesis]. University of KwaZulu-Natal: Pietermaritzburg, South Africa. pp. 1-255.

[12] Mugambiwa, S.S., 2023. Climate change adaptation strategies among livestock herders in the Mutoko District of Rural Zimbabwe. International Journal of Development and Sustainability. 12(7), 256–266.

[13] Hassan, R., 2010. Implications of climate change for agricultural sector performance in Africa: policy challenges and research agenda. Journal of African Economies. 19(2), 77–105. DOI: https://doi.org/10.1093/jae/ejp025

[14] Mugambiwa, S.S., 2021. Multilevel approach to climate change adaptation in rural Zimbabwe: a well-articulated framework devoid of effective implementation. African Journal of Development Studies. 11(4), 165–181.

[15] Gbetibouo, G.A., 2006. Understanding farmers' perceptions and adaptations to climate change and variability. International Food Policy Research Institute Research Brief. IFPRI: Washington, DC, USA.

[16] Nabikolo, D., Bashaasha, B., Mangheni, M., et al., 2021. Determinants of climate change adaptation among male and female headed farm households in eastern Uganda. African Crop Science Journal. 20(2012), 203–212.

[17] Mugambiwa, S.S., 2021b. Evoking the epistemology of climate governance through indigenous knowledge systems for sustainable development in rural Zimbabwe. Jàmbá: Journal of Disaster Risk Studies.

13(1), 1–10.

[18] Braun, V., Clarke, V., 2006. Using thematic analysis in psychology. Qualitative Research in Psychology. 3(2), 77–101. DOI: https://doi.org/10.1191/1478088706qp063oa

[19] Adger, W.N., Arnell, N.W., Tompkins, E.L., 2005. Successful adaptation to climate change across scales. Global Environmental Change. 15(2), 77–86. DOI: https://doi.org/10.1016/j.gloenvcha.2004.12.005

[20] Mandleni, B., 2011. Impact of climate change and adaptation on cattle and sheep farming in the Eastern Cape province of South Africa [Ph.D. Thesis]. University of South Africa: Pretoria, South Africa. pp. 1–171.

[21] Mugambiwa, S.S., Tirivangasi, H.M., 2017. Climate change: a threat towards achieving , sustainable development goal number two' (end hunger, achieve food security and improved nutrition and promote sustainable agriculture) in South Africa. Jàmbá: Journal of Disaster Risk Studies. 9(1), 1–6.

[22] Bryman, A., 2012. Social Science Research Methods, 4th ed. Oxford University Press: Oxford, UK. pp. 1–766.

[23] Ngigi, S.N., 2009. Climate change adaptation strategies: water resources management options for smallholder farming systems in Sub-Saharan Africa. The Earth Institute at Columbia University: New York, NY, USA.

[24] Sahoo, S.N., Sreeja, P., 2017. Development of flood inundation maps and quantification of flood risk in an urban catchment of Brahmaputra River. ASCEASME Journal of Risk and Uncertainty in Engineering Systems, Part A: Civil Engineering. 3(1), A4015001. DOI: https://doi.org/10.1061/AJRUA6.0000911