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The Impact of Climate Change on Agricultural Productivity and Economic Stability in Rural Zimbabwe

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ABSTRACT

This study examines the relationship between climate change, agriculture, and the economic trajectory of rural Zimbabwe focusing on Mutoko district, a region that largely depends on subsistence agriculture. Over the years, the region has experienced a drastic reduction in agricultural production owing to the variability in rainfalls, long draughts, as well as extreme weather conditions. These climatic variations have resulted in lower output in agricultural activities, economic crisis, and increasing instances of hunger and poor nutrition amongst households and the economy. A qualitative exploratory research design was adopted, and data was collected through semi-structured interviews, focus group discussions, and participant observation from 30 smallholder farmers in the Mutoko district. The study found that climate change has significantly affected farming practices resulting in decreased crop production. This has strained the economic welfare of the region and increased the rate of food insecurity. The paper concludes by recommending a need for improved climate policy, encouraging the adoption of climate-resilient farming practices, and appropriate assistance to marginalized communities as a means towards improving the community's resilience to climate change and sustainable livelihoods in rural Zimbabwe.

INTRODUCTION

In rural Zimbabwe, communities rely on agriculture as the backbone of the economy (Nyahunda & Tirivangasi, 2021). Climate change, however, has been adversely impacting agricultural production which is crucial to the economic well-being of rural communities (Nadi, 2014; Bhatasara, 2016). This study aims to investigate the impact of climate change on agricultural productivity within the Mutoko District and the impact such changes have on the economy of the local communities. For decades, agricultural activities have been the bedrock of rural economies in Zimbabwe where a large percentage of the population derives food, income, and employment from them (Ani et al., 2022). For instance, in Mutoko District a majority of the people practice subsistence farming; their fate is pegged on the land and its ability to produce. However, in the last few years, most agrarian economies have been challenged by climate change and its relative impacts on the environment. The consequences of climate change on the agricultural industry with regard to rural communities need emphasis because the rural socio-economic fabric is usually at risk from changes in the environment. In rural Zimbabwe, agriculture is much more than an economic function, but rather, a way of life (Nhemachena, 2007). Thus, disruption of agricultural-induced productivity affects the household economy as well as the general social interaction among the people (Nyahunda & Tirivangasi, 2021).

Climate change is emerging as a severe global environmental issue (Ledda et al., 2021; Ahmed et al., 2023) and agriculture is one of the production sectors most susceptible to climate change globally (Karimi et al., 2018). The prevalence of irregular or severe weather phenomena in various places will increase the likelihood of crop failures (Nielsen & Vigh, 2012). Agricultural producers are expected to experience erratic food supplies and diminished income as a result of rising input costs and

additional losses stemming from severe weather phenomena (Mitter et al., 2018; Aggarwal et al., (2019). When agricultural systems encounter disruptions due to climate change, farmers, as producers, are the initial recipients of the impacts. Farmers possessing low adaptive capacity may exhibit greater vulnerability to climate change compared to those with strong adaptive capacity (Grothmann & Patt, 2005; Adom, & Amoani, 2021; Thomas et al., 2007; Asare-Nuamah & Botchway, 2019). Perception of climate change necessitates a sequence of subjective evaluations of its attributes and intensity. To mitigate the adverse impacts of climate change on agricultural output, farmers must identify and execute appropriate strategies based on their views of climate change (Niles et al., 2013).

Growing climate variability over the years has been rated negatively on Zimbabwe's agriculture by many researchers, with the majority of the studies reporting a decrease in crop yields, an increase in the occurrence of pests and diseases, as well as a change in the timing of growing seasons (Nyahunda & Tirivangasi, 2021; Dodman & Mitlin; Gutsa, 2017; Whimbi, 2009). While such studies are informative, there is a gap that seeks localized, social research that addresses the circumstances surrounding environmental changes. Since the economy of Mutoko District is primarily agrarian with communities practicing traditional farming through the use of Indigenous Knowledge Systems (IKS) it becomes more essential to explore how rural societies cope with climate change in their localities. This study, therefore, seeks to respond to this call focussing on the perspectives of the farmers in Mutoko District and their interactions with climate change. Through close attention to the practices and experiences of farmers affected by climate change, the study provides a nexus of the relationship between climate, agriculture, economies, and the state of people's resilience to climate change.

The agricultural sector in Zimbabwe is highly susceptible to climate change (Muzerengi & Tirivangasi, 2019). Determinants of crop production changes suggest that rising temperatures, changes in precipitation, and extreme weather events have contributed to declines in maize and sorghum production (Clapp et al., 2018; Ledda et al., 2021). Climatic anomalies in the region have seen an increase in temperatures and decreased annual rainfall resulting in successive droughts (Nkoana et al., 2018; Moeletsi et al, 2013; FAO, 2017). This has resulted in a direct effect on agricultural outputs where there are decreased harvests of maize, sorghum, millet, and other cereal crops that are basic staple foods (Nyahunda & Tirivangasi, 2021). Erratic rainfall patterns have altered the normalized patterns of farming, leading to more adverse effects for some of the rural farmers who depend on rains to plant and harvest (Nkoana et al. 2018; FAO, 2016; Abid et al., 2018). In addition to climatic parameters such as temperature and the amount of precipitation, the rising occurrences of extreme conditions, such as floods, and heatwaves, have also posed challenges to Zimbabwean farmers (Nyahunda & Tirivangasi, 2021; FAO, 2013). These incidents have both short-term and long-term impacts, such as total loss of crops, reduction in production levels or farming activities, and destruction of essential supporting agricultural facilities such as road networks, irrigation systems, and storage facilities. FAO has shown how such incidence affects food security in rural settings where farming is mainly done for household consumption (FAO, 2008).

Climate change stands to have some far-reaching economic effects on the agricultural sector in Zimbabwe (Mapfumo et al., 2015; Mano & Nhemachena, 2006; Jiri et al., 2016). Agriculture is a major part of Zimbabwe's Gross Domestic Product (GDP), especially in the rural areas. Given the adverse effects that climate change brings to the agricultural sector, the entire economy suffers as well resulting in more people lapsing into poverty, reduced income levels, and increased food insecurity (Mugabe et al., 2012). Various studies indicate that smallholder farmers comprise the majority of farmers who are at risk of the consequences of climate change (Nkoana et al. 2018; Muzerengi & Tirivangasi, 2019; Whimbi, 2009; Evangelista et al., 2013). These farmers often do not have the means for climate adaptation, such as drought-resistant seeds and irrigation devices. There is thus a downward spiral where the economy of these communities becomes less resilient to shocks as their productivity drops making it harder for them to bounce back from such shocks (El Benni & Finger, 2014; Wangmo et al, 2022; Dhifaoui et al., 2023). However, the adoption of traditional practices such as drought-resilient crop

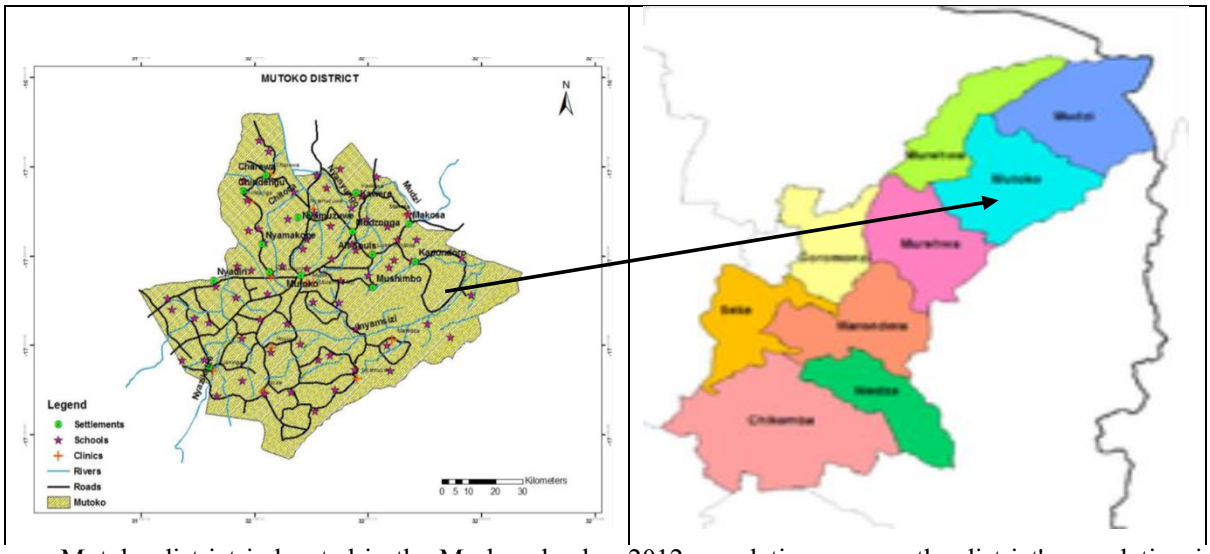
varieties, intercropping, and water harvesting has enabled sustained agriculture (Joshua et al., 2011; Jiri et al., 2015; Chai et al., 2022). However, the efficacy of these practices is also challenged by the increasing extent of climate change. Researchers tend to agree that IKS is important but there is a need for a paradigm shift to provide for the essence of scientific engagement in the communities. This could strengthen the adaptive capacity of the farmers in rural areas and assist in reducing the negative effect of climate change on agriculture in Zimbabwe.

The adverse effects of climate change on agricultural production in Zimbabwe are evident (Mano & Nhemachena, 2007; Moyo, 2016). This has consequences for food availability, poor earnings, exacerbated poverty, and other resources. As agriculture is the backbone of the rural economy, a decline in this sector can create a chain of effects such as affecting local businesses, employment, and economic systems in general (FAO, 2016). The rural economy of Zimbabwe, which is heavily reliant on agriculture, is faced with the problems attributed to climate change, especially that of unproductive farming and its diminishing returns (Nyahunda & Tirivangasi, 2021). The agricultural sector is very important for Zimbabwe's Gross Domestic Product (GDP) since a lot of people depend on farming, especially the rural population. However, there are negative economic impacts as a result of the continued decrease in agricultural production due to climate change (Nhamo, 2009; Maponya & Mpandeli, 2012). The impact is largely felt in rural communities where reduced crop harvests do correlate with lower household incomes, which leads to increased levels of poverty and food insecurity (Esham & Garforth, 2013; Alfonso, 2021). In essence, in rural areas where other forms of income are limited, the effects of climate change on agriculture can be more catastrophic as they can deepen the already existing economic vulnerabilities and hamper sustainable development progress as well. This phenomenon also significantly affects industrialization since agriculture is interrelated to other industries like manufacturing and trade, which rely on agricultural production in one capacity or another for raw materials, markets, and income.

The objectives of this study are as follows: (1) To investigate the link between climate change and the level of productivity of agriculture in the peasant sector in Zimbabwe. (2) To examine the socio-economic effects of reduced agricultural production on the economy of rural families in Zimbabwe.

MATERIALS AND METHODS

Study Area



Mutoko district is located in the Mashonaland East province (MEP) of Zimbabwe. The district spans an area of 4,092.5 square kilometers, as reported by Mvumi et al. (1988). According to the 2012 population census, the district's population is 146,127 people (Moyo, 2016). Mutoko was designated as an administrative station in 1911 and is situated 143 km away from Harare, the capital

city of Zimbabwe. The district derives its name from Chief Mutoko, a local leader, and is predominantly inhabited by the Buja ethnic group. The district consists of a growth point, communal spaces, resettlement farms, and small-scale commercial farms. The population density in the growth point is 198 people per square kilometer, while the communal areas have a density of 46 people, resettlement farms have a density of 23 people, and small-scale commercial farms have a density of 10 people (Bhatasara, 2016). Mutoko Rural District (MRD) is comprised of twenty-nine (29) wards, each containing six (6) villages. Each village is home to approximately one thousand (1000) individuals or eighty (80) to one hundred and twenty (120) families. Certain villages are equipped with Village Development Committees (ViDCos) that are accountable to the Ward Development Committee (WaDCos). Additionally, every village is overseen by a village headman who assumes the responsibility of managing the district daily. At the ward level, the district is represented by a councilor who is elected by the people. The council is led by a Chief Executive Officer (CEO) (Mvumi et al. 1998).

Research Methods

The study employed a qualitative exploratory research design. Purposive sampling was adopted to select thirty (30) participants including small-holder farmers, local leaders, and NGO representatives. Semi-structured interviews, focus group discussions, and participant observation were employed as data collection tools. The focus groups involved smallholder farmer groups who discussed common agricultural activities, economic challenges, and climate change impacts. Interviews conducted by use of semi-structured questionnaires included questions involving different stakeholders like farmers themselves, local community leaders, and representatives of various NGOs. The questions sought views on issues regarding agricultural practices, and the effect of laws governing these practices vis-à-vis adaptation to the impacts of climate change. Participant observation was applied to allow the researcher to witness how the community interacts with one another in matters related to climate change adaptation. Data was analyzed using thematic analysis to identify key issues that relate to, agricultural practices, economic impacts, and farmer strategies to adapt to the effects of climate change.

RESULTS AND DISCUSSION

Perceptions of Climate Change

Participants of the study concurred that climate change is a reality, as they reported observable variations in the weather conditions over the last two decades. Most of them pointed to shorter rainy seasons and frequent droughts, which the region has frequently experienced in the recent past. These observations were often an accumulation of their experiences of reduced output in a season, failure of the crops, and inability to plant or harvest on the scheduled days. All in all, such observations explain the growing concern about the local agricultural systems due to climate variations and the increasing awareness of the population about the future of their farming systems. Farmers in Mutoko are more aware of how climate change affects them both negatively and positively than ever before. For instance, some participants mentioned that high temperatures and irregularity in rain patterns have caused low fertility in the soils and low moisture, which also impacts the yields of the crops. Many people have realized that once dependable crops are no longer dependable. This has in turn led some farmers to try out other new varieties of crops and ways of farming, although the outcomes of these efforts have been rather disappointing. When asked about their perceptions of climate change, some of the participants had this to say; “Earlier we used to know and anticipate the onset of rains and thereafter go ahead to schedule the planting season. But now this is not the case, the weather has changed completely. Some rains come in very late and when they do, they are too heavy and sweep away the crops or come in very little amount making it dry. This has made farming very hard and has reduced our yield drastically” (Participant 1: Elderly Farmer).

The finding stresses the adverse consequences of climatic change for the traditional ways of farming. It emphasizes how fluctuations in the distribution of rainfall in terms of their timing, onset or greater intensity, or even lack of rain completely have weakened the farmers’ capacity to schedule and undertake planting seasons. Such unpredictability leads to crop destruction or drought, which are detrimental to agricultural

productivity and decrease yields. “Climate change has made our life more miserable. Farming was the cornerstone of our family’s income. However, due to the occurrence of droughts and hot weather, we are experiencing a declining trend in our crops harvested. It is hard to earn enough cash for food for our households let alone the school fees for our children” (Participant 21: Female Smallholder Farmer).

The finding emphasizes the multifaceted social and economic nature of rural areas, especially those dependent on farming, and more importantly the role of climate change in making such an already dire situation worse. “I have observed that the yields have not been as before because the fertility of the soil has been reduced and the rains have become unpredictable. We have been trying various ways of adjusting like engaging in dryland farming, planting resistant varieties, and others but it's not enough. Climate change and where it affects crops is not only where crops are grown but even the whole lot” (Participant 30: Young Farmer).

The finding illustrates how climate change disrupts agricultural productivity through declining soil fertility and unpredictable rainfall patterns. Farmers are grappling with reduced yields despite employing adaptive strategies like dryland farming and planting climate-resistant crop varieties.

The results show the negative effects of climate change on agricultural production in Mutoko District, which negatively affects the constituents in the area economically. The variability of climatic conditions, especially the variability of rainfall and frequencies of climatic extremes, hampered the traditional farming activities that used to be dependable. This caused depletion of agricultural production and a decline in fertility of the land further endangering the livelihood of the small-scale farmers who largely depend on the agricultural sector for earnings and food. These findings are also consistent with the existing literature on climate change impacts in the sub-Saharan region where agriculture systems that depend on rainfall have been significantly affected (Nadi, 2014; Jiri et al., 2015; Muzerengi & Tirivangasi, 2019; Bocchiola et al., 2019). The adaptation measures so far adopted, like growing crops that resist drought, although useful, have proven inadequate to mitigate the effects of climate change. These factors reinforce the necessity to refine existing climate policies and provide additional resources that aim at improving adaptability (Nkoana et al. 2018; Nkoana et al., 2018; Birthal et al., 2021; Coracero, 2021). Diversity of opinion and action is evident in the way different participants view and tackle the challenges brought by climate change.

Some farmers are very optimistic and can come up with solutions by utilizing the community or indigenous knowledge systems to cope with the changing circumstances. Such individuals are likely to regard the impact of climate change as a chance for them to develop new ways of practicing agriculture. However, some show anger, demotivation, and even defeatism especially those who are resource and support-strapped. As this demonstrates, some community members are more able than others to deal with such climate change-related impacts, which suggests the need for targeting specific groups within a community to help implement strategies aimed at climate change resilience. Furthermore, the evidence shows that socio-economic factors, including but not limited to the level of education, or the degree of access to information, affect the understanding of climate change. For example, wealthier and more resourceful farmers are likely to be early adopters of new practices and technologies. However, their counterparts with many constraints remain stuck in conventional ways and struggle with the impacts of climate change. Moreover, the educational background of individuals also affects how they perceive and react to climate change, and more educated people tend to understand more of the science behind it and its possible solutions (Moeletsi et al, 2013; Bezabih et al., 2023; Balwinder-Singh et al., 2020). As such, these findings indicate the need to pay attention to the socio-economic and educational characteristics of the population when developing measures and policies for climate adaptation.

Impact on Agricultural Productivity

Climate change has had severe effects on agricultural productivity in the Mutoko District. Farmers reported to have decreased crop yield, especially on maize which is a key food crop in the area. Irregular rainfall has rendered the seasonal planting calendar extinct leading to severe crop deficits. Further, the rise of pests and diseases due to weather changes has worsened the scenario. In Mutoko District, there is a growing concern

regarding the effects of climate change on agriculture, as many farmers are claiming that there is a decrease in crop production and agricultural productivity. There have been raised concerns by farmers that some of them do not tend to plant their crops at the most appropriate time due to poor rainfall distribution. Some of the farmers who grow staple food crops like maize and sorghum are experiencing a depressing trend in production due to the weather-changing patterns. This decrease in the productivity of these crops has put stress not only on the food security situation but also on the income of farmers and households that grow these crops for self and market sale. When asked about the impact of climate change on agricultural productivity some of the participants had this to say; "Our maize harvests have since changed with time, and they are way down from what they were. In the past, we used to store enough maize each season to fill up the granary, but today, we barely manage to get enough that lasts for a few months. It is the crops that suffer for the reason that there is not enough rain when it is anticipated and when it eventually does fall it is usually very late to rescue the crops" (Participant 15: Middle-aged Male Farmer).

The finding brings out strongly the effects of climatic fluctuations on maize production which is a food security crop for many households. Farmers used to be able to produce enough maize for their entire year's consumption, however, rainfall patterns have changed to a degree that yield is greatly limited. "Dairy farming has also suffered losses. The grass is getting finished, and we have to go long distances to search for water for the cows. A number of my neighbours have disposed of the animals due to lack of enough feeds which is improving every day. This destruction in livestock is a great drawback to their economic activities" (Participant 27: Elderly Farmer).

The findings reveal a downward trend in agricultural production, which seems to be mostly caused by climate change and its associated erratic weather patterns. Among the participants, there was a common concern over the drastic reduction of crop production, mainly maize, which is the predominant crop in the region. Most participants emphasized that the rains now do not come when they used to, and when they do, not enough moisture is accumulated for farming activities. As a result, what was previously an annual food security status cannot be maintained, with almost every household now going hungry at certain periods of the year. This situation has however not improved, as it has become more challenging to produce other food crops, especially vegetables which are key for food and market sales. The effect of climate change is not only limited to crops but also livestock farming, which many participants also engage in as a source of livelihood. Overgrazing and poor nutrition of the animals due to unending drought have led to the deaths of many animals making it hard for the families to survive economically. The dual blow to crop farming and livestock farming just accentuates the multi-dimensionality of the problems arising from climate change. As a result of these challenges, agricultural productivity is, in general, compromised thereby placing food security at risk and reducing the earnings of households. The findings underscore the importance of such measures as the development of irrigation systems and the promotion of climate-resilient agriculture to counter climate change and ensure sustainable livelihoods.

The effects of the adaptation strategies on the farmers with respect to the changing climate conditions have certainly not yielded the intended results. Some farmers have tried to adopt crop rotation and even new technologies to grow their crops, in view of the conditions around them. Studies reveal that even though these efforts have improved productivity in some cases, they are however limited in scope when it comes to agricultural inputs such as improved seeds, forms of irrigation, and finances (Nyahunda, & Tirivangasi, 2021; Maponya, & Mpandeli, 2012; Balting et al., 2021). The management of these social and technological processes is very effective, but the effectiveness of these measures varies among individuals and the resources available at their disposal (Gwimbi, 2009; Alfonso, 2021; Bai, 2022). In essence, the findings of this study illustrate that there are existing gaps in the provision of assistance to support farmers' resilience towards climate change to increase agriculture productivity. Those who are responsible for planning action must include the aspects of the provision of climate change-adapted technologies, funding, and farming knowledge to enhance sustainable agriculture and reduce the negative effects of climate change.

Economic Stability and Livelihoods

The reduction of agricultural output has produced a lot of social and economic problems for rural communities in the district. Farmers who used to supply excess food crops to the market could no longer grow enough food crops for their consumption. Increased income stagnation has created high levels of poverty among most households which struggle to meet basic needs. This social disorganization has equally extended its arms to other sectors including local markets and petty businesses which rely on farming activities. Climate change has negatively altered the economic stability and sources of sustenance in the district. Further, low productivity and unstable market conditions have led to farmers receiving less money from the sales of their crops. This has caused an increase in economic challenges, whereby many households are unable to afford most of their needs while striving to maintain their lifestyle. When asked about the impacts on economic stability, some participants had this to say; "Given the incomplete harvests, we do not have enough food for their families let along find something to even sell at the market. The crops we sell are not in a position to give us sufficient money to pay for school fees or seek any medical services. We now only focus on how we shall keep the body and soul together before the season approaches." (Participant 8: Female Head of Household)

The finding emphasizes the negative economic and social consequences that farming families experience due to losses in yield resulting from climate change. Not being able to produce enough food means that children and families have problems with nutritional intake and no surplus for sale in the marketplace. The income that could be received from the crops would further enhance their purchasing power to cater for essential services such as education and health care. "Farming was never as dependable as before when we lived without any worries, but now, it's more like rolling dice. Other years, there is no profit harvest, and all the available relief is food from abroad or cash from relatives in urban areas. It is very difficult to make any planning where the next season is uncertain as it is" (Participant 13: Middle-aged Male Farmer).

The decline in agricultural production has greatly affected the economic well-being of families. As farmers, it has created challenges in their occupation. As they narrated, incomes have dropped drastically as crop yields have reduced and livestock herding has been abandoned. Given this situation, most households are unable to afford basic needs such as food, education, and medical care among others. This economic pressure is quite high for houses that are female-headed as they are most likely to be the ones who succumb to economic hardships. That level of security that came with farming as a means of livelihood is slowly eloping and many families are left in despair as fortune is no longer assured. Dependence on help from outside and remittances from relatives residing in cities has become a strategy. The continued financial vulnerability has equally also constrained long-term community values and investments. Many families have been trapped in poverty cycles owing to the inability to look forward because of the climate change that has made things so unpredictable, thus, every unfortunate season diminishes their chance of bouncing back and prospering even more. The implications of these findings aggravate the need to address economic provision and security focusing on access to finance, climate-based farming practices, and other forms of livelihood diversification.

The findings are consistent with existing literature by asserting that to address economic impacts and increase resilience, there is increasing recognition of the fact that diversified livelihood strategies and support mechanisms are required (Gutsa, 2017; Nhemachena, 2007; Bhatasara, 2016; Assouto, 2020). Some of the communities have embarked on looking for other sources of income, such as engaging in small businesses, crafts, and other non-agricultural activities, as a way of augmenting their income from farming. However, the outcome of such diversification is often constrained by a lack of resources, training, and market opportunities. There is a need for appropriate interventions that will enhance the diversification of livelihoods and offer financing, training, and market opportunities to enable communities to adjust and improve their economic position. This is important as addressing the multifaceted economic consequences of climate change would go a long way in helping policymakers and development practitioners enhance the resilience of rural people.

CONCLUSION

This study has established that climate change exerts measurable effects on both agricultural productivity and economic activity in the Mutoko District. The impact of climate change on agricultural production and economic activity has been heavy, depicting the harsh realities of rural communities in Zimbabwe. The sharp fall in crop production as a result of inconsistent rainfall patterns, extended droughts, and climate extremes, exemplifies the precariousness of conventional farming. This reduction puts food security at risk and also lowers the income of the households which causes negative effects to the economy as a whole. The findings stress that there are immediate efforts that need to be put in place to deal with the short-term effects of climate change as well as other efforts that are aimed at building the capacity of communities in the long run. Policy measures should comprise the development of assistance, capacity building, and appropriate technologies incorporating indigenous knowledge. By bringing together the best of both worlds, that is, indigenous and modern approaches, rural communities in Zimbabwe will be able to adapt to the challenges posed by climate change, increase agricultural productivity, and improve their economic status.

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