

# Climate Change Impacts on Food (In)Security: a Case Study of Enyezane, Kwazulu-Natal, South Africa

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## 1 ABSTRACT

Climate change significantly threatens food security, and localized studies are crucial for effective responses. This study examines the impacts of climate change on food security in Enyezane, KwaZulu-Natal, South Africa. Enyezane faces increased climate-related shocks like droughts and temperature extremes, leading to crop failures, reduced agricultural yields, and water scarcity. The study explores these challenges and the community's coping mechanisms, including diversifying crops, using resilient varieties, and relying on traditional knowledge and social networks. The importance of urban planning in mitigating food insecurity is highlighted. Planning can promote climate-resilient agriculture, efficient water management, and community-based food systems. This study calls for government support, social safety nets, and infrastructure development to bolster food security in Enyezane, aligning with the Sustainable Development Goals. The study emphasizes the adverse effects of climate change on Enyezane's food security. It analyzes the community's coping strategies while highlighting the potential of urban planning to address these challenges. The findings offer valuable insights to inform policies and targeted interventions that can promote food security and climate resilience in Enyezane, and similar regions facing the impacts of climate change.

Keywords: Climate change, food security, Enyezane, South Africa, Climate resilience

## 2 INTRODUCTION AND CONTEXTUALIZATION

Most developing countries have enormous issues in terms of food security as a result of climate change. Food insecurity affected approximately 30 million more individuals in low-income countries in 2021 as a result of increased food commodity prices, which was a significant contributing factor (World Bank, 2022). In all regions of the world, there is widespread food insecurity and malnutrition in all its forms (FAO, 2022). Achieving goal 1, which is no poverty, and goal 2, which is end hunger, of the Sustainable Development Goals (SDGs) has been challenging in recent times, as indicated by the 2022 Global Hunger Index (GHI) study. This study also suggests that the recent global progress in addressing hunger has come to a halt (Von Grebmer et al., 2022). If hunger-eradication efforts are not stepped up, 8% of the world's population would be hungry by 2030 (Food and Agriculture Organization et al., 2022). The severity of the issue is most extreme in Asia, where 10.2% of the population experienced acute food insecurity in 2020, up from 319.9 million in 2015 (UNICEF, 2021). More than half (425 million) of the hungry people in the globe in 2021 resided in Asia (FAO, 2021). Furthermore, except for Asia, moderate to severe food insecurity has remained consistent. According to UNICEF (2021), food insecurity distribution varies substantially even within the Asian region. For example, the proportion of malnourished persons in 2020 ranged from 2.5% in Eastern Asia to nearly 15.8% in Southern Asia (UNICEF, 2021). In contrast, the rate of undernourishment in Western Asia (15.1%) was nearly comparable to that in Southern Asia (UNICEF, 2021).

Hasanuzzaman et al., (2013), stated that higher temperatures hamper crop development and raise the danger of pests and diseases, which lower crop yields (Hasanuzzaman et al., 2013). It also affects precipitation patterns, which results in short-term crop failure and a long-term loss in food output (Pörtner et al., 2022). Additional studies have shown that water scarcity, usually associated with drought, reduces soil moisture and causes low yields (Mar et al., 2018). Nonetheless, heavy rain that washes away topsoil affects soil fertility through deterioration and hence reduces crop yields (Shourie and Singh, 2021). Early rains before a planting season disrupt planting and harvesting seasons, causing food insecurity (Kyei-Mensah et al., 2019).

Climate change has raised serious concerns about future water availability in many parts of the world, as it impacts factors such as precipitation, which has ramifications for hydrological systems, water quality, and groundwater recharge (Masipa, 2017). These all pose significant obstacles to climate adaptation. In general, climate change depletes water supplies and has an impact on vulnerable communities' health and food security, especially in southern hemisphere nations with limited capacity to adapt (Malhi et al., 2021).

According to Ogundeji (2022), the African continent is especially vulnerable to climate change because of the greater-than-average temperature increase that will result from global warming, and because agriculture, primarily rain-fed, serves as the main means of subsistence for rural communities. Furthermore, rural homeowners and farmers are particularly vulnerable to climate change due to additional issues such as a lack of access to land, acute poverty, and lack of knowledge and financial support to implement adaptation measures (Ogundeji, 2022). Climate change has jeopardized the food security of millions of people in Sub-Saharan Africa. Climate change will exacerbate drought conditions in Sub-Saharan Africa and across the continent, making water security for food and agricultural development more challenging (Simpson, 2016).

South Africa is a country with significant food insecurity challenges. According to the Global Hunger Index (2020), South Africa has a hunger index score of 13.5, indicating a serious level of hunger. The country's food insecurity is mainly due to factors such as poverty, unemployment, and inequality. The country's population growth rate is currently at 1.28%, which is higher than the global average of 1.05%. Food security is a critical issue in South Africa, where the population is growing at a rapid rate. The country's population growth is projected to increase from 58 million in 2020 to 79 million by 2050, according to the United Nations. This growth is expected to place significant pressure on the country's food production and distribution systems (Index, 2020).

With reference to the above context, this study focuses on the Enyezane area located in KwaZulu-Natal, South Africa. Climate change poses immense challenges for food security in most areas of South Africa. Jacob Zuma, a former president of the Republic of South Africa, said in his 2014 State of the Nation Address that the government has elevated food security to a major priority (Masipa, 2017). This is because South Africa and other countries across the world are increasingly acknowledging that climate change and its effects on food insecurity are serious issues. South Africa is usually regarded as a food-secure nation when compared to other African nations since it produces enough staple foods and can import food to meet the population's basic nutritional needs (FAO, 2008). Hart and Aliber (2009) make a similar argument, arguing that while South Africa may appear to have enough food security on the national level, this cannot be stated for individual households, particularly those located in rural areas where agriculture is the primary source of income for the vast majority of residents. However, Landman (2004) discovered that South Africa continues to have a significant problem concerning food security.

In terms of the Constitution of South Africa specifically Section 27 (1)(b) everyone has a right to sufficient food and water. This is also consistent with South Africa's millennium development goals, which call for cutting poverty in half by 2015. Even though South Africa has been able to fulfill the food needs of its expanding population over the years, according to national food security indicators, there are no reliable data on food security at the household level (Statistics South Africa, 2009). According to Hendriks (2005), in South Africa, a high number of rural households are affected by food insecurity. According to research by Knueppel et al. (2009) and De Cock (2012), South Africans who live in rural areas are the most severely impacted by climate change which led to food insecurity. More than 14 million individuals, or roughly 35% of South Africa's population, are subject to food insecurity (Demetre, Yul, and Zandile, 2009). The authors claim that if a person receives less than R211 per month, they are considered to be food insecure. The main issue with food security in South Africa, according to Bonti-Ankomah (2001), is the availability of food. This is so because the availability of food is influenced by demand and disposable income.

People in KwaZulu-Natal are now more vulnerable to future climate change as a result of the multiple daily pressures in their life. Additionally, efforts to reduce the hazards associated with climate change are constrained by a lack of organizational support (e.g., from the government and other organizations) (Ndlovu et al., 2021). The province has a largely rural population, and the majority of people their live-in high-density poverty. KwaZulu-Natal is characterized by warm to scorching summers, heatwaves, wildfires, and moderate winters. In the area surrounding Cape St. Lucia, the highest daily air temperatures during the summertime can reach 40.1 °C (Ndlovu et al., 2021). The province has experienced a falling water presence throughout time, and it is expected that things will become worse before they get better (Shen et al., 2017). In a study on adjusting to climate change in KwaZulu-Natal, it was shown that women in rural regions have been suffering from reduced harvests owing to drought, with the diversification of livelihoods through fishing having been hampered as water sources have dried up (Yende, 2020). According to Yende (2020), due to their scarce financial, human, and technological resources, lack of support from the municipal and provincial governments, and other factors, rural households are more severely impacted by the negative effects of

climate change. Unfortunately, for those who have cattle, a short-term drought approach has been switching from cropland to livestock, but this reduces natural capital (Bahta and Myeki, 2020). Food security in KwaZulu-Natal has been and will continue to be significantly impacted by climate change, like many other provinces in South Africa.

Given the above, the study addresses the following question; how have climate-related shocks impacted food security in Enyezane, and what coping strategies has the community employed to overcome these challenges?

### 3 BACKGROUND ON STUDY AREA

Enyezane is a rural area in Estcourt, KwaZulu-Natal Province, South Africa, in the uThukela District.

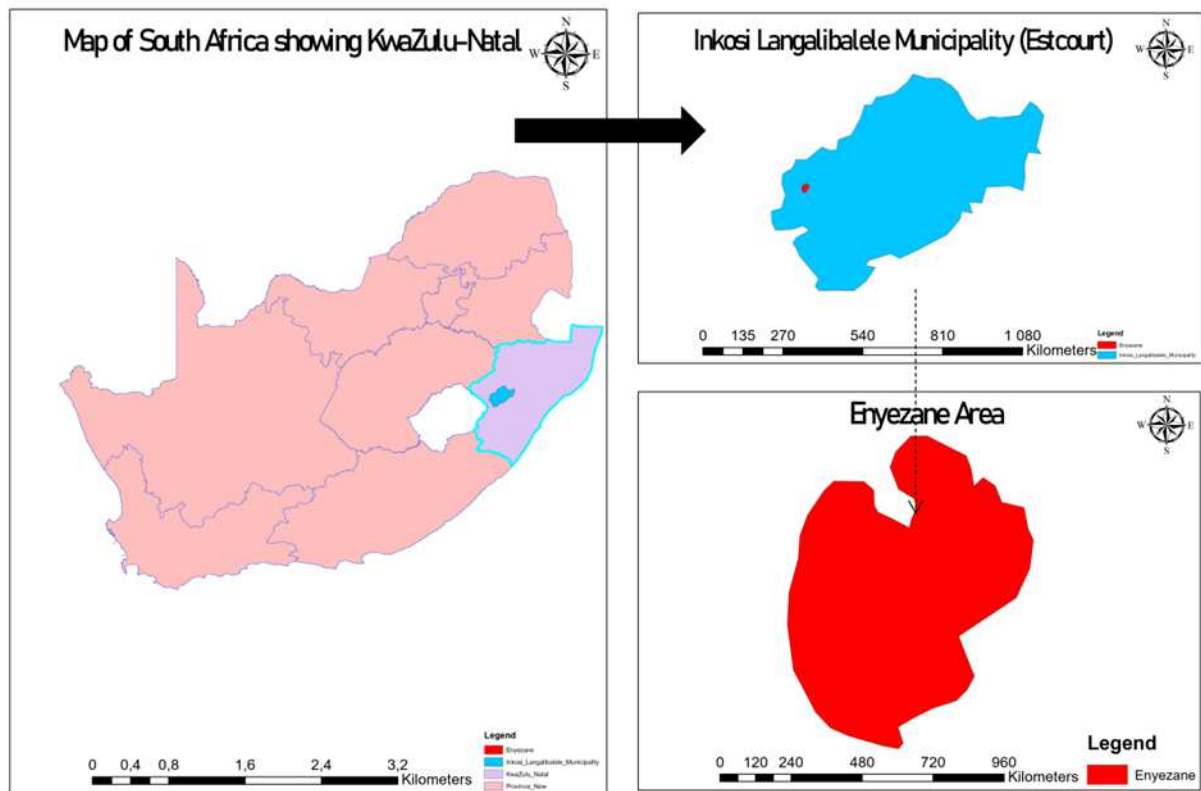


Fig:1 Locality map of Enyezane: KZN, Inkosi Langalibalele Municipality, and Enyezane

Farming is the main economic activity in Enyezane, and there are sizable bacon and processed food plants positioned all around the town. The area is connected to the rest of South Africa by the N3 highway, which runs close by. Enyezane which is under Estcourt is located at the confluence of the Bushmans and the Little Bushmans River. It is also on the main Durban and Johannesburg railway line some 160 km north of Durban and 25 km south of the Tugela River crossing (Inkosi Langalibalele Disaster Management Draft Sector Plan 2017/2018, 2017). Enyezane is under Inkosi Langalibalele Local Municipality. The population of the Municipality as a whole is 223 898 people (Final integrated development plan review 2020/2021, 2020). The majority of the population is African, which makes up 91% of the total population. Like many other municipalities, this particular one exhibits a higher female population, with women comprising 54% of the municipal residents, while men make up the remaining 46%. Furthermore, in this municipality, women lead 52% of households (Final integrated development plan review 2020/2021, 2020). Given that farming settlements make up the majority of the municipal area, male absenteeism is a sign that most farmers are no longer engaged in traditional commercial agricultural activities, which typically use men as labor, and as a result, the majority of men look for employment in major urban centers elsewhere in the world (Final integrated development plan review 2020/2021, 2020). The figure below shows the spatial context of Enyezane.

#### 4 LITERATURE REVIEW: FOOD SECURITY AND CLIMATE CHANGE

The Intergovernmental Panel on Climate Change's (IPCC) Working Group I Sixth Assessment Report (released on 6 August 2021) outline that the world average surface temperatures could increase by 1.0°C to 5.7°C by the end of this century. The rate of global mean sea level rise has accelerated and will continue throughout the 21st century, ranging from 0.32m to 1.01m. 2021 was Singapore's second wettest year since 1980, with higher-than-average rainfall for most months and annual total rainfall of 2809.6mm at the Changi climate station. (From "2021 Climate and Weather: The Year in Review", NEA). While a localized temperature change of 2°C or 3°C may not seem serious, it has grave consequences on a global scale because this temperature increase directly impacts the sustainability of water, food supplies, ecosystems, coastal stability, and public health (Tol, 2018). In the context of this study, climate change can be defined as the long-term alteration of temperature, precipitation patterns, and other climate variables in the Enyezane region of KwaZulu-Natal, South Africa. This phenomenon is primarily driven by human activities, such as the emission of greenhouse gases from industrial processes, transportation, and deforestation. Climate change in this context encompasses both gradual shifts in average weather conditions and an increase in the frequency and intensity of extreme weather events, including droughts, heatwaves, and heavy rainfall.

Climate change is expected to disrupt food production in various regions worldwide, causing increased food prices and significant adverse effects from 2050 to 2100 (Dawson et al., 2016). The United States, with its high carbon dioxide emissions, experiences record-breaking temperatures, and since it's a vital part of the global food network, these climate changes have far-reaching global consequences (Dawson et al., 2016). Changes in global temperatures and precipitation patterns impact food production, processing, and quality. Rising sea levels and extreme weather events due to climate change further hinder the global transportation of food (Dawson et al., 2016). Based on worst-case greenhouse gas emissions and population growth, the USDA predicts that the number of undernourished people worldwide could increase by 175 million by 2080 (Dawson et al., 2016). China, as the world's most populous nation and one of its largest greenhouse gas emitters, faces complex challenges related to climate change and food security. With a growing population and a significant agricultural sector, China's ability to feed its people is crucial. The country is experiencing shifts in temperature and precipitation patterns, which impact crop yields. This is evident in regions such as Northern China, which has seen decreased wheat production due to water scarcity caused by changing climate conditions (Tao et al., 2014). Climate adaptation strategies and investments in more resilient crop varieties are crucial for China's food security (Zhang et al., 2019).

Germany, a leading European country, is also affected by climate change, which poses challenges to its food security. While Germany has a highly advanced agricultural sector, it is not immune to the impacts of a warming climate. Changing rainfall patterns and an increased frequency of extreme weather events, such as heavy rainfall or droughts, can disrupt crop production and impact food availability. Recent studies in Germany have shown that climate change can lead to a reduction in crop yields for wheat, maize, and barley (Reckling et al., 2016). Adaptation measures, like precision agriculture and the cultivation of more drought-resistant crop varieties, are necessary for Germany to secure its food supply in a changing climate. Climate change poses a significant threat to food security in Africa, impacting both agricultural production and food availability. For instance, in Kenya, rising temperatures and erratic rainfall patterns have led to reduced crop yields and increased vulnerability among smallholder farmers, who make up a substantial portion of the population (Nyangena et al., 2019). This is exacerbated by extreme weather events such as droughts and floods, which disrupt farming activities and further compromise food production (Mugo et al., 2020). Additionally, the changing climate has resulted in the expansion of pests and diseases, which threaten staple crops like maize and beans (FAO, 2016). To address these challenges and enhance food security, comprehensive adaptation strategies and policies are crucial in Kenya and across Africa.

Climate change is a key concern within South Africa. Mean annual temperatures have increased by at least 1.5 times the observed global average of 0.65°C over the past five decades and extreme rainfall events have increased in frequency. These changes are likely to continue: the 2013 South African Long Term Adaptation Scenarios and the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR5) for Representative Concentration Pathway (RCP) 8.5 suggest warming relative to 1986–2005 of 3–6°C by 2081–2100 in the interior, yet less certain precipitation changes in terms of both direction and magnitude. Climate change poses a significant threat to South Africa's water resources, food security, health, and

infrastructure, as well as its ecosystem services, and biodiversity. Considering South Africa's high levels of poverty and inequality, these impacts pose critical challenges to national development (Barange et al., 2018).

According to Morin (2014), food security refers to a condition where all individuals within a community, region, or nation have consistent and reliable access to sufficient, safe, and nutritious food that meets their dietary needs and preferences for an active and healthy life. It encompasses not only the availability of food but also factors like accessibility, affordability, and utilization. In contrast, food insecurity refers to a state where individuals or households lack consistent access to enough food due to various socio-economic and environmental factors, often leading to hunger, malnutrition, and uncertainty about future food availability (Saint Ville et al., 2019). Food insecurity can manifest as mild, moderate, or severe, with individuals experiencing varying degrees of vulnerability to hunger and inadequate nutrition. Addressing food insecurity is essential for ensuring the well-being and health of populations worldwide (Saint Ville et al., 2019). The United Nations Food and Agriculture Organization (FAO) estimates that nearly 900 million people on the planet are suffering from chronic hunger. This state of affairs led to the making of the United Nations Millennium Development Goals in 2000, having the first goal to "Eradicate extreme poverty and hunger" with a target of halving the proportion of people who suffer from hunger. However, projections of a rapidly growing population, coupled with global climate change, are expected to have significant negative impacts on food security. Under a no-climate change scenario, based upon projected changes in population and agricultural land use only, results show that 31 % (2.5 billion people by 2050) of the global population is at risk of undernourishment if no adaptation or agricultural innovation is made in the intervening years. An additional 21 % (1.7 billion people) are at risk of undernourishment by 2050 when climate change is considered.

## 5 METHODOLOGY

An explanatory case study was a suitable research approach for investigating the impacts of climate change on food security in Enyeyane, KZN, given the complexity of the topic, the need for in-depth understanding, and the qualitative nature of the research objectives. It enabled the exploration of the specific context of Enyeyane and provided valuable insights into the issues at hand. A qualitative research approach was employed through the use of semi-structured interviews which allowed the researcher to gain an in-depth understanding of the local context, including the specific socio-cultural and economic factors that influenced food security in Enyeyane. Through interviews and observations, researcher captured the diverse experiences and perceptions of community members. Purposive sampling was used to select 20 participants that include local farmers, livestock owners, and residents who had experience dealing with climate-related challenges in Enyeyane who provided valuable insights into the research based on their knowledge and experience of climate change and food security in the region. The study was conducted from March 2023 until the end of November 2023.

## 6 RESULTS AND DISCUSSION

### 6.1 Extreme weather events: droughts and floods

The study revealed that climate patterns in Enyeyane have undergone significant changes in recent years. Respondents consistently reported alterations in the timing and intensity of seasons. One participant noted, "We used to have predictable seasons, but now it is all unpredictable. Sometimes, we experience summer-like temperatures during what should be the rainy season." This unpredictability in climate patterns has raised concerns among the local population. The alteration of climate patterns observed by respondents highlights the need for adaptive strategies in Enyeyane. These changes could potentially disrupt traditional agricultural practices and food production systems, thus impacting food security in the region. Respondents overwhelmingly identified extreme weather events, particularly droughts and occasional floods, as major climate-related challenges in Enyeyane. A participant expressed, "Droughts have become more frequent and severe. We struggle to grow crops, and our water sources are drying up." These events were often cited as causing food shortages and economic hardships. The recurring droughts and occasional floods in Enyeyane are clear indications of climate change impacts. These events pose significant threats to food security, as they disrupt agricultural activities and access to clean water. Effective mitigation and adaptation measures are essential to address these challenges.

Another challenge is that the community of Enyezane rarely get notified by the municipality of predications on extreme weather. One of the participants mentioend that “we rarely receive timely warnings about extreme weather events. When floods or storms hit, it is often too late to protect our homes and crops.” This lack of early warning systems contributes to increased vulnerabilities. Another respondent mentioned, “after disasters strike, we struggle to get help. Emergency response teams are ill-equipped and understaffed, making recovery slow and difficult.” The inefficiency in disaster response further compounds the challenges faced by the community. A community member stated, “Our roads and bridges are not built to withstand extreme weather. When they get damaged, it disrupts the movement of goods and services, affecting our livelihoods.”

## 6.2 Water scarcity

Participants emphasized the growing problem of water scarcity and the need for improved irrigation practices. One of the participants outlined the following, “Access to water for irrigation is a constant struggle. Our local rivers are drying up, and the cost of drilling boreholes is prohibitive for many small-scale farmers like me.” Another participant stated, “Efficient irrigation systems are the need of the hour. Climate-smart irrigation methods can help us make the most of the limited water resources we have left.” These statements highlight the urgency of addressing water scarcity issues and implementing sustainable irrigation solutions in the face of climate change. Such efforts are crucial for ensuring food security in the Enyezane area.

Water plays a crucial role in agricultural activities in rural households (Wani et al., 2009). However, decreased rainfall during periods of drought have already caused agricultural yields to decrease in some parts in South Africa (Dalin and Conway, 2016; Funk and Brown, 2009). Additionally, drought conditions further exacerbate poverty in areas experiencing soil erosion and land degradation. This is as a result of a relationship that exists between land degradation and drought (Wani et al., 2009). The effects of the current drought are seen in a small farm in the Enyezane community. The lack of water resources in this community have resulted in low agricultural yields which have hindered farming activities in some households. Other households have sized production of certain crops which intake much water such as spinach and cabbage.

## 6.3 Crop yield variations

Findings from the study indicate that climate change has had a significant impact on crop yields in the Enyezane area, KwaZulu-Natal. Respondent stated, “Over the past few years, we have e seen unpredictable weather patterns affecting our maize and bean crops. Sometimes, it is prolonged drought, and other times, it excessive rainfall. It is become increasingly challenging to predict our harvests.” Another respondent added, “The changing climate has made it difficult to rely on traditional planting and harvesting times. We often have to adjust our planting schedules, and this uncertainty affects our overall crop production.” These responses illustrate the consensus among respondents about the adverse impact of climate change on crop yields. The unpredictability of weather patterns disrupts traditional farming practices and jeopardizes food security in the region.

## 6.4 Livestock production challenges

The study found that livestock production faces numerous challenges due to climate change. Respondent highlighted, “Our cattle and goats are struggling to find enough pasture due to prolonged dry spells. We have also seen an increase in disease outbreaks, which we suspect is linked to changing weather conditions.” Another respondent added, “my cattle have tick-borne, and I do not have medicine that I can use to treat it”. Another affected respondent mentioned, “Extreme heatwaves are stressing our poultry, leading to lower egg production. We are also concerned about the availability of water for our animals during droughts.” Livestock farmers in the Enyezane area have faced substantial challenges due to climate change. Respondents reported that increased temperatures and prolonged droughts have stressed their animals, leading to reduced livestock production. One respondent mentioned, “Our cattle used to be healthier, but now, they suffer from heat stress and lack of water, affecting milk and meat production”. This results in a shortage of food because most people in the community rely on cows for milk, meat, leather, and hundreds of other products that people use in everyday life.

Another growing concern that was raised on account of the extreme weather events in the area was the increased cases of ‘tick-borne’ which are small arachnids that feed on the blood of mammals, including cattle.

They attach themselves to the cow's skin and feed on its blood, which can lead to various health problems for the cow. The cow usually ends up dying because of it. One of the respondents who is an owner of livestock highlighted that he has noticed that tick populations often vary with the seasons. He further outlined that in this area, ticks increase during the spring and summer months when temperatures are higher and humidity levels rise. The tick-borne challenge is further exacerbated by the water shortages experienced in Enyazane as one of the farmers indicated that "I cannot go to Endiphini (Endiphini is where tick-borne disease is treated with some chemicals) because there is no water and the river is far". These responses underscore the multifaceted challenges faced by livestock farmers in the Enyazane area. Climate change-induced factors like reduced pasture and heat stress not only affect livestock health but also jeopardize the livelihoods of farmers.

### 6.5 Adaptation strategies and practices

Several participants that were interviewed highlighted their practice of retrieving water directly from the nearby river or through rain water harvesting which they stored in large containers called "Jojo tanks" that hold up to 5,000 litres of water and were kept for the purposes of irrigation or household tasks. This diligent process underscores their commitment to sustaining their agricultural endeavours through resourceful water management." We store rainwater in the Jojo tanks or during times when the rivers aren't dried up, we get water from the river and store it so that we are able to still water our crops using water cans".

Another strategy that has been employed is during the extreme winter months, in the absence of a broiler, chickens are sensitive to cold temperatures, and prolonged exposure to low temperatures can lead to cold stress. This can result in reduced egg production, decreased feed consumption, and overall poor health. Livestock farmers have employed the ingenious "iMbawula" method, to create a cozy and comfortable environment for her cherished chickens amidst the chilly winter season. This implies building a round metal container and lighting up some fire wood inside of it which then produces heat for the chicken (see figure below).



Fig. 2: iMbawula to keep her chickens warm and comfortable during the cold winter.

Due to the uncertainty of the climate and the impacts on agricultural activities in Enyazane, another strategy employed is livelihood diversification where community members and farmers are exploring different ways to generate and income to sustain their livelihoods such as firewood trading and petty trading such as selling of vegetables, fruits, sweets among other things. Diversification was also witnessed in the crops as the community is increasingly moving to drought-resistant crops such as sorghum to counter food security challenges posed by the change in weather. One participant explained that "I told my family that we can't just stick to maize for porridge anymore because the maize crops aren't doing well. So now we're trying out other crops like sorghum, and they seem to be handling the heat better."

The reliance on social networks in the community was also another strategy used to cope with the effects of climate change. Some participants mentioned that many community members would come together to provide support in the form of vegetables and maize in the times when other community members were not able to provide for their own household. One participant stated "if my crops are not able to yield any fruit, I know that my neighbours will support me. We support each other in this community because we all know that

these things are unpredictable and tomorrow it could be you in the same situation so we come together and assist each other with some veg or maize when its really bad". There is also an increased reliance on the government support. This was evident in the participants in the study identified the importance of government support programs in mitigating the impacts of climate change on food security in Enyezane. They emphasized the need for targeted assistance to those most affected by climate-related challenges. Respondent stated, "Government support programs are a lifeline for us. They provide food and resources during times of drought and extreme weather events. Without them, many families would suffer even more." Another respondent mentioned, "These support programs need to be more accessible and better advertised. Many people in our community do not know about them, and that needs to change." The respondents' recognition of the importance of support programs highlights the vital role of government in addressing food security challenges in Enyezane. It's evident that while these programs exist, there is room for improvement in terms of accessibility and awareness.

A crucial response to the urgent problem of food scarcity within the Enyezane community, brought about by the extensive repercussions of climate change, is the implementation of a Government Intervention food parcel program. This essential initiative is designed to offer assistance to individuals and families who have been severely affected by the far-reaching consequences of environmental shifts. Its primary objective is to strengthen food security for those grappling with the profound challenges posed by climate change, ultimately ensuring their sustenance and well-being in the face of ongoing environmental challenges.

## 7 CONCLUSION

In conclusion, the primary objectives of this study were to investigate the impacts of climate-related shocks on food security within the Enyezane community, exploring the coping strategies employed by residents to address food insecurity. The study uncovered significant insights into the experiences of the Enyezane community with climate-related shocks and food insecurity. The findings indicated that climate-related shocks, such as extreme weather events and changing rainfall patterns, have had adverse effects on food security in Enyezane. These shocks disrupted agricultural activities, reduced crop yields, and compromised the availability and affordability of food, thereby exacerbating food insecurity in the community. In response to these challenges, the Enyezane community employed a variety of coping strategies. These strategies included diversifying livelihoods, reliance on social networks for support, and the use of government assistance programs. These efforts demonstrated the resilience and adaptability of the community in the face of food insecurity threats. This research underscores the pressing need for a comprehensive approach to address food insecurity in Enyezane, considering climate resilience, community empowerment, and urban planning integration. Implementing these recommendations can contribute to building a more food-secure and resilient Enyezane community in the face of climate-related challenges.

## 8 REFERENCES

- Abdu-Raheem, K, A., and Worth, S, H., 2012. Household food security in South Africa: Evaluating extension's paradigms relative to the current food security and development goals. *South African Journal of Agricultural Extension*. 40 (1), 91-103.
- Adams, W, M., 2001. *Green development: Environment and sustainability in a developing world*. 2nd Ed. Routledge, London.
- Adams, W, M., 2009. *Green development: Environment and sustainability in a developing world*. 3rd Ed. Routledge, London.
- Adeagbo, O., Herbst, C., Blandford, A., McKendry, R., Estcourt, C., Seeley, J. and Shahmanesh, M., 2019. Exploring people's candidacy for mobile health-supported HIV testing and care services in rural KwaZulu-Natal, South Africa: Qualitative study. *Journal of medical Internet research*, 21(11), p.e15681. *Annals in Social Responsibility*, 3(1).
- African Conservation Trust., 2015. Annual Report 2015. [Online]. Available from: <http://www.projectafrica.com/wp-content/uploads/2016/01/ACT-Annual-Report2015-sml.pdf> [Accessed 16 August 2023].
- Agricultural Research Council., 2015. Annual Report 2014/15: Transforming Africa's Agriculture: harnessing opportunities for inclusive growth and sustainable development. [Online]. Available from: [http://www.daff.gov.za/daffweb3/Portals/0/SOE/ARC\\_2014-15%20Annual%20Report%20-%201pgView%20-%20Sept%202015.pdf](http://www.daff.gov.za/daffweb3/Portals/0/SOE/ARC_2014-15%20Annual%20Report%20-%201pgView%20-%20Sept%202015.pdf) [Accessed 17 August 2023].
- Ajani, E, N., Mgbenka, R, N., and Okeke, M, N., 2013. Use of indigenous knowledge as a strategy for climate change adaptation among sub-Saharan Africa: Implications for policy. *Asian Journal of agricultural extension*. 2 (1), 23-40.
- Akpalu, W., Hassan, R, M., and Ringler, C., 2009. Climate variability and maize yield in South Africa: Results from GME and MELE methods. IFPRI Discussion Paper No. 843. International Food Policy Research Institute, Washington, DC
- Alam, M., Bhatia, R., and Mawby, B., 2015. Women and Climate Change: Impact and agency in Human Rights, Security and Economic Development. [Online]. Available from: <https://giwps.georgetown.edu/sites/giwps/files/Women%20and%20Climate%20Change.pdf> [Accessed 20 June 2023].
- Aliber, M., 2002. Poverty eradication and sustainable development. Human Sciences Research Council Publishers: Cape Town. 179
- Almanasreh, E., Moles, R. and Chen, T.F., 2019. Evaluation of methods used for estimating content validity. *Research in social and administrative pharmacy*, 15(2), pp.214-221.



[Accessed on 13 October 2023]

- Bender, S., Jarmin, R.S., Kreuter, F. and Lane, J., 2020. Privacy and confidentiality. In *Big data and social science* (pp. 313-331). Chapman and Hall/CRC.
- Benhin, J, K, A., 2008. South African crop farming and climate change: An economic assessment of impacts. *Global Environmental Change*, 18, 666-678.
- Benjaminsen, T, A., and Robbins, P., 2015. Nordic political ecologies. *Norwegian Journal of Geography*, 69 (4), 191-169.
- Bhandari, B., 2003. Participatory Rural Appraisal (PRA). Institute for Global Environmental Strategies (IGES). [Online]. Available from: [http://enviroscope.iges.or.jp/contents/eLearning/waterdemo/bhandari\\_m4.pdf](http://enviroscope.iges.or.jp/contents/eLearning/waterdemo/bhandari_m4.pdf) [Accessed 05 August 2023].
- Crisafulli, D., 2014. Disaster Management Amendment Bill.
- Crush, J., Frayne, B., and Pendleton, W., 2012. The crisis of food insecurity in African cities. *Journal of Hunger & Environmental Nutrition*, 7, 271-292.
- Cruz, R.R., García, D.I.D., Silva, S.L. and Domínguez, F.R., 2021. Integrated management of the cattle tick *Rhipicephalus (Boophilus) microplus* (Acari: Ixodidae) and the acaricide resistance mitigation. In *Insecticides*. IntechOpen.
- Daniel, K., 2015. Make cities and human settlements inclusive, safe, resilient and sustainable. *UN Chronicle*, 51(4), pp.26-27.
- Dawson, T.P., Peryman, A.H. and Osborne, T.M., 2016. Modelling impacts of climate change on global food security. *Climatic Change*, 134, pp.429-440.
- De Cock, N., 2012. A comparative overview of commonly used food security indicators in Limpopo province, South Africa. Belgium: Ghent University (Dissertation-MBA).
- DeGhetto, K., Gray, J.R. and Kiggundu, M.N., 2016. The African Union's Agenda 2063: Aspirations, challenges, and opportunities for management research. *Africa Journal of Management*, 2(1), pp.93-116.
- Elkoumy, G., Fahrenkrog-Petersen, S.A., Sani, M.F., Koschmider, A., Mannhardt, F., Von Voigt, S.N., Rafiei, M. and Waldthausen, L.V., 2021. Privacy and Confidentiality in Process Mining: Threats and Research Challenges. *ACM Transactions on Management Information System (TMIS)*, 13(1), pp.1-17.
- Erb, K. H., et al. (2016). Exploring the biophysical option space for feeding the world without deforestation. *Nature Communications*, 7, 11382.
- Faisal, I.M. and Parveen, S., 2004. Food security in the face of climate change, population growth, and resource constraints: implications for Bangladesh. *Environmental Management*, 34(4), pp.487-498.
- Faisal, I.M. and Parveen, S., 2004. Food security in the face of climate change, population growth, and resource constraints: implications for Bangladesh. *Environmental Management*, 34(4), pp.487-498.
- Fan, S., Teng, P., Chew, P., Smith, G. and Copeland, L., 2021. Food system resilience and COVID-19—Lessons from the Asian experience. *Global Food Security*, 28, p.100501.
- Gu, D., Andreev, K. and Dupre, M.E., 2021. Major trends in population growth around the world. *China CDC weekly*, 3(28), p.604.
- Gustavo, G., and Stamoulis, K., 2007. Rural development and poverty reduction: Is agriculture still the key? [Online]. Available from: <https://ideas.repec.org/a/ags/ejedef/112591.html> [Accessed 20 August 2023].
- Hall, C., Dawson, T.P., Macdiarmid, J.I., Matthews, R.B. and Smith, P., 2017. The impact of population growth and climate change on food security in Africa: looking ahead to 2050. *International Journal of Agricultural Sustainability*, 15(2), pp.124-135.
- Hasanuzzaman, M., Nahar, K., Alam, M.M., Roychowdhury, R. and Fujita, M., 2013. Physiological, biochemical, and molecular mechanisms of heat stress tolerance in plants. *International journal of molecular sciences*, 14(5), pp.9643-9684.
- Hendriks, S.L., 2005. The challenges facing empirical estimation of household food (in) security in South Africa. *Development Southern Africa*, 22(1), pp.103-123.
- Hergerl, G. C., and Zwiers, F. W., 2007. Understanding and attributing climate change. The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press: Cambridge.
- IPCC. (2014). *Climate Change 2014: Impacts, Adaptation, and Vulnerability*. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.
- Jenkins, J.C. and Scanlan, S.J., 2001. Food security in less developed countries, 1970 to 1990. *American sociological review*, pp.718-744.
- Johnson, L., & Williams, P. (2020). Assessing the Effectiveness of South Africa's National Climate Change Response Policy in Reducing Carbon Emissions and Promoting Agricultural Sustainability. *Climate Policy*, 20(8), 957-972.
- Kirsten, J. F., du Plessis, H. M., van Rooyen, C. J., & Ackermann, L. (2017). Mapping food security and vulnerability in rural South Africa: Impact of demographic, socio-economic and livelihood factors. *Agrekon*, 56(3-4), 270-290.
- Landman A.P, 2004. 'Nutrition-sensitive agriculture – A South African perspective', *Food Security* 5(6), 857–871. [Online]. Available from: <https://doi.org/10.1007/s12571-013-> [Accessed on 01 May 2023]
- Lemon, L.L. and Hayes, J., 2020. Enhancing trustworthiness of qualitative findings: Using Leximancer for qualitative data analysis triangulation. *The Qualitative Report*, 25(3), pp.604-614.
- Leonard, L., 2022. Climate Change Impacts and Challenges of Combating Food Insecurity in Rural Somkhele, KwaZulu-Natal, South Africa. *Sustainability*, 14(23), p.16023.
- Lin, H., Werner, K.M. and Inzlicht, M., 2021. Promises and perils of experimentation: The mutual-internal-validity problem. *Perspectives on Psychological Science*, 16(4), pp.854-863.
- Morton, J. F. (2007). The impact of climate change on smallholder and subsistence agriculture. *Proceedings of the National Academy of Sciences*, 104(50), 19680-19685.
- Mugo, R., Mutuku, J. M., & Kosura, W. (2020). Climate change impacts on food security in Kenya. In *Climate Change Impacts on Agriculture and Food Security in Kenya* (pp. 55-69). Springer.
- Nawrotzki, R, J., Robson, K., Gutilla, M, J., Hunter, L, M., Twine, W., and Norlund, P., 2014. Exploring the impact of the 2008 global food crisis on food security among vulnerable households in rural South Africa. *Food Security*, 6 (2), 283-297.
- Ndlovu, M., Clulow, A.D., Savage, M.J., Nhamo, L., Magidi, J. and Mabhaudhi, T., 2021. An assessment of the impacts of climate variability and change in KwaZulu-Natal Province, South Africa. *Atmosphere*, 12(4), p.427.
- Obaideen, K., Shehata, N., Sayed, E.T., Abdelkareem, M.A., Mahmoud, M.S. and Olabi, A.G., 2022. The role of wastewater treatment in achieving sustainable development goals (SDGs) and sustainability guideline. *Energy Nexus*, 7, p.100112.

- Ogundeji, A.A., 2022. Adaptation to Climate Change and Impact on Smallholder Farmers' Food Security in South Africa. *Agriculture*, 12(5), p.589.
- Pahl-Wostl, C., 2019. Governance of the water-energy-food security nexus: A multi-level coordination challenge. *Environmental Science & Policy*, 92, pp.356-367.
- Pérez-Escamilla, R., 2017. Food security and the 2015–2030 sustainable development goals: From human to planetary health: Perspectives and opinions. *Current developments in nutrition*, 1(7), p.e000513.
- Rosa, W., 2017. Goal 13. Take Urgent Action to Combat Climate Change and Its Impacts. *A New Era in Global Health: Nursing and the United Nations 2030 Agenda for Sustainable Development*, p.351.
- Rosenzweig, C., Elliott, J., Deryng, D., Ruane, A. C., Müller, C., Arneth, A., ... & Jones, J. W. (2014). Assessing agricultural risks of climate change in the 21st century in a global gridded crop model intercomparison. *Proceedings of the National Academy of Sciences*, 111(9), 3268-3273.
- Saint Ville, A., Po, J.Y.T., Sen, A., Bui, A. and Melgar-Quinonez, H., 2019. Food security and the Food Insecurity Experience Scale (FIES): ensuring progress by 2030. *Food Security*, 11, pp.483-491.
- Satterthwaite, D., Archer, D., Colenbrander, S., Dodman, D., Hardoy, J., Mitlin, D. and Patel, S., 2020. Building resilience to climate change in informal settlements. *One Earth*, 2(2), pp.143-156.
- Trafimow, D., 2022. Construct validity. *International Journal of Aviation Research*, 14(1).
- Turrentine, J., 2021. What Is Climate Change?. [Online]. Available from: <https://www.nrdc.org/stories/what-climate-change#whatis> [Accessed on 13 May 2023]
- Tuval-Mashiach, R., 2021. Is replication relevant for qualitative research? *Qualitative Psychology*, 8(3), p.365.
- UNICEF, 2021. The state of food security and nutrition in the world 2021.
- Union, A., 2006, January. Status of food security and prospects for agricultural development in Africa. In *Mali: AU Ministerial Conference of Ministers and Agriculture*.
- Usman, M.A. and Callo-Concha, D., 2021. Does market access improve dietary diversity and food security? Evidence from Southwestern Ethiopian smallholder coffee producers. *Agricultural and Food Economics*, 9, pp.1-21.
- Woolway, R.I., Kraemer, B.M., Lenters, J.D., Merchant, C.J., O'Reilly, C.M. and Sharma, S., 2020. Global lake responses to climate change. *Nature Reviews Earth & Environment*, 1(8), pp.388-403.
- World Health Organization, 2020. The state of food security and nutrition in the world 2020: transforming food systems for affordable healthy diets (Vol. 2020). *Food & Agriculture Organization*
- Xu, H., et al. (2009). Climate change and challenges of water and food security. *Science*, 327(5967), 628-631.
- Yende, A.N.P., 2020. Farmers' perception and adaptation to climate change: case study of vulnerable areas in uMhlathuze Local Municipality in KwaZulu-Natal, South Africa (Doctoral dissertation).
- Youmatter. 2020. Climate Change: Meaning, Definition, Causes, Examples and Consequences. [Online]. Available from: <https://youmatter.world/en/definition/climate-change-meaning-definition-causes-and-consequences/> [Accessed 07 September 2023]
- Zembe, A., NemaKonde, L.D. and Chipangura, P., 2022. Policy coherence between food security, disaster risk reduction and climate change adaptation in South Africa: A summative content analysis approach. *Jamba-Journal of Disaster Risk Studies*, 14(1), p.1173.
- Zhang, T., Wang, J., & Zhang, Y. (2019). Climate change impacts on China's agriculture: The past and future trend. *International Journal of Environmental Research and Public Health*, 16(7), 1209.