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**TOPIC: THE IMPACTS OF CLIMATE CHANGE ON RURAL LIVELIHOODS. THE
CASE OF COMMUNITIES IN BUHERA DISTRICT IN MANICALAND PROVINCE.**

**DISSERTATION SUBMITTED TO BINDURA UNIVERSITY IN PARTIAL
FULFULMENT OF THE REQUIREMENTS OF THE BACHELOR OF SCIENCE
HONOURS DEGREE IN DISASTER MANAGEMENT SCIENCES.**

APPROVAL FORM

DEPARTMENT OF DISASTER RISK REDUCTION

The undersigned certify that they have read and recommended to Bindura University of Science Education for acceptance of this dissertation entitled, “THE IMPACTS OF CLIMATE CHANGE ON RURAL LIVELIHOODS. THE CASE OF COMMUNITIES IN BUHERA DISTRICT IN MANICALAND PROVINCE.” Submitted to the Disaster Risk Reduction department in partial fulfillment of Bachelor of Science Honours Degree in Disaster Management Sciences.

Dr. J Bowora (Supervisor)



Date 30/09/24

Chairperson Pof E. Mavhura



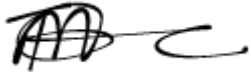
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DECLARATION

I, Maponga Tatenda M, hereby certify that this dissertation is the result of my own unique efforts and that it has not previously been submitted for any degree or examination at any other university. All extra sources I consulted were recognized as comprehensive references.

Student

(Tatenda M Maponga)

A handwritten signature in black ink, appearing to read 'Tatenda M Maponga', with a stylized flourish at the end.

Date 27/09/2024

DEDICATION

This work is an exceptional dedication to my lovely family and my friend Ropafadzo Gengere.

ACKNOWLEDGEMENTS

I would like to thank my supervisor, Dr. J Bowora, my amazing family, and grandma for their constant support and direction in completing this task. I'd also want to give a special mention to my friends for the intellectual contributions to my success. The author would like to thank all Zimbabwean Ministries for their invaluable assistance in completing this project, as well as the citizens of Buhera district's wards 1-4 for their contributions and hard work. The author would also like to express his gratitude to the Disaster Risk Reduction Department at Bindura University of Science Education for their cooperation.

ABSTRACT

Climate change has a disproportionate influence on rural communities in underdeveloped nations like Zimbabwe, whose livelihoods are heavily reliant on agriculture and natural resource extraction. This study examined the impact of climate change on rural livelihoods in Buhera District, Manicaland Province. Data was gathered through questionnaires, distributed to smallholder farmers, focus group discussions were held with the community members in the community.

Findings show that climate-induced droughts have reduced agricultural production. Smallholder farmers have been compelled to adjust by shifting planting seasons or growing drought-resistant crops. However, these coping techniques have caused extra costs. For example, fluctuating planting seasons has resulted in disputes with neighboring farmers over land use or water supplies. Droughts have increased the demand on forests for fuel wood, adding to deforestation and soil erosion. Furthermore, climate change has impacted cattle production. Findings show that reduced grass availability during dry spells has resulted in emaciated animals, and in some instances, this has contributed to high mortality rates. The study underlines the need for enhanced community and policy-level solutions to reduce the detrimental effects of climate change on rural livelihoods in Buhera district. These initiatives include supporting water conservation practices like rainfall gathering and irrigation projects, as well as offering financial assistance to smallholder farmers who choose drought-tolerant crops.

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LIST OF ACRONYMS

FAO	Food and Agriculture Organization
IPCC	Intergovernmental Panel on Climate Change
NGO	Non-Governmental Organization
UN	United Nations
ZIMSTAT	Zimbabwe National Statistics Agency
GPS	Global Positioning System
SLA	Sustainable Livelihoods Approach
UNICEF	United Nations Children's Fund
UNDP	United Nations Development Program
PWA	Persons with albinism

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CHAPTER ONE: INTRODUCTION AND BACKGROUNG OF THE STUDY

1.0 Introduction

Climate change, a complex and recurring phenomena, impacts every community globally. Consequently, Zimbabwe is currently undergoing decades of economic unrest due to its effects. The adverse impacts of climate change have resulted in inflation as well as a drop in economic performance. Citizens' incomes are highly volatile as a result of weather fluctuations, crop illnesses, pest infestations, and low market prices for their cash crops. Zimbabweans no longer have access to adequate food because to climate change, which is growing more frequent, intense, and unpredictable. Climate change is also affecting water supply schedules, impacting negatively rural life.

1.1 Background of the study

Buhera District, situated within Zimbabwe's Manicaland Province, is predominantly rural, characterized by a reliance on small-scale agriculture as the primary source of income for most residents. The region experiences a semi-arid climate with distinct wet and dry seasons. In recent times, Buhera has faced escalating challenges due to climate change, evidenced by erratic rainfall, prolonged droughts, rising temperatures, and an increase in extreme weather occurrences like storms and floods. These shifts in weather patterns profoundly impact the local economy, particularly the agricultural sector, which serves as its foundation.

The district's smallholder farmers heavily depend on rain-fed agriculture for their livelihoods. However, unpredictable rainfall and extended droughts lead to crop failures, reduced agricultural output, and heightened food insecurity. Climate change also affects livestock, water availability, and natural resources, compounding the vulnerability of rural livelihoods. Moreover, Buhera District grapples with socio-economic hurdles, including limited access to essential resources such as agricultural inputs, extension services, market opportunities, and financial services. These challenges, combined with the repercussions of climate change, intensify the struggles faced by rural communities, exacerbating poverty and vulnerability in the area.

Recognizing the specific ramifications of climate change on rural livelihoods in Buhera District is imperative for devising effective adaptation measures and interventions to bolster resilience and alleviate the negative impacts on local populations. Such understanding offers valuable insights into the interconnectedness of environmental, social, and economic factors shaping livelihood dynamics in rural settings. This knowledge can inform policy formulation, development strategies, and initiatives for sustainable resource management, aiming to address the pressing challenges faced by communities in the district.

1.2 Problem statement

Climate change poses a significant threat to rural livelihoods in Buhera District, Manicaland Province, Zimbabwe, where agriculture is the primary source of income. The district is experiencing irregular weather patterns, with temperatures projected to rise by 2-3°C by 2050, and increased extreme weather events, leading to crop failures, reduced yields, and food insecurity. These impacts exacerbate poverty and vulnerability among local populations.

Despite the severity of these issues, Buhera District faces critical deficiencies that hinder effective adaptation to climate change. Limited access to climate information and early warning systems prevents rural communities from preparing for and mitigating the impacts of adverse weather events. Inadequate water management infrastructure, particularly in the semi-arid climate, limits agricultural resilience and renders farmers vulnerable to fluctuations in rainfall patterns.

Weak agricultural extension services and financial constraints further compound the challenges encountered by rural livelihoods in Buhera. Limited outreach and support hinder the adoption of climate-smart agricultural practices, depriving farmers of essential knowledge and resources to enhance their adaptability. Rural communities struggle to secure resources for investments in climate-resilient technologies, drought-resistant crops, and alternative livelihood approaches.

Policy gaps and limited community capacities for climate adaptation also present significant obstacles to Buhera District's response to climate change. Integration between climate adaptation policies and broader development frameworks remains inadequate, undermining the effectiveness

of adaptation initiatives. Many residents lack the necessary knowledge, skills, and resources to implement adaptive measures effectively, limiting their ability to withstand and recover from climate-induced shocks and stresses. Addressing these critical gaps is imperative for bolstering resilience and safeguarding the livelihoods of rural communities in Buhera District.

Addressing these critical gaps is imperative for bolstering resilience and safeguarding the livelihoods of rural communities in Buhera District. Efforts to enhance the dissemination of climate information, invest in water infrastructure, strengthen agricultural extension services, mobilize financial resources, improve policy coherence, and enhance community capacities are vital for fostering adaptive responses to climate change impacts and ensuring sustainable development in the region.

Finally, Buhera District faces a deficit in community capacities for climate adaptation. Many residents lack the necessary knowledge, skills, and resources to implement adaptive measures effectively, limiting their ability to withstand and recover from climate-induced shocks and stresses.

1.3 Aim of the study

The study sought to investigate the extent to which the impacts of climate change have on the standard of living on rural people in Buhera district, Manicaland province of Zimbabwe. The findings of this study will help in developing better strategies for promoting small-scale farming in the district, which will improve people's livelihoods as well as development projects.

1.4 Research Objectives

The study sought to:

- 1) To examine the causes of climate change in Buhera district, Manicaland province of Zimbabwe.
- 2) To examine the impacts of climate change on rural livelihoods in Buhera district, Manicaland province of Zimbabwe.
- 3) To assess the vulnerability of different groups in the Buhera district to climate change.

4) To adopt improved mitigation measures that are sustainable as a way of reducing the effects of climate change in Buhera district, Manicaland province of Zimbabwe.

1.5 Research Questions

- 1) What are the causes of climate change in Buhera district, Manicaland province of Zimbabwe?
- 2) What are the impacts of climate change in Buhera district, Manicaland province of Zimbabwe?
- 3) Which groups in communities of the Buhera district are more vulnerable to climate change?
- 4) What improved strategies can be introduced to reduce the effects of climate change in Buhera district?

1.6 Assumption of the Study

Climate change has adverse effects to the rural livelihoods of people in Buhera district or climate change has nothing to do with rural livelihoods of people in Buhera district, particularly wards 1, 2, 3, and 4, Manicaland province of Zimbabwe.

1.7 Significance of the Study

1.7.1 To smallholder farmers

The results of this study may be of relevance to smallholder farmers as they will use the findings to develop farm management strategies that prioritize soil health in agricultural practices. Increased biodiversity and ecosystem services like water filtering and nutrient cycling are only two advantages of farming operations on soil health. Farmers be capable of adapting to technologies related to climate change more effectively in livestock-based production systems. These innovations include better surveillance, disease management for livestock, enhanced feed production, and water-saving measures.

1.7.2 To policymakers.

The findings have the significant to policy makers for one of the aims of the research is to provide a conceptual framework for evaluating the consequences across various levels of mitigation, with the goal of supplying climate policymakers with enhanced information. Moreover, the study will suggest subjects for policy-oriented inquiries and highlight inadequacies in data, methodologies, and analyses that impede a thorough assessment.

1.7.3 To researchers on climate change.

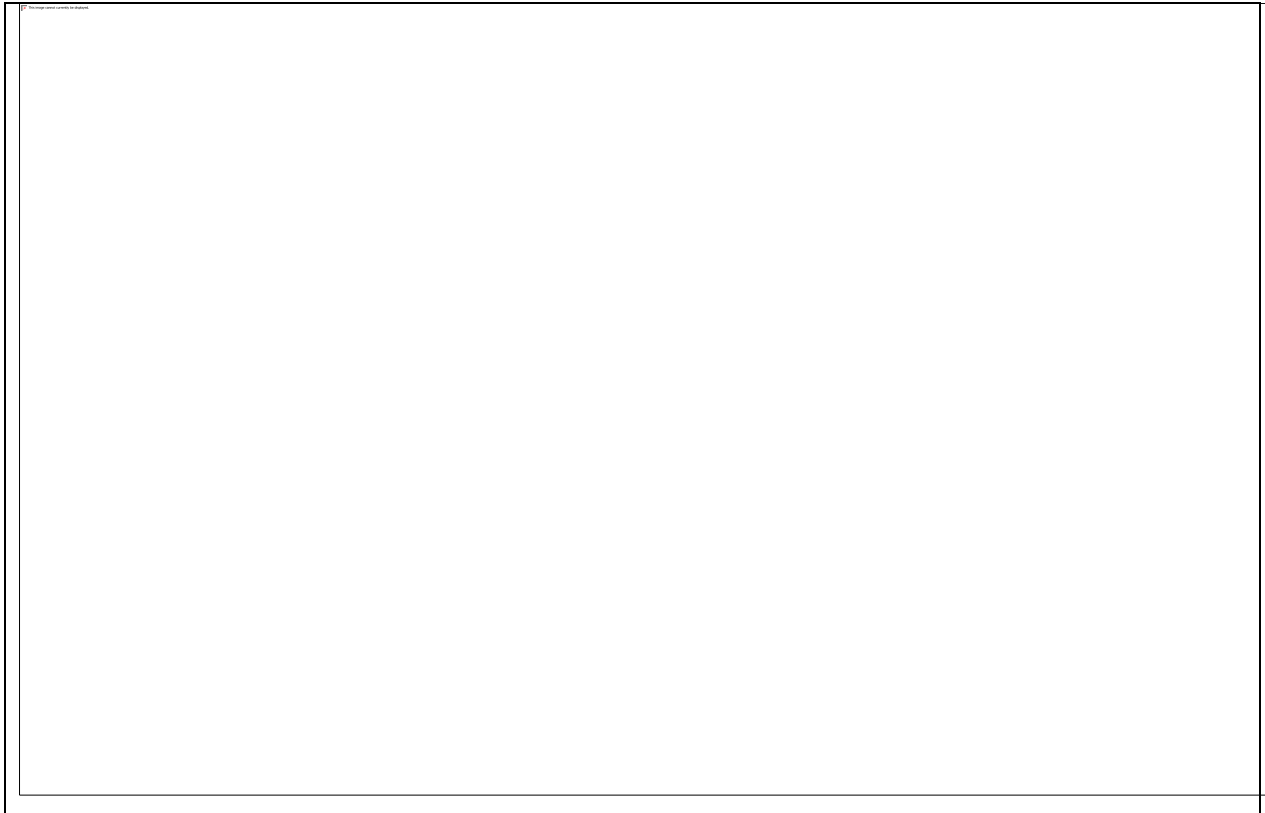
The discovery will permit researchers compare ancient climates to better understand how the climate system works and how it may alter in the near future. This aims to strengthen mitigation strategies in order to reduce the detrimental effects of climate change. It will also be important to develop long-term techniques to assessing and mitigating the impacts of climate change.

1.7.4 Weather forecasters on climate change.

The research findings are highly pertinent for forecasters responsible for comprehending and forecasting the effects of climate change on rural regions. Providing a thorough conceptual framework to evaluate these impacts across various mitigation levels offers forecasters valuable insights into the particular vulnerabilities and obstacles confronting rural communities. This structured framework facilitates a systematic examination of the diverse impacts of climate change, enabling forecasters to pinpoint crucial risk factors and determine priority areas for intervention.

1.8 Delimitation: Study area.

Figure 1.8.1 The map showing the study area Buhera wards 1-4



Source: Researcher's fieldwork 2023

The research was carried out in Zimbabwe's Manicaland Province. The province lies in the northern highlands, where rainfall is minimal and variable. Drought affects a large portion of the province, which is designated as Region 5 in the nation's climatic zones. The researcher selected Buhera from among the province's ten districts. The decision to replace it with Buhera district was not made by chance or defaults, but rather out of a strong conviction that the district, like other people in Zimbabwe all else, has seen significant increases in temperature, recurring droughts, and unpredictable rainfall patterns; however, the area's inhabitants rely heavily on agriculture powered by rain and natural resources for survival.

The study area is bounded to the north between Chikomba District and Wedza District, in the same Mashonaland East Province, to the northeast by Makoni District, to the east through Mutare District, and to the southeast by Chimanimani and Chipinge District. According to Mlambo (2008), Gutu District in Masvingo Province is located to the south and west of Buhera District. Summer temperatures range from 30 to 40 degrees Celsius, while winter temperatures range from 6 to

26 degrees Celsius, with an average of 22 degrees Celsius. Annual precipitation ranges from 500 to 800 millimeters. Buhera District's geographical coordinates are 19° 19'57.00"S, 31° 26'6.00"E. The region lies 3,904 feet (1,190 meters) above sea level (Mvumi, 2005). The rock formations are primarily granite dunes in Natural Region III, dolerite minerals red clays in Natural Region IV, and reddish clays in Region 5.

The local economy is primarily dependent on farming. Maize, millet, groundnuts, and groundnuts are the principal crops. Cattle ranching are also conducted in the region, and it is their primary source of income. Although the rainfall is unreliable, the area is fertile, with various irrigation plans in place to augment the populace's modest crops. However, due to government negligence, the schemes are now in disrepair. Ranching and animals enrich life.

Buhera District's population was anticipated to be 271,920 people in 2022. The bulk of the district's people are small-holder farmers who rely on a community land system run by local leaders. The community functions as a remote service center for the Save collective land. According to Mlambo (2014), Buhera is among Zimbabwe's worst districts. A large number of inhabitants make their living from semi-subsistence farming. The soil is weak, and the climate is semiarid. Any absence of rain or crop damage will result in calamity for the inhabitants.

1.9 The following definitions are used in the context of my study.

Livelihood: refers to the entire broad range of methods that people use to support themselves, their families, and their communities.

Mitigation: the structural and non-structural actions made to lessen the negative effects of environmental deterioration, technology risks, and natural hazards.

Rural: a wide area of land with random homes that is occupied. In comparison to cities and urban regions, rural areas have lower population concentrations along with poorer infrastructure.

Vulnerability: circumstances generated by environmental, social, economic, and physical processes that render an individual, a society, assets, or systems more vulnerable to the consequences of hazards.

1.10 Organization of the Study.

Five interconnected chapters comprise the presentation of this thesis. The purpose of segmenting the chapters is to guarantee a methodical and coherent progression of the ideas. The consequences of the drought on rural lives in the Buhera area are the main topic of the opening chapter. The core reasons for the community's vulnerability and its drought-adapted survival methods may be better understood in light of poverty, land degradation, low agricultural yields, and river drying. In addition, chapter two concentrates on the conceptual framework and conducts a literature evaluation that connects it to the research questions and objectives of the thesis. Additionally, at this point, it is thought to investigate what has been said regarding droughts internationally. The approach for methodically resolving the research challenge is presented in Chapter 3. It includes several procedures that the researcher often follows when examining the research topic. Several research tools, strategies, and techniques will be used in this chapter. To create Chapter 4, devoted to presenting the research study's quantitative and qualitative findings, this chapter is organized by subtopics, research design, data collection instruments, protocols for data collecting and analysis, and research ethics. The collected data will be shown in accordance with the research objectives and questions. Pie charts, graphs, and tables will show and present the data.

1.11 Chapter summary.

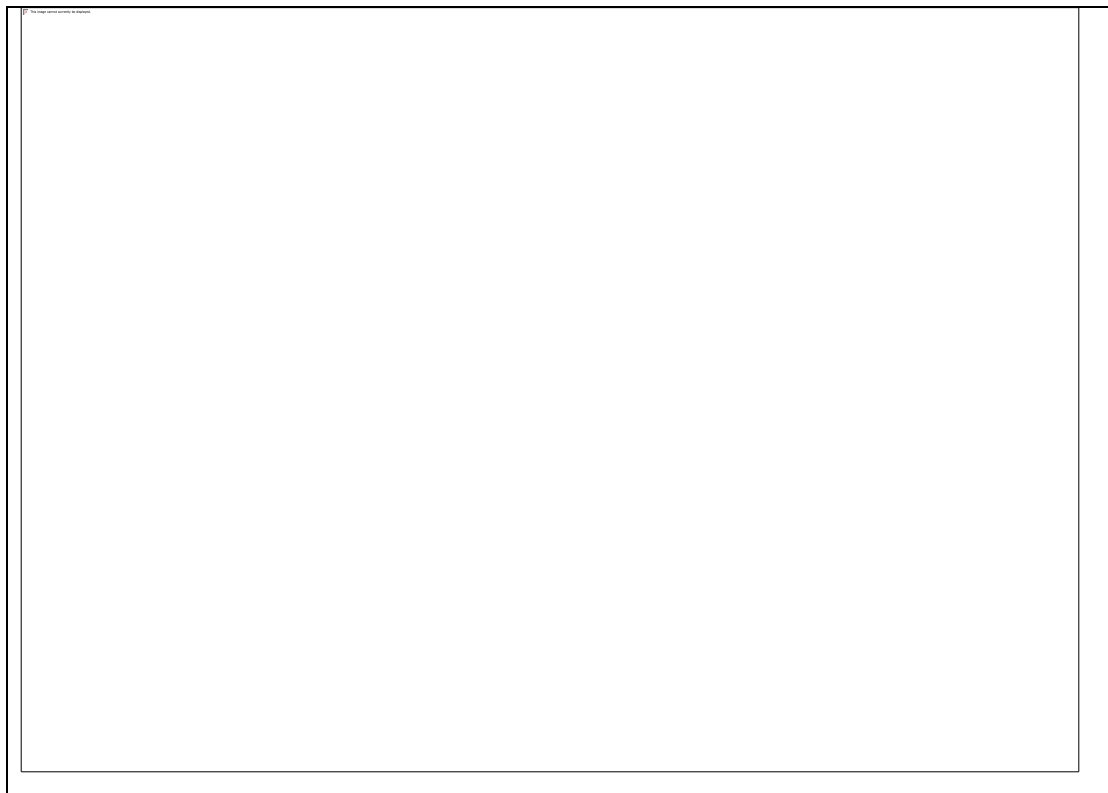
The section in question covered the factors that contribute to climate change, its effects, mitigation strategies, and how these factors influence Buhera's rural lives. Adverse effects include variations in rainfall patterns and water stress, to mention a couple. Reducing the use of fossil fuels and encouraging small-scale farmers to cultivate their seeds are examples of effective, enhanced mitigation strategies that must be reinforced to provide small-scale farmers with revenue streams.

CHAPTER 2: LITERATURE REVIEW

2.0 Introduction.

This chapter addresses the literature on the causes of climate change and how the consequences affect rural livelihoods. Climate change impacts are important because any successful sustainability requires an effective coping and recovery strategy. The nature and effectiveness of coping techniques will have an impact on the healing period. The initial section examines climate change, its origins and effects on rural livelihoods, and how enhanced mitigation strategies would raise the standard of life in all communities. This section will review the literature on the livelihood conceptual framework as well as causes, impacts, and communities' vulnerability due to climate change. The literature review will use secondary sources of data such as journals, reports, articles, and other related internet resources.

2.1. Sustainable livelihoods Conceptual framework.



Source: Adapted from Babulo et al. (2008).

The Livelihoods Conceptual Framework provides a holistic approach to understanding and analyzing livelihood systems, their dynamics, and the interrelationships between different

components. It helps researchers and practitioners identify key drivers, constraints, and opportunities for sustainable livelihood development and design appropriate interventions and policies. As a result of enhanced climate change mitigation efforts, this study acknowledges that the residents of Buhera Rural District rely primarily on exploiting natural capital to maintain food security. However, Garcia et al. (2015) note that when the climate changes, the former becomes ineffective, and as a result, communities tend to shift away from relying primarily on natural assets and toward new means of livelihood that cannot be substantially hampered by climate change.

These are the various resources and capabilities that individuals and households possess and can draw upon to sustain their livelihoods. They include human (skills, education, health), natural (natural resources, land), physical (infrastructure, equipment), financial (income, savings), and social (social networks, community support) assets. For example, agricultural land (Natural Capital) is a primary livelihood activity in Buhera, and agricultural land is a crucial natural asset. However, climate change can lead to changes in rainfall patterns, increased temperatures, and prolonged droughts, which negatively impact agricultural productivity. Reduced water availability and increased risks of crop failure can diminish the productivity of agricultural land, leading to decreased yields and income for farmers.

Livelihood strategies are the actions and decisions taken by individuals and households to utilize their assets and cope with livelihood challenges and opportunities. Strategies can include diversification (engaging in multiple income-generating activities), adaptation (adjusting livelihood practices in response to changes), and transformation (fundamental changes in livelihood systems and structures) (Ellis, 2000). SLA understands that people utilize a range of strategies to defend their livelihoods, and that many entities are involved, notably firms, ministries, grassroots organizations, and international agencies.

While priorities vary amongst institutions, SLA emphasizes that policies must be informed by local insights and poor people's priorities. SLA focuses on big partnerships between both the private and public sectors in order to achieve long-term viability which is critical for reducing poverty over the long term. Global development agencies such as IDS, the United Nations Development Program UNICEF, the Food and Agriculture Organization and governments all agree on these

concepts. SLA strengthens preexisting livelihood practices and fosters micro-macro connections (Easterly, 2006).

The Sustainable Livelihoods Approach has a noticeable effect on the integrated approach to catastrophic risk reduction management. To address emergencies, this strategy necessitates coordinated efforts from a range of disciplines, sectors, and agencies. Consequently, the diverse range of features of capital available to impoverished individuals is typified by the efforts of several disciplines, sectors, and institutions. Thus, catastrophe risk reduction management using an integrated strategy represents the apex of environmentally conscious living. Livelihood outcomes represent the desired results or impacts of livelihood strategies. They include improved well-being, increased resilience to shocks and stresses, and sustainable growth and development. Economic, social, and environmental variables are commonly used to assess livelihood results.

2.2 Causes of climate change globally.

In the United States, landfill emissions are one of the causes of climate change, according to Solomon, (2007). It is widely acknowledged that emissions from landfills, including fugitive emissions, contain significant amounts of methane (CH₄) and carbon dioxide (CO₂). In addition, the author conjectured that landfills were once viewed as liabilities because of their emissions and stench, Nevertheless, they currently rank as the third-biggest generator producing methane in the US.

Another intentional contributor to climate change is deforestation. Forest destruction, changes to the Earth's surface's physical composition, atmospheric carbon release, and involvement in climate change National Research Council, (2010) claims that the study identifies the following causes in particular: aerosol production, ozone depletion, greenhouse gas emissions, and changes in land cover, such as deforestation. According to Ward et al.'s calculation, the amount of climate forcing caused by changes in land use and cover is almost half that of anthropogenic greenhouse gas emissions and this amount may increase in the future.

According to Balogh, (2020) burning fossil fuels and other human activities produce gases that are released into the atmosphere, which in turn contributes to the greenhouse effect and global warming. Approximately 75% Human activity accounts for the majority of the world's emissions

of greenhouse gases. Carbon dioxide (CO₂) concentrations are expected to double by 2030 as a result of the greenhouse effect. Carbon dioxide is the primary atmospheric greenhouse gas produced by human activities. It primarily originates by the energy sector's combustion of fossil fuels (Solomon et al., 2007).

Sharma, (2016) claims that although China's economy is growing swiftly, the nation's transportation sector is also growing, which causes a spike in the release of greenhouse gases caused by the disproportionate consumption of energy from fossil fuels. The author also argues that the recent increase in CO₂ is mostly the result of burning fossil fuels. China's total carbon dioxide emissions in 2008, or around 8% of the nation's emissions, were from burning transportation fuels, according to Jing Yang, (2011). One of the primary global contributors to carbon dioxide emissions from the combustion of fossil fuels is transportation.

Furthermore, according to Kan, (2011), the majority of human activity that contributes to greenhouse gas emissions also contributes to air pollution. Therefore, China stands to gain from both climate change mitigation and improved air quality if it takes steps to reduce fossil fuel combustion and air pollution. The authors also point out that future studies should enhance the characterization of the links between climate change and health, as well as offer strategies for adapting to it and assessing how well adaptation measures are being implemented (especially at regional levels). Kan also gathers and improves long-term surveillance data on health issues of potential concern (such as morbidity from temperature extremes, vector-borne diseases, air quality, food- and water-borne illnesses, and the effects of extreme weather events on mental health). He also identifies thresholds and particularly vulnerable groups.

Another factor contributing to China's climate change, according to Paustian (2001), is the methane produced by rice farming, animal dung, and ruminant cattle. Deforestation and land-use change (mostly in the tropics), the utilization of energy from fossil fuels by farm machinery the manufacturing of agrochemicals, and soil degradation are agriculturally linked emission sources for CO₂. Paustian goes on to say that one of the main sources of the emissions that cause climate change is agriculture, specifically methane and nitrous oxide.

Furthermore, according to Dai (2013), employing data from 1978 to 2009, the relationship between the degree of urbanization and carbon emission is analyzed using co-integration analysis and the

Granger causality test, indicating that there is a long-run driving relationship between urbanization rate and carbon emission, and that an increase in growth in urbanization rate will result in an increase in carbon emissions. The author also claims that every 1% rise in urbanization rate results in a 1.61% increase in emissions of carbon dioxide. Dai says, “If considering the high urbanization rate as a sign of modernization in China, it will cause a sharp increase in carbon emission following the increased urbanization rate year by year and it goes against our goal to achieve low-carbon cities and sustainable development”.

No doubt, increasing urbanization leads to higher energy use, which fuels climate change. Since coal is now China's main energy source, rising energy consumption and rising carbon emissions are tightly related (Xiao-wen 2019). The author also demonstrates how energy usage reflects the impact of past urbanization rates on contemporary carbon emission levels. China must achieve low-carbon urbanization because it is believed that measuring a country's modernization level solely based on its rate of urbanization will lead to a significant increase in greenhouse gas emissions and negatively affect future volume control of carbon emissions. China is now the world's biggest energy consumer and carbon dioxide emitter as a result of its fast industrialization and urbanization Xu, Bin et al. (2004).

According to Yihui (2007), the temperature shift that occurred in the early half of the 20th century is not related to the volcanic eruptions in China that discharge volcanic materials and gases into the atmosphere. The author goes on to claim that throughout the previous 50 years or so, the frequency and intensity of catastrophic weather-related and environmental occurrences have significantly increased, according to certain assessments. investigations using climate models to identify the factors contributing to localized climate change According to Yihui, the previous 50 years may have been caused by an increase in greenhouse gas concentrations in the atmosphere, whereas the first half of the 20th century's temperature changes may have been brought on by solar activity, volcanic eruptions, and changes in sea surface temperature.

Russia's permafrost deterioration is causing increased warmth and the emission of trace gases." The main impact of climate change in Russia is a considerable increase in yearly mean near-surface temperature. Increasing intermittent temperatures, extreme cold and heat surges, permafrost degradation, droughts, floods, hurricanes, dust storms, natural catastrophes, shoreline erosion,

avalanches, slides, alien species invasion, and an increase in pest and disease outbreaks are the most frequently mentioned events that negatively impact terrestrial ecosystems in the literature (Lipka 2022).

White, (2021) claims that the use of petroleum, natural gas, and coal has a direct effect on the quality of the environment based on real-world data from Russia. According to Environmental Science and Pollution Research, the econometric study's findings show long-term links between Russia's carbon dioxide emissions, economic growth, and reliance on natural gas, oil, and coal. Long-run elasticity calculations show that growth in GDP is not affecting directly Russia's environmental quality. Nevertheless, Russia's ecological state is deteriorating due to rising carbon dioxide emissions produced by increased use of coal, gas, and oil.

2.3 Impacts of climate change globally.

Changing climate has further pose challenges to the expansion of the nation's water supply and sewage treatment systems. According to the United States Environmental Protection Agency (2002), the infrastructure for the country's wastewater and drinking water is old. Breaks in underground water mains, some of which are over a century old, are a major issue in older cities. Additionally common are sewer overflows that release raw wastewater into the environment. Greater rainfall will make many cities' current issues worse, particularly in areas where storm water catchments and sewers are integrated. Installing and maintaining sewage and drinking water infrastructure is quite costly.

Kundzewicz (2007) with rising temperatures, changes in water needs are anticipated. As temperatures rise, evaporation is expected to increase throughout the majority of the United States. The need for water for irrigation is predicted to rise in response to warmer temperatures and prolonged dry spells. The author further stated that increased water efficiency of plants as a result of growing atmospheric carbon dioxide may partially counterbalance this. Increased cooling water withdrawals by power-producing units are predicted to occur with rising temperatures. In addition, higher summer cooling demands will result in higher energy consumption and a subsequent need for extra cooling water for power plants. There will likely be a minor rise in municipal and industrial needs.

Bull (2007) believes that limited water resources and rising temperatures will most certainly limit energy generation in many regions. The competition for water among several sectors, including energy production is likely to intensify in some areas as precipitation and/or water from melting snow packs drop. The ability to generate energy from fossil fuels that include petroleum, natural gas, and coal is inextricably linked to the availability of adequate and economically viable water resources. Feldman (2008) predicted that, while fossil fuels meet the majority of the United States' annual energy needs, they also place a significant strain on the country's water supplies, both in terms of both quantity and quality consequences.

According to Williams et al. (2018), hydroelectricity is a significant supplier of electricity in many places of the United States, particularly the Northwest. Climate change is expected to have a significant impact on locations with less precipitation and/or melting snowpack. Significant differences in the timing and volume of stream flow in many western rivers have already been reported, which are consistent with the expected effects of rising temperatures. Greater amounts of rainfall falling as rain rather than snow, decreased snowpack, quicker peak runoff, and other effects are anticipated.

Hatfield et al., (2011), states that extreme weather, illness, and increased heat are likely to lower animal output. The central United States' confined animal operations dairy, beef, and swine will be adversely impacted by the anticipated rise in air temperatures. This will result in higher production costs due to decreased performance brought on by reduced feed intake and higher energy needs to keep livestock healthy. The author further states that the increased mortality of animals brought on by harsh weather conditions such as heat waves is not taken into account by these costs. When animals are stressed by intense heat, recuperation during the night is crucial to their survival. The absence of relief at night has been a characteristic of recent heat waves. Recent heat waves have claimed a great deal of lives; some areas have reported losing 5,000 head of livestock.

Over the past thirty years, several studies have suggested that the river's runoff is likely to decrease as a result of climate change Christensen et al., (2007). Furthermore, river diversions to support farm and urban requirements are getting close to the river's typical flow. Under the current circumstances, significant annual variations in reservoir storage are likely, even in the absence of

climate change. The water management will face difficulties meeting not only the burgeoning demands of a rapidly expanding population but even all current demands if the expected reductions in flow that come with global climate change materialize.

According to the U.S. General Accounting Office, (2003) there is rapid increase in the regional population with more than 300 million individuals are thought to call the United States home, representing a nearly 7% increase in population since the 2000 Census. According to current Census Bureau estimates, If the current pace of growth continues, the country's population will be over 350 million in 2025 and 420 million in 2050. Areas like the Southwest that could see a decrease in water supply as a result of climate change are predicted to see the fastest rates of population growth in 2025. Vulnerability of U.S. Residents due to climate change. Begum (2022) lists several detrimental repercussions on agriculture, including decreased production, detrimental effects on livelihoods, and dangers to the world's food security. Begum emphasizes how the decline in yield brought about by climate change has reduced financial returns. As a result, as air temperatures rise, soil conditions deteriorate and plant normalcy changes, leading to lower yields relative to potential yields, this affects people's ability to support themselves.

According to Tong, (2016) changes in rainfall patterns and an increase in the frequency of floods and droughts in some parts of China are only a couple of the negative effects that climate change is likely to have on water supplies. Tong also discovered that, although uncertainty is unavoidable in such estimates, the overall consequences of climate change, land conversion, and decreased water availability might significantly limit Chinese food output.

Furthermore, Zhang (2019) argues that in order to increase the degree of livelihood diversification and improve farmers' capacity, particularly small-holder farmers, to reduce present and future societal susceptibility to global warming and to advance sustainable livelihood, it is necessary to reduce high exposure to climate risks, such as dry spell. Zhang goes on to say that while households with diverse socioeconomic backgrounds are exposed to, sensitive to and adaptable to climate change in different ways, their susceptibility to it is far from equal.

As a result of a reduction in calorie availability brought on by climate change Nelson, (2010) predicted that by 2050, Child malnutrition would rise by twenty per cent by 2050 as less calories become available, compared to a world without climate change. According to Nelson, not only will there be fewer calories accessible in 2050 than in a world without climate change, but there will also be fewer calories available in rising nations compared to 2000. The author also discusses how variations in rainfall patterns affect when crops should be sown or transplanted and raise the risk of both short-term crop failures and long-term drops in productivity.

According to Showstack, (2013) another effect of climate change is migration brought on by it in Russia. The consequences of climate change drive internal migrants and indigenous tribes to shift. The strains already experienced by indigenous people in various Arctic nations are being exacerbated by rising temperatures, melting permafrost, sea ice loss, and other effects of climate change. As a result, some tribes are considering moving to safer places. Showstack also reports that researchers at the "Arctic Indigenous Peoples, Displacement, and Climate Change" A forum held on January 30 at the Brookings Institution in Washington, D.C., stated that native communities in Alaska, Russia, and Scandinavia are among those affected by climate change, and Diekmann (2010) investigated how climate change affects carbon-bearing soils and sediments, as well as the progressive erosion of coastal land. Currently, significant coastal and river erosion of carbon-bearing soils and sediments, thermal energy destruction of frozen hydrogen hydrates, and accelerated microbial metabolism in soils are the primary causes of the extended venting of the methane gas and carbon dioxide caused by permafrost's demise. The permafrost zones, with their extensive subsurface methane hydrates and rich organic soils, constitute massive frozen carbon storage.

2.4 The vulnerable groups to climate change globally.

2.4.1 Women

According to Brown et al., (2012) women are sensitive to the effects of climate change and fluctuations since they are mostly dependent on agriculture in rural areas. In the face of great poverty, agriculture provides rural women with the only source of security in their lives, families, and communities. Food insecurity has increased in countries like Bangladesh due to their vulnerability to the harsh repercussions of climate change and income inequities (FAO, 2015). The majority of Bangladesh's climate casualties are impoverished women. Gender

inequality makes these women more vulnerable than males in both rural and urban settings, and food insecurity has influenced the resilience and vulnerability of communities that are susceptible to climate-related disasters (Shamsuddoha, 2012).

The negative effects of climate change also have a significant influence on children and newborns, as these changes put their education, safety, family security, survival, and susceptibility to diseases including diarrhea, dehydration, and heat stress at risk (Goldhagen et al., 2020). According to an IPCC assessment from 2018, different populations are affected differently by climate change and its fluctuations, and in certain cases, these consequences cause large-scale migrations. Serious incidences of SGBV and physical assault against young girls were documented following the 2005 Kashmir earthquake (Smith, 2013). Years later, the UNDRR issued a warning that women were more likely to experience physical and sexual harassment during and after catastrophes, as well as an increase in domestic abuse with dangerous consequences (UNDRR, 2019).

2.4.2 Elderly

Smith, (2020) study on elderly susceptibility to a cyclone in Bangladesh's coastal area revealed vulnerability to be on the verge of extremes. The elderly were found to have fewer resources, less physical strength, and a weaker mental capacity than young adults, which rendered them more susceptible to a cyclone. The elderly rely on young adults for care, but they also have insufficient training, limited access to health facilities, and low social awareness. According to several academics, older persons are impacted by climate-related disasters in the Global South at every stage of the disaster and are less equipped to mitigate its effects. Furthermore, older individuals suffer terrible losses that are fundamental to their way of life, such as the loss of friendships and culture (traditional customs and indigenous knowledge they hold) as a result of death and relocation (Rahman, 2010).

2.4.3 Persons with albinism (PWA)

Temperature variations brought on by climatic changes and variations have disproportionately impacted the health and well-being of Persons with Albinism (PWA) (Astle et al., 2023). Despite PWA being protected by the Convention on the Rights of Persons with Disabilities (CRPD), discrimination and marginalization of PWA continue. People with disabilities are experiencing

unprecedented repercussions from the destructive effects of climate change and its variations, leading to an increase in unemployment and poverty (Stein, 2022).

Moreover, Native American cultures face distinct vulnerabilities. Native Americans who reside on existing reservations are limited in their options for resettlement due to reservation limits. In Alaska, over 100 towns on the shore and low-lying places along rivers are exposed to increased floods and erosion owing to warming Gamble et al., (2008).

According to Gamble et al., (2008) majority of people in the United States live in metropolitan regions, which are among the places on Earth that are changing the fastest. Cities have grown more dispersed, intricate, and integrated with the infrastructure and economies of their respective regions and countries in recent decades. The author further states that numerous social issues are also present in cities, such as inequality in health and well-being, crime, traffic congestion, neighborhood deterioration, and unemployment. The stress of already-existing issues will rise due to climate-related changes like rising temperatures, water scarcity, and extreme weather. Air pollution, population expansion, and aged buildings and infrastructure all exacerbate the effects of climate change on cities.

2.5 Enhanced global climate change mitigation efforts.

As per Crippa, (2013) discussions concerning the latest global climate change mitigation initiatives, such as the UN's REDD+ (Reducing Emissions from Deforestation and Forest Degradation), have revolved around the preservation of customary knowledge and land-management techniques. By paying to conserve forests in developing countries, developed countries can earn credits towards reducing their emissions. REDD+ aims to reduce greenhouse emissions by conserving forests in developing countries and increasing forest carbon stocks. The author further states that Indigenous peoples live in many of the targeted forests, but they frequently lack the political and legal standing to defend their lands against governmental and nongovernmental organizations looking to profit from the REDD+ program.

To emphasize tribal independence and autonomy in the midst of climate change, Whyte (2013) advised politicians, researchers, and climate adaptation professionals to use a framework that

situates justice within the systems of responsibilities that matter to tribes and many others, which range from inter-species interactions to government-to-government collaborations. He contended that "justice is attained when these duty schemes function in a way that promotes the ongoing well-being of ethnic groups.

Additionally, some tribes are reducing the effects of climate change through community development and environmentally friendly building practices. Apart from its positive impact on the environment, sustainable construction also lowers expenses, conserves energy, and improves durability. According to Lantz et al., (2013) the Intertribal COUP claims that creating sustainable housing can help tribal communities become more economically and energy independent. Under a program that Intertribal COUP has been developing, faculty and students from tribal colleges construct energy-efficient buildings using local straw bale construction materials (Corydalis et al., 2008).

In addition to its benefits to the environment, tribes are pursuing energy efficiency to lower the energy bills of their low-income members. Certain tribes have plans for adapting to climate change that include energy-efficiency measures. Included in the Swinomish Climate Change Initiative is a draft strategy for reducing greenhouse gas emissions and increasing energy efficiency. The objectives of this strategy (SITC 2010) are to lower the tribal government's energy expenses and consumption. Cut back on greenhouse gas emissions inside the reservation to help slow down climate change worldwide. According to Jing, (2010) the Chinese government declared its 2020 carbon intensity target and is actively participating in international climate discussions to support global efforts to combat climate change. The author goes on to say that China is under a lot of pressure both locally and globally since it is the world's largest carbon emitter.

In addition, electric Vehicle Promotion in China is another enhanced mitigation strategy. The government is promoting the use of electric vehicles to reduce emissions, including subsidies for purchases and investments in charging infrastructure, as a response to the energy crisis and environmental problems. According to Wang (2014), in response to the energy dilemma and environmental issues, countries conduct research and commercialization of electric car technology. To address the energy crisis and environmental issues, countries conduct research and

promotion of electric vehicles. Tan (2014) also provides an in-depth assessment of the current EV scenario in China, covering revenue generation, charging infrastructure, battery endurance, and policies.

The Forest Carbon Sink Initiative was embraced by China. A desire to boost the productivity and coverage of forests as well as the size of carbon sinks to absorb carbon dioxide. Shao et al., (2011) calculated that without requiring more forestland area, China's forest carbon sequestration would increase from 96 to 152 Tg C/yr if it adopted American forest management practices. The author went on to say that China's President pledged the nation to an unparalleled rise in forest carbon sink by 2020, compared to 2005 levels, by increasing forest coverage by 40 million hectares and forest stock volume by 1.3 billion m³. This was made during the UN Climate Change Summit in September 2009.

The utilization of zero-carbon sources such as nuclear power and hydroelectricity helps to reduce emissions from electricity generation. Approximately 37% of Russian electricity consumption comes from zero-carbon sources such as water-powered electricity and nuclear power. Furthermore, around 37% of Russian energy consumption comes from completely carbon-neutral sources such as hydroelectric power and nuclear power (United Nations Framework Convention on Climate Change, 2009). Between 1990 and 2008, emissions in this category fell by 559 percent, changing it from a net emissions source to a net sink.

All continents and seas have seen changes in their natural and socioeconomic systems in recent decades, and climate change is now acknowledged as a significant policy concern. According to Henry et al. (2012), in order to meet the Paris Agreement's ambitious goal of "keeping global temperature rise to less than 2 degrees Celsius above pre-industrial levels," which was agreed upon at COP 21 in 2015, there has been a recent global advance in the development and implementation of environmentally friendly policies, particularly mitigation measures that reduce carbon dioxide emissions.

Russia has been modernizing toward a low-carbon society as one of the nations with the greatest energy resources and greenhouse gas emissions, particularly after the 2008–2009 global financial crisis.

2.6 Causes of climate change in Africa.

Khobai et al., (2022), states that South Africa's electricity needs are largely met by coal, accounting for about 77% of its energy production. This heavy reliance on coal has led to increased carbon emissions, contributing to global warming and climate change. South Africa has been working to address global warming and climate change problems related to carbon emissions, which have exacerbated ecological challenges in recent years due to the country's substantial dependency on coal. Khobai further says that there is a long-term relationship between carbon emissions and economic growth in South Africa. There is bidirectional causality flowing between these two variables, indicating that economic growth can lead to increased carbon emissions, and vice versa.

Higher temperatures and drier weather can raise the risk of wildfires, which can destroy ecosystems, cause property damage, and claim lives (Jubert, 2011). Climate change will cause conditions for fire to worsen in some places. There will be an increase in fire conditions in certain areas, unpredictable rainfall patterns that cause overall drying and wet conditions in other areas, and an increase in the frequency and severity of natural extreme weather events and cycles like heat waves, floods, and droughts. The author goes on to say that the past 60 years' worth of weather records for South Africa show that the climate in the area is changing

.

Mash, (2009) asserts that another factor contributing to climate change is the eradication of trees for agricultural and urban expansion. Climate change is made worse by it because it limits the quantity of carbon dioxide that can be taken in from the atmosphere. Mash goes on to say that deforestation and an excess of greenhouse gasses from burning fossil fuels are the causes of climate change.

2.7 Causes of climate change in Zimbabwe

In Zimbabwe, land use changes like deforestation add to the rise in greenhouse gas emissions. Land clearance for agriculture is the primary cause of deforestation and bushfires in the nation. Vehicle emissions and the burning of fossil fuels, particularly coal, to produce electricity at the Hwange power station in Zimbabwe's west, are the main sources of emissions (UNEP, 1997).

Zimbabwe contributes very little to greenhouse gas emissions worldwide, yet the country might experience significant effects from climate change.

Furthermore, deforestation has significantly increased in Zimbabwe as a result of the country's demand for firewood and agricultural land. For instance, when the need for firewood grows and Buhera villages depend more on it for energy, the amount of carbon dioxide in the atmosphere rises and contributes to climate change.

According to Faso (2017), Zimbabwe's fast population expansion is making the country more vulnerable to climate-related dangers, increasing competition for scarce natural resources, and degrading the country's base of natural resources. With a high percentage of poverty (63%) and persistent food insecurity, the country faces significant challenges from climate risks. These challenges are compounded by years of political and economic instability, difficult and contentious land reforms that leave many farmers without title to the land they work, and rapid population growth.

The majority of the agriculture in the Buhera district is rain-fed, making it very susceptible to climate change. Climate change have a negative impacts on population growth, since it will increase vulnerability to dangers associated with the climate, intensify competition for land, result in land degradation, and increase greenhouse gas emissions (Faso, 2017). The increasingly erratic and unpredictable rainy season and the ensuing uncertainty about water availability, when combined with more intense and prolonged extreme weather events, could further strain already precarious livelihoods, undermine pre-existing coping mechanisms, and pose a persistent threat to health.

2.8 Impacts of climate change in Africa.

Climate change is the cause of the susceptibility of rain-fed agricultural systems, according to Serdeczny et al. (2017). The rain-fed agricultural systems, which now provide a living for a sizable section of the population, are especially sensitive to these climate changes (Adams 2017). It may be anticipated that the rate of rural-urban movement will increase as agricultural livelihoods

become more precarious, contributing to the region's already notable urbanization trend. Furthermore, in accordance with Schneider (2001), moving into unauthorized communities may expose a person to a variety of risks, such as epidemics of infectious disease, flash flooding, and rising food prices, which are distinct from but having no fewer dangerous than those they would have faced in their home country.

Variations in climate are causing a rise in the spread of food-, water-, and vector-borne illnesses, especially vector-borne illnesses in Africa. Human health can be impacted by climate change in both direct and indirect ways. As temperatures rise and rainfall becomes more erratic in Africa, the likelihood of malnourishment, malaria, and diarrheal illness is expected to rise (USAID, 2017). Climate change also poses direct dangers such as extreme weather events, UV-related malignancies and diseases, heat exhaustion, respiratory disorders linked to access to fresh air and clean water quality, increased waterborne illness transmission, and vector- and food-borne illnesses. All of these risks are predicted to rise in the coming years (Young 2019).

Increased temperature and reduced precipitation lead to violent conflict in Africa, as detected by several studies. Although a number of research investigations do not discover a significant correlation between decreased precipitation and violent conflict in Africa, a number of studies do show a correlation mostly when it interacts with other factors. (Scheffran, 2019).

Africa is the continent most vulnerable to the effects of climate change, despite having made the least contribution to global greenhouse gas emissions. This is owing to the continent's high population living in the subtropics, which is expected to experience higher temperatures and less precipitation, the significant dependence of the populace on natural resources, livestock, and agriculture for their livelihoods, severe destitution in many African regions, which makes it difficult for individuals impacted to prepare for an increased incidence of drought, floods, and the degraded state of Africa's natural resources.

About 70% of people live in developing nations in Africa, Asia, and the Asia Pacific region, where the majority of people are either directly or indirectly employed in the agriculture sector. These people also tend to reside in arid or semiarid regions with highly variable climates. As a result, these people's livelihoods are in jeopardy because of climate change. Yadav (2015) asserts that

prompt action is necessary to lessen the potentially serious impacts of climate change on the yield and productivity of various field crops.

Agriculture contributes to climate change by emitting nitrous oxide from fertilized crops and methane from animals. These changes have an impact on the production of food, storage, processing, sales, availability, outreach, pricing, and quality. The climatic changes caused by climate change have a considerable impact on food distribution networks, food ecosystems, and food systems in general. Zvomuya (2011) reports that the Department of Environmental Affairs commissioned new research that indicates that South Africa will likely see changes in rainfall patterns and rising average temperatures as a result of climate change, with a major impact on the livestock industry.

According to Tirivangasi (2021), temperatures are expected to rise as a result of climate change, particularly in southern Africa, where increases in temperature are expected to be 2°C more than those worldwide. Given the high rate of sickness already linked to environmental variables in this area, Smith (2014) hypothesized that this temperature increase may pose serious risks to people's health and quality of life. The issues of HIV/AIDS, destitution, unstable access to food and water, inequality, and unemployment will make it more difficult for us to handle the consequences of climate change. The author goes on to say that there will be direct health effects, such as heat exhaustion brought on by higher temperatures, as well as indirect effects, including changes in the distribution and/or severity of vector-borne diseases and possible increases in infectious diseases from polluted water. Disease surveillance, data collection, and more targeted research is critical (Smith, 2014).

2.9 Impacts of climate change in Zimbabwe.

Researchers have also looked into how climate change would affect human health. In Zimbabwe, research into the possible effects of climate change on human health has been sparse. Reviews undertaken illustrate the multifaceted nature of the problem, with population changes, a rise in malaria occurrences, water-related concerns, and variations in heat stress caused by temperature increases all documented. Malaria cases frequently peak during the rainy season, when there are

numerous stagnant water bodies and high temperatures. It is believed that one in every three Zimbabweans lives in malaria-prone areas (Greenhood et al, 2005).

The research conducted by the United States Department of International Development (USAID, 2013) looks at how Zimbabwe's food security status has changed over time. According to the report, Zimbabwe is still plagued by chronic food insecurity despite the country's slow progress. Furthermore, the Zimbabwe Vulnerability Assessment Committee (UNICEF, 2020) survey found that during the 2015 hunger season, approximately 1.668 million people in rural regions required food assistance, accounting for roughly 19% of the total populace in rural areas (around 8.7 million people). This illustrates the degree of susceptibility that smallholder farmers face due to their excessive dependence on rain-fed farming.

According to Smith et al., (2007) climate change "will greatly increase hunger, especially in the poorest parts of the world" unless there are major reductions in greenhouse gas emissions. According to WFP (2009), this means that by 2050, 10–20 percent more people worldwide will be in danger of starvation than they would have been in the absence of climate change. Nearly all of these will be in poor nations, with Africa accounting for the majority at 65%. This has serious ramifications for diet, especially for kids.

To lessen a household's sensitivity to the changing environment, affluence, institutional capability, and technology accessibility and availability are crucial. Drought-tolerant crops, better seed types, and diversifying outside of agriculture are some ways smallholder farmers might adapt to reduce the effects of climate change (Deressa et al., 2008). The last ten years have seen increased political and economic unrest in Zimbabwe, which has made things worse for smallholder farmers. Improved seed kinds and fertilizers, for example, were not available in the nearby marketplaces. Because of the high turnover rate and the poor compensation of skilled laborers leaving the nation, agriculture extension agencies and local service providers were less effective. Due to the ineffectiveness of agriculture extension services, this had an impact on smallholder farmers in rural areas.

Investigations into the potential effects of climate change on human health have also been conducted. There has been little research into the possible effects of climate change on human

health in Zimbabwe. Reviews highlight how complex the situation is, with population shifts, growing malaria incidence, water-related issues, and variations in heat stress caused by rising temperatures all mentioned. Malaria cases frequently peak during the rainy season, when there are many stagnant reservoirs and high temperatures. According to estimations, one in every three Zimbabweans lives in a malaria-prone area (Hartman et al., 2002). However, in the event of climate change, more places would certainly become vulnerable to the illness.

2.10 The vulnerable groups to climate change in Africa.

According to some climate change research, women in Africa are more susceptible than men to the effects of climate change due to unequal power relations, restricted access to resources (financial, natural, social, and human), and limited economic prospects (Denton, 2002). Their options are further restricted by their subservient roles and positions in society, as well as by inequalities in the cultural norms that direct their life. The direct reliance of women on natural resources is one of the other issues. Furthermore, Enarson et al., (2004).states that research on the victims of climate-related disasters has already demonstrated that women are more susceptible since they disproportionately belong to the socially and economically marginalized groups who typically experience the worst effects. Men and women will respond to climate change differently in terms of priorities and coping and adaptation strategies to increase resilience, given the gender-specific impacts and vulnerabilities.

In addition, fewer water resources expose communities differently in Africa due to climate change. Climate change affects water availability and quality, exacerbating water stress in many African regions. For example, in a country like Botswana which has many livestock water should be readily available. Decreased rainfall and increased evaporation rates reduce freshwater supplies, impacting both domestic water use and agriculture. Additionally, changing rainfall patterns can increase the frequency and severity of droughts and floods, further affecting water availability and quality (UNEP, 2016).

Climate change influences the transmission of vector-borne illnesses in Africa, including malaria and dengue fever. Rising temperatures and shifting patterns of precipitation make circumstances ideal for disease vectors, raising the possibility of epidemics. Vulnerable populations, including

children, the elderly, those with limited access to healthcare as well as those people with chronic diseases are particularly at risk (WHO, 2018). However, efforts are being made to reduce the spread of these outbreaks to save lives.

It is anticipated that people who are already the most disadvantaged and vulnerable would bear the brunt of climate change, based on the effects of climate-related disasters that are already being felt on a human level (Brody et al., 2008). Due to their lack of resources (financially, technically, humanly, and institutionally), the impoverished will be particularly exposed to the effects of climate change. Their lives, livelihoods, health, and general well-being are already in danger due to early indicators of climate change that are already manifesting in the unpredictability of the existing climate (e.g., droughts, unpredictable rainfall patterns, and floods). For those in poverty who depend on subsistence farming, the effects of climatic shocks and pressures are likely to have a detrimental effect on their well-being, human capital, and security of food and livelihood (Edgar, 2005). The impoverished people of South Africa will be at risk if they are unable to increase their resistance to climate change.

2.11 The vulnerable groups to climate change in Zimbabwe.

Climate change affects agricultural productivity in Zimbabwe, leading to decreased crop yields and increased food insecurity. Changing rainfall patterns, increased temperatures, and prolonged droughts pose major challenges to smallholder farmers, who rely heavily on rain-fed agriculture. For example, in Masvingo, the lack of rainfall has caused a decline in livestock health as the animal struggles to find water to drink. Studies have shown that climate change impacts can reduce maize yields in Zimbabwe by up to 50% by 2030 (Siziba et al., 2020).

Climate change affects the transmission of vector-borne diseases in Zimbabwe, including malaria and cholera. Rising temperatures and shifting precipitation patterns provide ideal circumstances for agents of disease, raising the danger of epidemics. Climate change is making the situation worse as warm water temperatures are creating more favourable conditions for mosquitoes to breed. Vulnerable populations, including children and those with limited access to healthcare, are particularly at risk (Mabaso et al., 2012).

Climate change impacts rural communities in Zimbabwe, particularly those dependent on natural resources for their livelihoods. Decreased agricultural productivity, water scarcity, and environmental degradation disrupt income-generating activities and increase vulnerability. For example, in Buhera climate change impacted people's livelihood because agriculture is one of their sources of livelihoods and climate change is causing them to be food insecure. Adaptation strategies and support systems are crucial for building resilience in these communities (Smith et al., 2018).

2.12 Enhanced Africa's climate change mitigation efforts.

According to Nhamo, (2011) one approach to enhance South Africa's climate change mitigation efforts is by investing in renewable energy sources such as solar and wind power. These sources of energy have a lower carbon footprint compared to traditional fossil fuels like coal, which is a major contributor to greenhouse gas emissions in South Africa. Innovative technology is another mitigating strategy that South Africa has implemented. With this shift, South Africa would be able to carry out its planned mitigation initiatives for climate change while reducing the detrimental socio-economic effects linked to the coal sector (Smith et al., 202). The adoption of cutting-edge technology like carbon capture, utilization, and storage has to be given top priority to do this. By capturing CO₂ emissions at the source and using or storing them, these technologies seek to significantly lower the quantity of CO₂ emitted into the atmosphere.

In addition, Solomon et al., (2007) states that the nation should keep putting into practice and bolstering already-in-place measures aimed at mitigating the effects of climate change, such as the 2004 Renewable Energy Policy, the 2003 Integrated Clean Household Energy Strategy, the 2004 Climate Change Response Strategy, and the 2005 Energy Efficiency Strategy. By implementing these policies, South Africa may advance its efforts to mitigate the effects of climate change and develop a resilient, low-carbon economy. By implementing these policies, South Africa may advance its efforts to mitigate the effects of climate change and develop a resilient, low-carbon economy.

2.13 Enhanced mitigation efforts in Zimbabwe.

Several climate change mitigation strategies may be solved by utilizing these extensive Indigenous knowledge systems and traditions. By recognizing the changes in climatic patterns, the problems that result, and potential remedies, many indigenous peoples are addressing climate change on their own. However, notes that since smallholder farmers can implement these measures, IKS should be the first step in any climate change response strategy. Additionally, since they need little to no money, the majority of smallholder farmers who are typically quite impoverished find them appealing. These people are especially susceptible to climate change since they frequently depend on the land for their livelihoods. Protecting native areas and promoting awareness of sustainable practices are two examples of mitigation strategies.

Mabhuye, (2020) lists many strategies for increasing adaptability at the household and community levels, including terracing, agro-forestry, early warning systems, better post-harvest management, awareness-raising, and support for alternative crop cultivars and animal types. According to Mabhuye, other interventions that may be used to improve adaptive capacity include the use of early warning systems, post-harvest management, awareness-raising campaigns, and the encouragement of alternate animal and crop breeds. Consequently, to ensure the sustainability of people's livelihoods in the face of ongoing and future climate uncertainty, coordinated efforts must be made to improve adaptive capacity at the household and community levels.

Effective strategies for mitigating climate change also rely on established policies and institutional capabilities. Mushore and colleagues (2015) observed a deficiency in the implementation, integration, and coordination of policies among governmental departments, NGOs, and other institutions involved in disaster management in Zimbabwe. These institutions encounter multiple challenges, including political interference, resource constraints, and a lack of coordination in managing drought. Policies need to be implemented at all stages of drought management, from monitoring to impact assessment (Tsegai, 2017). However, achieving policy coherence and coordination is challenging due to involvement from various sectors, decision-making levels, and socio-economic and technological transitions.

Severe weather events like drought pose significant challenges to sustainable development in the region (UNECA, 2015). While African nations have made efforts to promote eco-friendly policies

and address natural disasters, more proactive measures are needed to combat drought. Social issues, such as increasing poverty exacerbated by drought among vulnerable groups like women, the elderly, and youth, hinder sustainable development. Therefore, there's a need to focus on reducing poverty by initiating programs that actively involve vulnerable groups in enterprise development.

To enhance resilience and reduce risks, integrated approaches are employed to manage climate change impacts. These approaches involve engaging communities in climate-related actions, from influencing policies and prioritizing their needs to supporting their development goals. Additionally, developing adaptation strategies tailored to local communities and fostering collaboration between practitioners and researchers on climate-related issues are crucial (IPCC, 2014). These integrated efforts aim to alleviate pressure and effectively address the risks associated with climate change.

2.14 Gaps in Literature

Existing research lacks guidance on sustainable mitigation strategies tailored to Buhera District's unique context, instead focusing on short-term coping mechanisms. There is also a lack of evidence on climate-resilient technologies and alternative livelihood approaches. Furthermore, the dissemination of climate information is restricted, hindering rural communities' ability to prepare for and mitigate adverse weather events. Effective climate information dissemination strategies are crucial for enhancing resilience and promoting sustainable livelihoods, supporting informed decision-making and adaptation to climate change impacts.

2.15 Chapter Summary

In summary, the body of literature on climate change underscores its severity as a global issue, impacting both people and ecosystems worldwide. Its effects are already prominently felt in numerous nations, Zimbabwe included. Urgent measures are imperative to mitigate greenhouse gas emissions and adjust to the evolving climate. Collaborative efforts are pivotal in effecting change and fostering a sustainable future for all.

CHAPTER 3: RESEARCH METHODOLOGY

3.0 INTRODUCTION.

This chapter outlines the methodology employed in the research. It begins with a discussion on the geographical context of the study area, encompassing its physical characteristics. Following this, the research design, grounded in pragmatism, along with sampling techniques, and procedures for data collection and analysis are detailed to align with the study's objectives. The advantages of

selected research instruments are elucidated, along with their relevance to the study. Additionally, ethical considerations are addressed, accompanied by strategies implemented to address them.

3.1 Research Design

According to Deutch and Cook, (2010) a research design is the arrangement of conditions for the collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy and procedure.

3.2. Mixed Approaches

This research uses a mixed-methods approach, blending qualitative and quantitative techniques, grounded in a pragmatic philosophy. This flexible and adaptive design combines the detailed insights of qualitative data with the broad applicability of quantitative data. Pragmatism informs the study, emphasizing practical solutions and effective methods, with the ability to refine and adjust as necessary. By merging mixed-methods and pragmatism, the study can thoroughly explore the research question, harnessing the strengths of both approaches to yield a multifaceted and detailed understanding of the phenomenon being studied.

3.3 Sample size

This is the collective term used to describe the population that study results are meant to correlate with and that study participants are chosen from. The target population for this study included 105 respondents comprised of 40 smallholder farmers of wards 1 to 4, 5 extension officers, 2 weather forecasters, 5 environmentalists, 3 from the Civil Protection Unit, and 50 from the community. This study's sample size was determined using the formula $n = (Z^2 \times \sigma^2) / E^2$, with a 95% confidence level, 0.5 standard deviation, and 0.05 margin of error. The calculated sample size was adjusted to accommodate specific sub-groups, resulting in a final sample of 105 respondents from various stakeholders, ensuring reliable results for the study.

3.4 Target population

As per Babbie and Mouton (2015), the target population refers to "the complete group of individuals or elements that the researcher is interested in and wishes to generalize the findings to." In this study, the target population comprised the community members and pertinent

stakeholders, from which the researcher drew samples. Specifically, two villages were purposefully chosen from Buhera District: Chinyama and Chikore villages. These selections were made based on their different vulnerability to climate change and their sizable populations, each exceeding 100 households. Consequently, these two villages were deemed suitable for the study's objectives.

Table 1.0: Population, Sample size, and Sampling technique

Description	Sample	Sampling	Instrument
Smallholder farmers	40	Stratified	Questionnaires
Extension Officers	5	Stratified	Key Informants interviews
Weather Forecasters	2	Stratified	Interviews
Environmentalist	5	Stratified	Interviews
Civil Protection Unit	3	Stratified	Interviews
Community	50	Stratified	Focus group discussion

Source: Researcher's fieldwork 2023

3.5 Stratified sampling technique

Stratified sampling is a probability sampling strategy that involves dividing the population into homogenous subpopulations termed strata according to certain attributes (Groves et al., 2009). To correctly determine the sample size in each stratum, proportionate stratified selection was once more used. This was followed by simple random sampling from first-, middle-, and top-level management in each stratum, where the variable was homogeneously distributed within the stratum.

3.6 Data collection instruments and procedures

3.6.1 Questionnaire Surveys

To obtain comprehensive data from research participants (40 smallholder farmers), forty semi-structured questionnaires were designed with questions about climate change. Using the tool, a series of questions was posed, such as "Have you noticed any changes in temperature or rainfall patterns in the past five years? If yes how has it affected your livelihoods?"

For several reasons, it was quite helpful to ask these questions regarding how climate change is affecting rural livelihoods. First of all, it made the researcher's understanding of the precise ways that rural communities and individuals are being impacted by climate change more clear. Improved mitigation strategies can then be adopted by using this information to develop policies and initiatives that can assist in addressing these issues. Furthermore, it was beneficial to pose these questions to establish rapport and trust with the respondents, since this may increase the likelihood that they will give truthful and accurate answers. Lastly, the answers to these questions offered insightful information about the perspectives and experiences of the participants, information that will be useful for developing further studies and interventions.

3.6.2 Key Informant Interviews.

In addition to their extensive local knowledge and experience, 5 extension officers (key informants) frequently possess a profound awareness of the local context, culture, and unique difficulties that rural communities confront. More open-ended questions let the key informants comment on their viewpoints as well as those of the community. Among the queries were the following: How has climate change affected the means of subsistence and income? What are the main obstacles to the community's climate change adaptation? To assist individuals in need in adjusting to the effects of climate change, what support do you need? Context and insights that cannot be captured in a survey format were offered by the interviewees' replies. Following that, interventions and policies that are specifically designed to meet the requirements of the community may be developed using the information provided. Key informants frequently possess specific expertise and information that can offer insightful opinions on the subject. Secondly, they succeeded in giving access to communities or hard-to-reach groups that are not usually included in surveys. Thirdly, they assisted in supporting or refuting the conclusions drawn from other research techniques, such as surveys. Building connections and trust within the community through active engagement with key informants proved to be beneficial for the researcher in terms of future research and cooperation.

3.6.3 Interviews.

When concerns about the effects of climate change on rural livelihoods were asked during interviews with the Civil Protection Unit, environmentalists, and weather forecasters, they ranged

widely. What alterations have you seen in the local temperature or weather in the past several years? Was one of the queries posed? What effects have these modifications had on your way of life and means of support? Which major obstacles brought on by climate change do you now encounter? To enhance your ability to cope with the effects of climate change, what would be necessary? Are other groups or your government making enough of an effort to lessen these effects, in your opinion? Speaking with respondents in person about how climate change is affecting their rural livelihoods has several benefits. Initially, the study provided the researcher with a deeper comprehension of the problems at hand as well as the viewpoints and experiences of individuals most impacted in the studied region. Secondly, it made it easier for the researcher to establish rapport and confidence with the respondents as a critical aspect of future study. Thirdly, it offered insightful information about how to effectively tackle the issues posed by climate change in rural areas. Lastly, the answers may be used to pinpoint feasible solutions and resilience and adaptation techniques.

3.6.4 Focus group discussions.

Certain questions, including, "What changes have you observed in the weather and climate in your community in recent years?" The respondents (community members) in 4 groups made up of 10 respondents were asked about the effects of climate change on rural livelihoods. Have the resources found in nature such as water, soil, and wildlife been less accessible lately? What types of difficulties have you encountered as a result of global warming? Which techniques have you applied to adjust and lessen the effects of climate change? Concerning the effects of climate change, what urgent requirements do you believe your community has? They were shown to be important in forming the ways that climate change will affect rural lives through focus group talks. First and foremost, focus groups enable members to have more in-depth and animated discussions to fully comprehend the current situation of the community. Second, fresh viewpoints and ideas that would not have surfaced in one-on-one interviews were produced by the group dynamic. Additionally, the chance to exchange adaptation stories and tactics may encourage attendees and promote better collaboration and coordination in the face of climate change issues. Last but not least, future policy and decision-making at the local and governmental levels can benefit from the knowledge gathered via focus groups.

3.7 Research ethics

Johnson et al., (2016) defines ethics as a behavior attitude in human activity that encompasses right and bad deeds. Additionally, as they promote fairness, mutual respect, and trust after the research, ethics and ethical concerns are extremely important parts of doing research. Before, during, and after the study, the researcher considered ethical issues.

3.8 Before the study

A letter of authorization was acquired from the Department of Disaster Risk Reduction at Bindura University of Science Education before the project. The researcher then proceeded to request permission to speak with the community from the chief, counselors, and Buhera District Council. Furthermore, the researcher obtained the participants' verbal agreement and presented himself through an introduction letter from Bindura University of Science Education, guaranteeing that data were acquired with the participants' full understanding.

3.9 During the study

During the study, the researcher ensured that no names were written on the questionnaires for confidential purposes and participants were allowed to participate voluntarily after they were educated on the main purpose of the study and they were allowed to withdraw at any stage during the study. In addition, participants ensured that the data collected were going to be used for academic purposes only.

3.10 After the study

The researcher used the data for academic purposes only and the benefit of Buhera district council, Zimbabwe. In addition, the collected data were treated as grouped for anonymity. Lastly, participants who participated in the study were thanked by the researcher.

3.11 Limitations of the study.

There was limited time for the research, and the population to be of use had been occupied with work and other commitments, however, this was curbed by the use of social network systems which provided access to the community and generated knowledge of its characteristics. Biased

findings In view of recent political violence, participants in this study may be apprehensive to reveal the truth for fear of political conflicts. Therefore, triangulation was used to avoid the likelihood of bias. Permission will be requested from the councilor, chief, and headman to ensure that the research collects authentic data.

3.11 Chapter Summary

This chapter reviewed the research methodology that was taken and utilized by the researcher and outlined key aspects of that including research design, population, sample size, and research instruments. Also, an overview of reliability, validity, and research ethics were covered and justified.

CHAPTER FOUR: DATA PRESENTATION, ANALYSIS AND DISCUSSION.

4.1 Introduction

This chapter elucidates the process of preparing, analyzing, and subsequently employing the collected data to test the research hypothesis. The chapter also represents the research findings of the study through analysis and discussion of graphical presentation of data relating to the findings of the research questions and objectives set out in chapter one and interpretation of the results. The main thrust was on data presentation, analysis, and discussion and the data was obtained from questionnaires distributed to respondents of wards 1 and 2.

4.2. Demographics

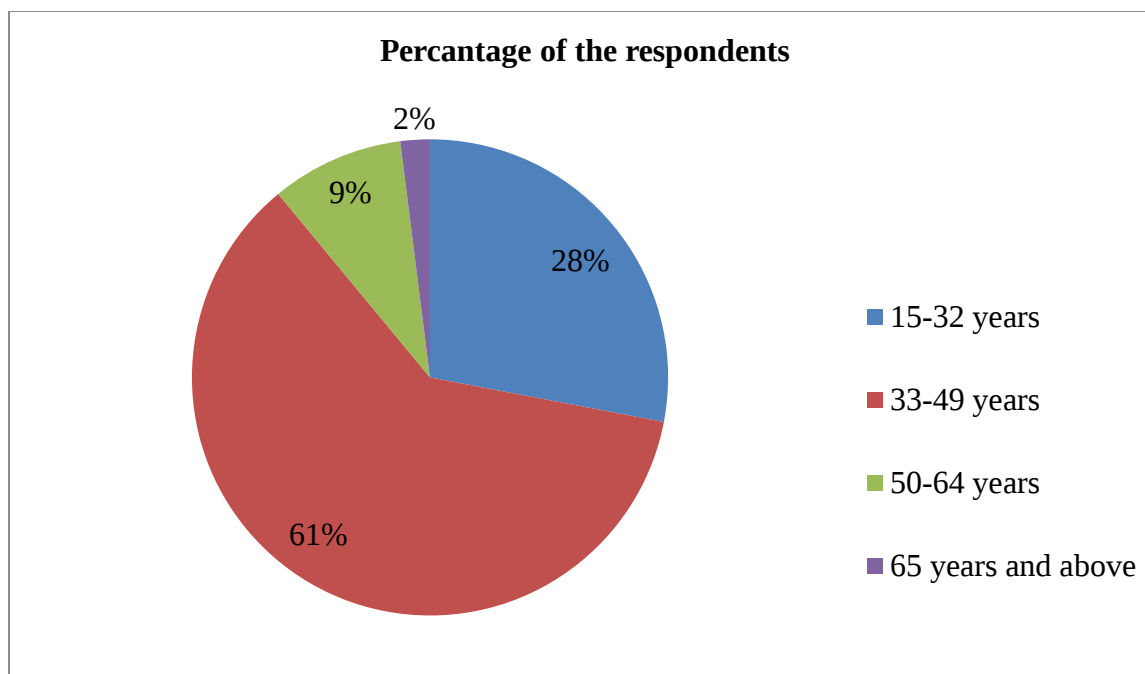
This chapter aims to provide a detailed understanding of the demographic understanding of the demographic makeup of the sample population which helps in identify potential biases in the sample as well as enhancing the generalizability of the findings.

4.2.1. Age of respondents

The population was divided into many age categories, with those between the ages of 15 and 49 constituting the biggest group and accounting for slightly more than half of the entire population (54%). Those under the age of fourteen, who account for only 32% of the population, are the second biggest group. The remaining population is divided into two groups: 1.6% of people are 50–64 years old, and 2.4% of people are 65 and older. Based on the statistics, it can be observed that the population of the Buhera South district is very youthful, with less than half of the people under the age of fifteen.

The age categories of 15–32, 33–49, 50–64, and 65 and above had the highest percentages of responders (28%, 61%, 9%, and 2%, respectively). Rural-urban migration, which is more common among age groups under 32, is most likely the cause of the high percentage of people between the ages of 15 and 32. This generation is quite nomadic; they travel around in search of employment or better educational opportunities. Conversely, when individuals retire or lose their jobs, the majority of them goes to rural regions and often settles there permanently. Moreover, the age distribution of rural house ownership grows with age. This indicates that starting a family comes with growing older; therefore having older respondents to the poll is expected. This explains the higher percentage of participants who are over 33 to 49 years old. The data is further displayed in Figure 4.1, the chart below.

Figure 4.1: Percentages of respondents by age group



Source: Author's fieldwork 2024

4.2.2 Gender

Another factor which was taken into consideration was the respondents' gender distribution. Based on the sample, it was found that 61% of respondents were women and 39% of those who were questioned were males. This matches national figures from 2018 that showed 50.5% of those living in community lands were male and 49.5% were female (ZIMSTAT, 2018). According to the ZIMSTAT 2018 report, women outnumber men by a greater proportion overall, although the findings of this study indicate that women outnumber men by a bigger percentage. Given that males frequently move to cities or abroad in quest of employment to support their families, this works effectively in rural areas.

Male population movement to urban centers, leaving their families in rural regions, is said to be the result of the "rural to urban push in search of employment opportunities" (Shumba, 2001, p. 13). This may be the result of their movement in search of better pastures since their traditional means of subsistence are endangered by drought as a result of climate change. The following Table 4.1 displays the proportions of men and women:

Table 4.1: Gender distribution of respondents

Gender	Males	Females
Percentage of Respondents	40	60

Source: Author's fieldwork 2024

Since women are the ones whose livelihoods are most affected by climate change, they engaged in this research in large numbers. However, some women chose not to participate because they were responsible for managing or caring for their houses in the absence of their husbands. Though it is typically typical to find most homes in African rural communities headed by women, this suggests the primary reason why women made up a larger share of respondents.

4.2.3. Size of households

Fifty percent of the participants were from homes with more than five members. Twenty percent of the total responders were households with five members. Seventy percent of all households were made up of more than four individuals. The number of individuals that need to be fed, clothed, and sent to school depends on the size of the homes in the study area, albeit there are other benefits like working in the fields. Based on data from the 2012 census, the average household size nationwide was 4.9 (ZIMSTAT, 2018).

The idea that 70% of the homes in this survey had more than four persons is not all that dissimilar from this. This indicates that big households are the norm in the area. Large families pose issues with clothes, food, and school fees, as well as financial strain on students. With the changing climate, this is a difficulty. Household livelihoods are in jeopardy because of this. For various household sizes, the corresponding percentages are displayed in Table 4.2 below.

Table 4.2: Sizes of households for respondents

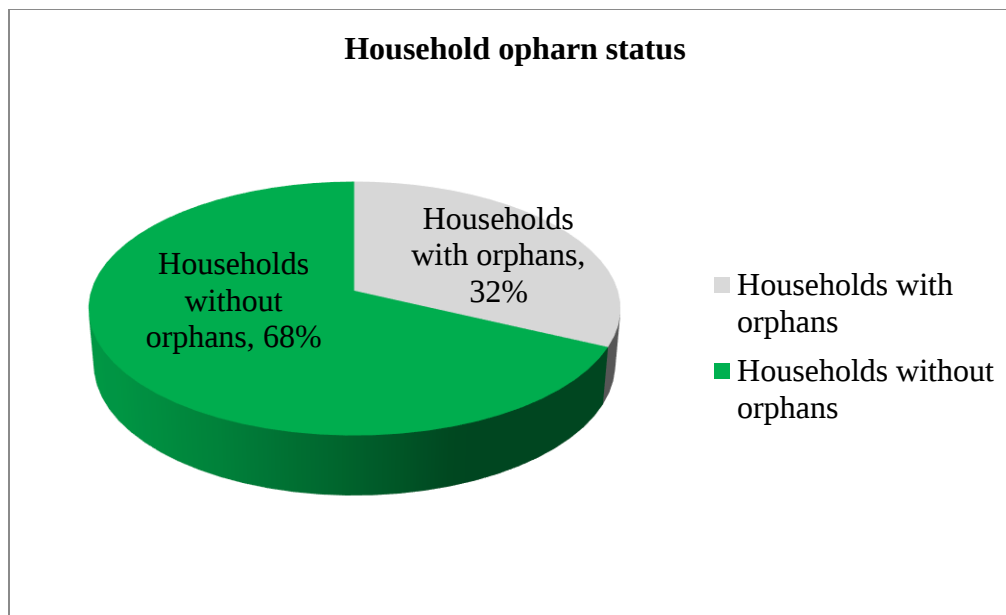
Size of Household	ONE	TWO	THREE	FOUR	≥FIVE
Percentage of Respondents	5	8	10	22	55

Source: Author's fieldwork 2024

4.2.4 Households with orphans

There were orphans among the kids, either without a parent at all or just one. When dangers arise, orphans are more exposed than kids who have parents. According to the data gathered, there were orphans in 29% of the homes and no orphans in 71% of the households. This indicates that there is a climate risk because nearly one-third of the households surveyed had susceptible features. Orphans, who may already have limited access to healthcare, may be disproportionately affected by the spread of illnesses and the breakdown of healthcare systems brought on by climate change. Orphans may be directly at risk for diseases such as waterborne infections, malnourishment, and respiratory conditions due to increased heat waves, water scarcity, and shifting disease patterns. Figure 4.7 illustrates this data below.

Figure 4.2 shows percentages of households with and without orphans

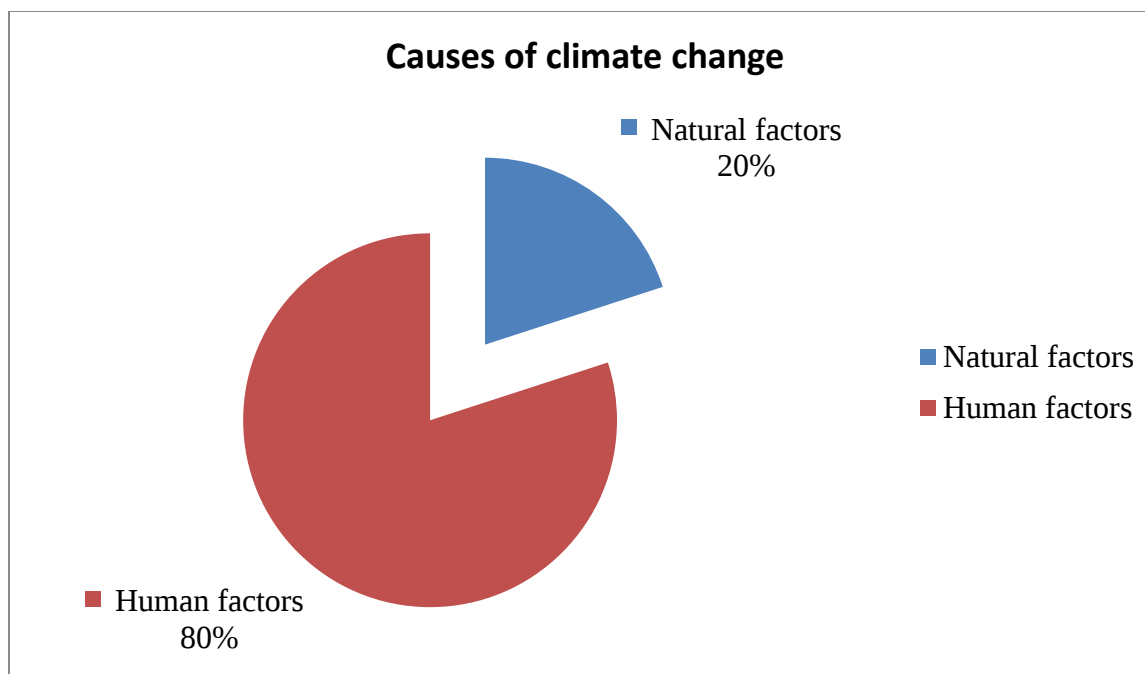


Source: Author's Fieldwork 2024

Objective 1: The causes of climate change in Buhera district.

In recent decades, Buhera has undergone discernible alterations in its weather patterns, characterized by shifts in rainfall distribution, heightened occurrences of droughts, and greater unpredictability in seasons. These fluctuations in climate have exerted significant impacts on the agricultural sector, which constitutes the primary pillar of the local economy. Figure 4.2 below illustrates the factors contributing to climate change in Buhera district.

Figure 4.3: Natural and human factors that causes climate change in Buhera district.



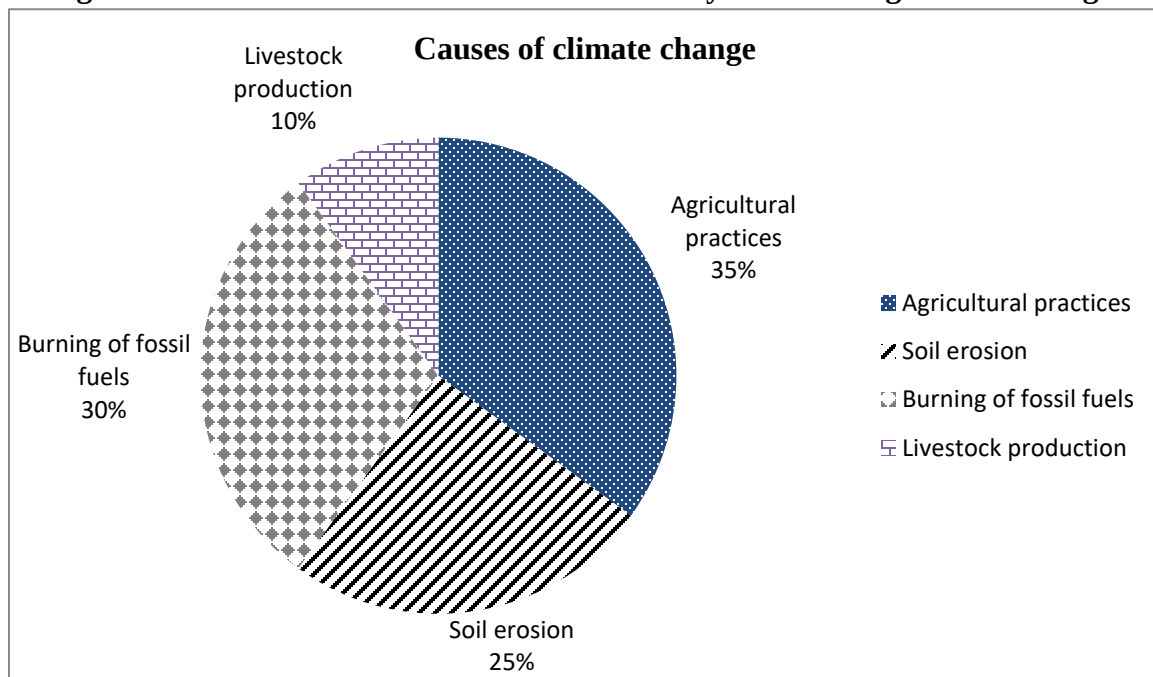
Source: Author's fieldwork 2023

From the data collected, 20% of respondents observed that natural factors accelerate climate change in their localities. A further study on natural factors that communities refer to as acts of God. During the focus group on the 15th of January 2024, some participants had to say,

“The main causes of climate change are the El Nino- Southern Oscillation and changes in solar radiation, with the human factors contributing 80% and this is due to burning of fossil fuels for energy production, which emits greenhouse gases like carbon dioxide into the atmosphere, deforestation, agricultural practices as well as population growth”.

Thorough deliberations on the information provided by communities across all study locations unveiled that the causes of climate change significantly influenced livelihood strategies within the Buhera district communities. One of the other participants had to say, "My kids are not attending school anymore; we just eat one meal a day and there are no extra costs to send them to school. I used to farm vegetables, but because of the shifting environment, my family is having difficulties meeting their necessities, and I am also a single mother". Some communities pointed out those manmade factors are the most common factors of climate change as compared to natural systems.

Figure 4.2.2 Human activities in the area of study area causing climate change.

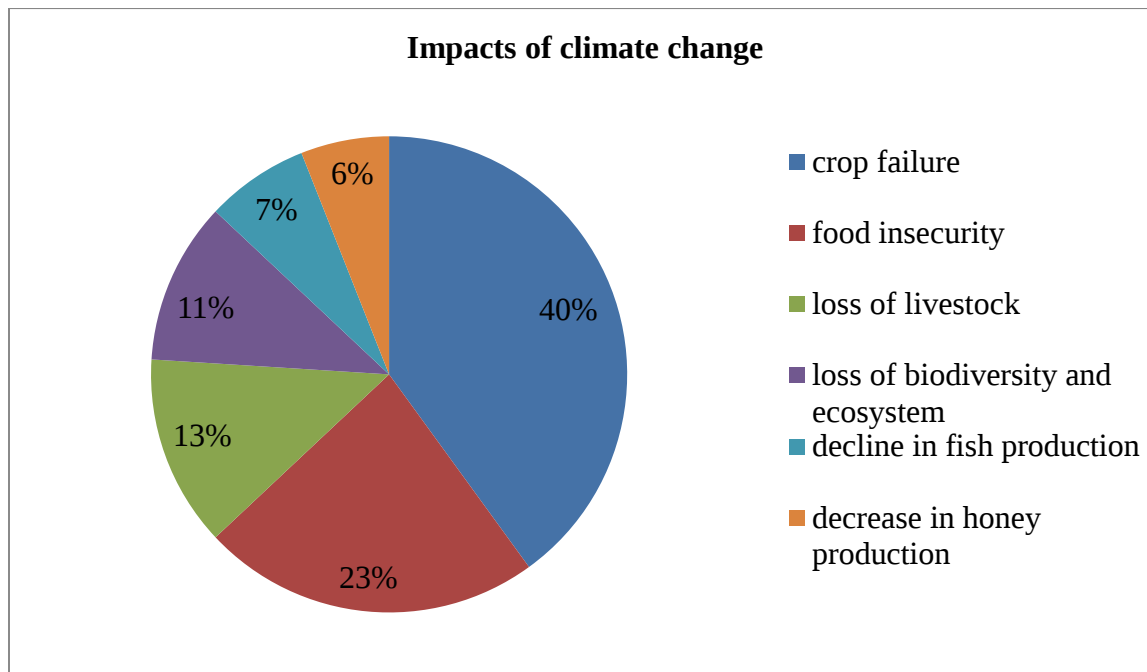


Human activities in Buhera significantly contribute to climate change with agricultural practices being the largest contributor. Intensive farming methods such as monoculture and excessive use of fertilizer, lead to soil degradation. Livestock production accounts for 10 percent. Overgrazing leads to soil degradation, reduced vegetation, and increased methane emissions. Poor manure management from poultry farming also contributes to methane and nitrous oxide emissions. The burning of fossil fuels is responsible for 30% of climate change contributions. Energy generation for irrigation pumps and electricity contribute to emissions. Fuel-powered irrigation pumps are notable contributors. Soil erosion, accounting for 25% of climate change contributions, is primarily caused by deforestation and land degradation. Poor farming practices, such as inadequate soil conservation measures, also lead to erosion.

Objective 2: The impacts of climate change on rural livelihoods in Buhera district.

During the interviews the participants were asked about the impacts of climate change on rural livelihoods. The responses are illustrated by the pie chart Figure 4.3 below:

Figure 4.4 shows impacts of climate change on rural livelihoods



Source: Author's fieldwork 2024

The findings shows that crop failure has severely impacted by climate change and this was supported by responded 1, who said,

“I have been farming for years, but the rains have become very unpredictable. Sometimes it rains so much that my crops are destroyed and other times it does not rain at all. This has made it very difficult for me to earn a living.”

Participant 2 said, “The droughts have been so severe that I have lost all my cattle. Without my cattle, I cannot provide for my family. We are struggling to get by.”

The findings also clearly indicated that climate change has also impacted livestock production and many people are struggling to cope up with the effects of climate change and they need support to rebuild their livelihoods.

Table 4.3 Shows climate change impacts and consequences for sources of livelihoods

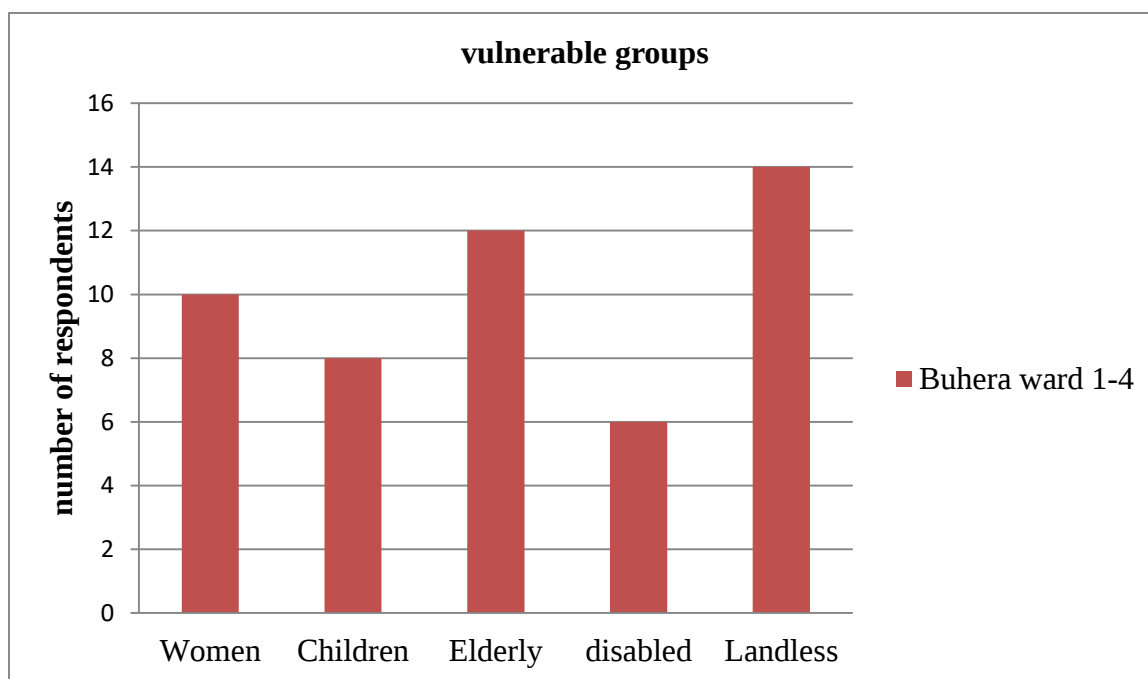
Climate change impact	Direct consequences for sources of livelihoods
Increased frequency and severity of droughts.	▪ Reduces agricultural productivity leading to lower incomes and food insecurity
	▪ Greater destruction of crops and trees by pests ▪ High threats of wildfires which destroys apiculture ▪ Increased risk of livestock mortality as well as milk and meat production for selling.
Land use conflicts	▪ Damages to raw materials leads to decline in mining industry which resulted in loss of jobs and reduced wages or salaries for the working task force.
More health risks	▪ Infectious diseases affect the economic status of the household not only through loss of livelihood but through health expenses. ▪ It also reduces productivity as people are unable to work or tend to their crop when they are sick.
Shifting agricultural seasons and erratic rainfall	▪ Reduction in quantity and quality of agricultural yields and forest products. ▪ Reduced access to water for domestic use as well as livestock production

Source: Author's fieldwork 2023

The above finding shows that climate change impacts in Buhera district have significant consequences for livelihoods. More health risks, land use conflicts, shifts in rainfall patterns and increased temperatures pose challenges for agriculture, a primary source of livelihood. Decreased crop yields and water scarcity affect farmers' incomes and food security. Livestock farming also faces difficulties due to declining pasture quality and increased water scarcity. These disruptions jeopardize the economic stability of communities reliant on agriculture and livestock, highlighting the urgent need for adaptation strategies to safeguard livelihoods.

Objective 3: Vulnerability of different groups in Buhera West wards in relation to climate change.

Figure 4.5 Vulnerable groups of ward 1-4 of Buhera



Source: Author's fieldwork 2023

The results of the study show that the Buhera district's wards 1 through 4 have different groups of people that have been affected by climate change vulnerability. The largest group is the landless followed by the elderly, women, children and the disabled. A 35-year-old resident of Buhera also responds to climate change impacts in wards 1 through 4. Concerned about the vulnerability of various groups, including the landless, elderly, women, children, and disabled, they stress the importance of community action to address these challenges and build resilience against climate change's effects. The vulnerability assessment of Buhera District to climate change was determined using the Social Vulnerability Index (SoVI). The aim was to identify and prioritize areas for intervention. The SoVI analysis employed a comprehensive methodology, utilizing household surveys and administrative records. The results revealed that half of the population has high vulnerability, 30% medium, and 20% low. Key factors contributing to vulnerability include limited education and employment opportunities, poor household infrastructure, and dependence on rain-fed agriculture, limited healthcare access, and environmental exposure. These factors underscore the need for targeted interventions to enhance resilience. Therefore, policy and decision-making efforts should prioritize areas for climate change adaptation and mitigation.

Objective 4: Improved mitigation measures which are sustainable as a way of reducing the effects of climate change in Buhera district.

Table 4.4 shows the adoption of improved mitigation measures and their benefits.

Mitigation measures	Co-benefits	Environmental impacts	Social impacts
Reforestation	• Reduce risk of flooding for downstream communities	• Improved air quality • Increased water retention • Increased biodiversity	• Increased quality of life for the people in the area
Adoption of sustainable livestock management,	• Improved livelihoods and food security • Increased income	• Improve soil quality • Reducing methane emissions	• Increased income for local communities • Creation of jobs and increase economic activity
Climate-resilient water management practises.	• Improved water security • Increased economic activity • Improved livelihoods and health	• Reduces water shortages • Reduce flooding by regulating water flow and storage • Reduces soil erosion	• Improves health and well-being • Increase access to education by providing water for schools
Climate-resilient farming techniques	• Food security • Economic developments	• Reduces greenhouse gas emissions • Reduces water pollution	• Improves services like education and healthcare • Reduce poverty

Source: Author's fieldwork 2023

The findings reveal several mitigation measures such as improved farming methods, improved livestock management among others. Nevertheless, there are changes in water volumes and

salinity levels which have a direct effect on people's daily living .One smallholder farmer had to say,

“I've observed significant shifts in our farming practices due to the changing climate. We've had to adjust by adopting better techniques to cope. It's been a challenge, but we're also striving to improve our livestock management. However, it's not just about farming methods. The water situation has become more difficult to manage. We've noticed fluctuations in water levels, and the increasing salinity is affecting both our crops and animals. These changes directly affect our daily lives. Since our livelihoods depend heavily on the land and water, any alterations have a profound impact on us. We're doing our best to adapt, but its proving to be quite demanding”

4.7 CHAPTER SUMMARY

This section presented, evaluated, and interpreted the primary research data collected during the fieldwork survey in the study region. The outcomes of the data analysis were presented using visual instruments such as tables, graphs, and pie charts. The data was analyzed using descriptive statistics and cross-tabulation. The results indicate that climate change is adversely affecting the residents of Buhera South. Overall, diverse populations face constraints related to income and finances, knowledge deficiencies, and soil quality issues, all of which significantly impact their well-being.

CHAPTER 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter presents the summary and conclusions of the findings a study that examined the impacts of climate change on rural livelihoods. The chapter also draws and presents policy recommendations from the findings.

5.1 Summary of the findings and conclusions

Chapter 1 set out the background of the study. Chapter 2 provided a framework, a literature review on the causes, impacts, of climate change globally including the community vulnerability, and improved mitigation measures. Chapters 3 provided the methodology frameworks while Chapter 4 provided the research findings. This chapter revisits the research's central proposition and the research objectives

5.2 What are the causes of climate change in Buhera district, Manicaland province of Zimbabwe?

The first objective investigated the elements contributing to climate change, in Buhera District, various factors combine to worsen the effects of climate change, as illuminated in existing research. Deforestation emerges as a leading force, as substantial areas of forest are lost to expanding agriculture and urban development. This loss not only reduces local biodiversity but also emits significant amounts of greenhouse gases. At the same time, swift changes in land use exacerbate the problem, as traditional farming methods are replaced by more intensive practices. These changes disrupt local climates, disturb natural water cycles, and worsen soil erosion, making the district more vulnerable to extreme weather events.

Population growth serves as an additional catalyst, increasing the demand for resources and adding pressure on the environment. As the population in Buhera expands, so does the need for housing, infrastructure, and agricultural space, leading to more deforestation and land degradation. Moreover, higher resource consumption per person contributes to increased emissions and environmental harm. These interconnected factors emphasize the need for comprehensive interventions addressing not only the symptoms but also the underlying causes of climate change

in Buhera District. Effective strategies should prioritize preserving forests, implementing sustainable land management practices, and stabilizing population growth to enhance resilience and protect the district's natural balance for future generations.

5.3 What are the impacts of climate change in Buhera district, Manicaland province of Zimbabwe?

Objective two addressed the inquiry into the negative repercussions of climate change in Buhera. Statistical evidence indicates that rural populations have been significantly affected by crop failures, as evidenced by the largest proportion, followed by food insecurity (23%). The review of literature offers a comprehensive understanding of the intricate interplay among climate change, human well-being, and food security in Zimbabwe. Although research on the specific health ramifications of climate change is limited, existing studies highlight various complexities.

Despite endeavors to alleviate food insecurity, persistent hunger remains a challenge, particularly in rural areas dependent on rain-fed agriculture. Smallholder farmers are particularly vulnerable to environmental shifts, with the looming specter of heightened hunger in impoverished regions. Forecasts emphasize the urgent imperative for substantial reductions in greenhouse gas emissions to avert a grim scenario, with Buhera district expected to bear a disproportionate burden of starvation.

Effective interventions should prioritize bolstering household resilience through access to drought-resistant crops, improved seeds, and diversification strategies beyond agriculture. Nevertheless, barriers such as political instability and resource constraints impede adaptation endeavors, exacerbating the plight of vulnerable communities, notably rural smallholder farmers. Urgent measures are crucial to fortify resilience and mitigate the adverse effects of climate change on human well-being and food security in Zimbabwe.

5.4 Which groups in communities of Buhera district are more vulnerable to climate change?

In Buhera District communities, the research has pinpointed several groups experiencing heightened vulnerability to the detrimental effects of climate change. Among these, smallholder farmers stand out as particularly at risk, heavily dependent on rain-fed agriculture for their

livelihoods. The shifting patterns of rainfall, increasing temperatures, and prolonged droughts significantly undermine their capacity to maintain crop yields, exacerbating food insecurity and jeopardizing their economic stability. Additionally, rural populations, whose sustenance relies on natural resources, confront heightened vulnerability as climate-induced declines in agricultural productivity disrupt sources of income.

Moreover, children and individuals with limited healthcare access face elevated risks due to the proliferation of vector-borne diseases like malaria and cholera, compounded by climate change. Changes in rainfall patterns and rising temperatures create conducive environments for disease vectors, amplifying the probability of outbreaks. Access to clean water and sanitation becomes increasingly challenging, further exacerbating their vulnerability. Consequently, the findings underscore the urgent necessity for implementing adaptation strategies and support systems to bolster resilience within Buhera communities, enabling them to endure and rebound from the adverse impacts of climate change.

5.5 What improved strategies can be introduced to reduce the effects of climate change in Buhera district?

The study findings underscore various crucial elements of bolstered mitigation efforts in Buhera, with a particular focus on policy and institutional capacity, early warning systems, and the integration of Indigenous Knowledge Systems (IKS). Firstly, the research emphasizes the significance of well-established policies and institutional readiness for effective climate change mitigation. It identifies challenges such as political interference, limited resources, and coordination issues among governmental bodies, NGOs, and other institutions involved in disaster management.

Additionally, the study highlights the importance of early warning systems in enhancing adaptive capacity in Buhera district. These systems play a vital role in minimizing the impacts of extreme climatic events by timely disseminating information to vulnerable communities.

Moreover, the research underscores the potential of incorporating Indigenous Knowledge Systems (IKS) into climate change adaptation strategies. Indigenous communities possess valuable traditional knowledge that aids in identifying shifts in climatic patterns and devising appropriate

responses. Furthermore, the promotion of environmentally friendly policy frameworks and the management of natural calamities emerge as critical components of effective climate change mitigation efforts in Buhera, as elucidated in the study's findings.

5.6 Conclusion of the findings.

5.6.1 The causes of climate change in Buhera district.

The findings of the study showed what is causing climate change in Buhera. The main drivers of climate change in the Buhera district both natural and man-made are highlighted in the conclusions. The effects of land degradation, agricultural practices, deforestation, and altered precipitation patterns on the regional climate are covered in this chapter. In order to lessen future repercussions, it also discusses how global climate change is aggravating these local effects and highlights the necessity of sustainable land management techniques.

The Buhera district may choose to employ adaptation and mitigation techniques to tackle the issues brought about by climate change. These include community-based programs to increase resilience to climate unpredictability, better water management strategies, encouragement of sustainable agricultural methods, and reforestation activities.

5.6.2 The impacts of climate change on rural livelihoods in Buhera district.

The findings of the study indicate that the Buhera district's problems with water shortages have been made worse by climate change. Fewer water sources have resulted from extended droughts and erratic rainfall patterns, making it difficult for rural populations to get safe, dependable water for agricultural and home usage. The lives of disadvantaged groups, who already struggle financially, have been made more difficult by this. The research also emphasizes how the Buhera district's food insecurity has increased due to climate change. Food shortages and hunger have affected rural communities due to water constraint and agricultural activity interruptions. In addition to having an impact on people's physical health, this has kept the community's poverty cycles alive.

Based on empirical data gathered through fieldwork, questionnaires, interviews, and other research methodologies, one of the study's main conclusions is that climate change poses a major danger to

the agricultural output of the Buhera area. Traditional agricultural methods have been disturbed by the shifting climate, which has reduced crop yields and cattle output. The livelihoods of rural populations that significantly depend on agriculture for their subsistence have been directly impacted by this.

5.6.3 Vulnerability of different groups in Buhera West wards in relation to climate change.

The research findings provide a thorough analysis and synthesis of the data acquired during the study, demonstrating the susceptibility of various groups in Buhera West wards in connection to climate change. The chapter concludes that many elements make the Buhera West wards' diverse social groups more vulnerable to the impacts of climate change. The results of the study show that vulnerable populations, women, children, and the elderly, for example are disproportionately impacted by the effects of climate change because they have less access to resources, less influence over decisions, and depend on natural resources for their subsistence.

From the study findings, it is proved that women living in Buhera West wards are especially susceptible to the effects of climate change. This is caused by the gender disparities that already exist that restrict women's access to economic and educational opportunities. Women suffer the most from climate-related catastrophes like droughts and floods since they are typically the major caretakers and food producers in many households. This can result in food insecurity and malnutrition among their family.

5.6.4 Improved mitigation measures which are sustainable as a way of reducing the effects of climate change in Buhera district.

The research findings have led to the proposal of a number of improved strategies aimed at mitigating the effects of climate change globally, regionally and in the Buhera district respectively. These strategies include the promotion of sustainable agricultural practices, conservation of water, and the implementation of reforestation programs to increase carbon sequestration among local communities. Additionally, the conclusions drawn highlight the significance of integrating traditional knowledge with contemporary scientific approaches in order to develop effective strategies for mitigating climate change. Government agencies, non-governmental organizations,

and local communities are all expected to be involved in the multi-stakeholder approach that is necessary for the successful global implementation of these strategies.

5.7 Implementable Recommendations

This study suggests the following to deal with the causes, and impacts of climate change in Buhera district:

- **Enhanced Climate Change Education:** This is achieved by providing comprehensive education and awareness programs to rural communities in Buhera District about climate change, its impacts, and adaptation strategies can empower them to make informed decisions and take appropriate actions.
- **Promotion of Sustainable Agriculture Practices:** To enable rural farmers in Buhera District adapt to changing climate conditions and maintain food security, sustainable agricultural practices such conservation agriculture, agroforestry, and water collecting techniques should be promoted.
- **Access to Climate Information Services:** Improving access to timely and accurate climate information services can enable rural communities in Buhera District to better plan their agricultural activities, reduce risks, and enhance resilience to climate change impacts.
- **Diversification of Livelihoods:** Supporting the diversification of livelihood options beyond agriculture, such as promoting small-scale enterprises, eco-tourism, and renewable energy projects, can provide alternative sources of income for rural households in Buhera District.
- **Community-Based Adaptation Initiatives:** Enhancing community-led adaptation activities and involving local stakeholders in decision-making and execution will help make rural communities in Buhera District more resilient to the effects of climate change.

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APPENDICES

APPENDIX 1: QUESTIONNAIRE GUIDE

My name is Maponga Tatenda M, and I am a student at Bindura University of Science Education pursuing an honours degree in disaster management sciences. I'm conducting research on "THE IMPACTS OF CLIMATE CHANGE ON RURAL LIVELIHOODS: THE CASE OF COMMUNITIES IN BUHERA DISTRICT". You are respectfully asked to participate in this research by contributing your suggestions. The information you enter will be kept absolutely secret and used for academic reasons exclusively.

Section A

❖ Tick in the provided box to show your answer

i. Respondent's age

15-32

☐

33-49

☐

50-64

☐

65+

☐

ii. Tick in the provided box to show your social group.

Married

☐

Unmarried

☐

Divorced

☐

Widow

☐

Elderly

☐

Disabled

☐

iii. Respondent's Household Size

☐ 5 <

> 5 ☐

Section B

NB: Circle the number of each question to share your thoughts on climate change.

Question 1: What do you see as the primary causes of climate change in the Buhera district?

Answer options:

1. Greenhouse gas emissions from human activities
2. Deforestation and land degradation
3. Changes in land use patterns
4. Agricultural practices
5. Industrial activities and pollution
6. Natural factors (e.g., solar radiation)

Other (please specify)_____

Question 2

Which of the following things do you believe contributes the most to climate change in the Buhera district?

Answer options:

1. Increased burning of fossil fuels (e.g., coal, oil, gas)
2. Clearing of forests for agriculture purposes
3. Infrastructure development
4. Use of chemical fertilizers
5. Changes in rainfall patterns

Other (please specify)_____

Question 3

How do you think changes in land use practices impact climate change in Buhera district?

Answer options:

1. Deforestation reduces the number of trees that absorb carbon dioxide, leading to increased greenhouse gas emissions.

2. Conversion of natural habitats to agricultural land alters the water cycle and contributes to changes in local climate patterns.
3. Changes in land use can disrupt ecological balance and biodiversity, affecting local weather patterns.

Other (please specify)_____

SECTION C

Question 4

How has climate change impacted rural livelihoods in Buhera district? Please select all that apply.

Answer options:

1. Changes in rainfall patterns affecting agricultural productivity
2. Increasing frequency and intensity of droughts, leading to crop failures and livestock losses
3. Decline in water availability for domestic and agricultural use
4. Disruption of traditional farming and fishing practices
5. Increased prevalence of pests and diseases in crops and livestock
6. Loss of natural resources and ecosystem services

Other (please specify)_____

Question 3

Which vulnerable communities in Buhera district are most affected by climate change? Please select all that apply?

Answer options:

1. Small-scale farmers
2. Women and children
3. Indigenous communities
4. Elderly population

Other (please specify)_____

Question 4

In your opinion, what are the key challenges faced by vulnerable communities in adapting to climate change impacts in Buhera district? Please select all that apply?

Answer options:

1. Limited access to resources and technologies for climate adaptation
2. Lack of information and awareness on climate change and adaptation strategies
3. Financial constraints to implement adaptive measures
4. Limited access to markets and infrastructure
5. Limited capacity for disaster preparedness and response

Other (please specify)_____

Question 5

What measures do you think can be taken to mitigate the impacts of climate change in Buhera district? Please select all that apply.

Answer options:

1. Promotion of climate-smart agricultural practices, such as conservation farming and agroforestry
2. Improved water management and irrigation systems
3. Reforestation and afforestation programs
4. Enhanced early warning systems for disaster preparedness
5. Capacity building and awareness campaigns on climate change and adaptation strategies

Other (please specify)_____

Question 6

In your opinion, what role can the government, NGOs, and local communities play in implementing climate change mitigation measures in Buhera district? Please select all that apply?

Answer options:

1. Government policies and regulations to reduce greenhouse gas emissions and promote sustainable practices

2. Provision of financial support and incentives for climate change adaptation and mitigation initiatives
 3. Collaboration between NGOs, government agencies, and local communities to implement climate resilience projects
 4. Strengthening local institutions and community-based organizations for climate change planning and decision-making
 5. Encouraging community participation and ownership in climate change mitigation efforts
- Other (please specify)_____

THANK YOU FOR YOUR VALUED SUPPORT

APPENDIX 2: KEY INFORMANTS INTERVIEW GUIDE

My name is Maponga Tatenda M, and I am a student at Bindura University of Science Education pursuing an honours degree in disaster management sciences. I'm conducting research on "THE IMPACTS OF CLIMATE CHANGE ON RURAL LIVELIHOODS: THE CASE OF COMMUNITIES IN BUHERA DISTRICT". You are respectfully asked to participate in this research by contributing your suggestions. The information you enter will be kept absolutely secret and used for academic reasons exclusively.

NAME OF INSTITUTION:.....

Question 1

In your experience as an extension officer working in Buhera district, what do you perceive as the main causes of climate change in this region?

Question 2

From your observations, are there any specific local factors or activities in Buhera district that contribute to climate change?

Question 3

In your role as an extension officer, what efforts or initiatives have you observed in Buhera district to address the causes of climate change?

Question 4

What are the primary agricultural practices and crops cultivated by farmers in Buhera district?

Question 5

How have the farmers in Buhera district been affected by climate change?

Question 6

What specific challenges do farmers face in adapting to climate change in this region?

Question 7

What support or resources are available to farmers in Buhera district to help them cope with the impacts of climate change?

Thank you for your valued support.

APPENDIX 3: INTERVIEW GUIDE

My name is Maponga Tatenda M, and I am a student at Bindura University of Science Education pursuing an honours degree in disaster management sciences. I'm conducting research on "THE IMPACTS OF CLIMATE CHANGE ON RURAL LIVELIHOODS: THE CASE OF COMMUNITIES IN BUHERA DISTRICT". You are respectfully asked to participate in this research by contributing your suggestions. The information you enter will be kept absolutely secret and used for academic reasons exclusively.

Question 1

Based on your expertise, what are the primary causes of climate change in Buhera district?

Question 2

Are there any specific local factors or activities in Buhera district that amplify the causes and impacts of climate change?

Question 3

In your role as an environmentalist/weather forecaster/civil protection unit member, what initiatives or strategies have been implemented in Buhera district to address the causes and impacts of climate change?

Question 4

How has climate change specifically affected Buhera district in terms of extreme weather events, agricultural productivity, water availability, or other relevant aspects?

Question 5

What scientific data or evidence do we have to support the observations of climate change impacts in Buhera district?

Question 6

Are there any specific climate change adaptation or mitigation projects or programs that have been implemented in Buhera district? If so, what have been the outcomes or successes?

Question 7

What are the main challenges or barriers faced in implementing climate change initiatives in Buhera district, and how are these being addressed?

Question 8

How local communities in Buhera are district being engaged and involved in climate change adaptation and mitigation efforts?

Question 9

Are there any ongoing researches or monitoring initiatives related to climate change in Buhera district? What kind of data is being collected, and how is it being used?

Question 10

What role do early warning systems play in mitigating the impacts of climate-related hazards in Buhera district? How effective are these systems?

Question 11

What are the future projections or forecasts for climate change in Buhera district? How can this information guide decision-making and planning processes?

Question 12

How can individuals, communities, and organizations in Buhera district contribute to climate change mitigation and adaptation efforts?

THANK YOU FOR YOUR CONTIUED SUPPORT

APPENDIX 4: FOCUS GROUP DISCUSSION

My name is Maponga Tatenda M, and I am a student at Bindura University of Science Education pursuing an honours degree in disaster management sciences. I'm conducting research on "THE IMPACTS OF CLIMATE CHANGE ON RURAL LIVELIHOODS: THE CASE OF COMMUNITIES IN BUHERA DISTRICT". You are respectfully asked to participate in this research by contributing your suggestions. The information you enter will be kept absolutely secret and used for academic reasons exclusively.

Section A

1. What do you think are the main causes of climate change in Buhera district?
2. How do these causes of climate change specifically impact you as a community?
3. In what ways do you see changes in weather patterns affecting the community in Buhera district?
4. How has climate change impacted agricultural productivity in this district?
5. What are the specific challenges related to water availability and quality due to climate change in Buhera district?
6. How have natural ecosystems in Buhera district been affected by climate change?
7. In what ways has climate change impacted the health and well-being of the community in Buhera district?
8. What actions can the community take to address and mitigate the causes of climate change in Buhera district?
9. How can sustainable agriculture practices contribute to reducing greenhouse gas emissions and enhancing climate resilience in Buhera district?
10. What initiatives can be undertaken to promote reforestation and tree planting in Buhera district?

11. What are the potential benefits of proper waste management in mitigating climate change in Buhera district?
12. How can education and awareness programs on climate change empower the community in Buhera district to take sustainable actions?
13. Are there any specific challenges faced by the community in addressing the causes of climate change in Buhera district?

THANK YOU FOR YOUR SUPPORT

