WOMEN AND CLIMATE CHANGE INDUCED WATER MANAGEMENT STRATEGIES IN ZIMBABWE

By

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A thesis submitted in fulfilment of the requirements for the degree.

DOCTOR OF PHILOSOPHY

in the

Department of Anthropology, Archaeology and Development Studies at the
UNIVERSITY OF PRETORIA
FACULTY OF HUMANITIES

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July 2023

ABSTRACT

The multifarious effects of climate change are visible in arid and semi-arid rural African communities. These effects have disproportionately affected women, yet there are a few empirical studies that have investigated how women are being impacted**.** This study, therefore, investigates how women are disproportionately affected by climate change and the water conservation strategies that are being used to combat the effects of climate change. This research was conducted in Mudzi District in Zimbabwe, using a mixed methodology which is largely qualitative. The data was collected using in-depth interviews, questionnaires, and focus group discussions. Respondents to the questionnaire were selected using snowball sampling whereas purposive sampling was used to select participants of the focused group discussion and in-depth interviews. One of the findings of the study is that the notion that climate change affects women remains poorly understood in the literature. The experiences of women and the effects of climate change are treated the same. However, this study argues that although climate change affects women, not all the women are impacted uniformly. The study found that variables such as the women's age, marital status, education, social status, and (dis)ability. determine the degree of exposure to the climate change effects. Furthermore, the study found that the effects of climate change undermine women's livelihoods which are climate-sensitive thus leading to accelerated constraints such as increased poverty due to poor yields. Moreso, the effects of climate change have increased water scarcity which has induced water management strategies. From this research, indigenous water conservation strategies which include but are not limited to water rationing, water harvesting, water recycling, and the drying of vegetables were identified. The aim was to document the strategies and to make them considered for climate mitigation actions. Moreover, an inclusive continuous plan of action that addresses the disproportionate vulnerability of women to the vagaries of climate change is vital to ensure sustainable livelihoods.

KEYWORDS: Climate change; women and climate change, water conservation, water stress, climate change adaptation, indigenous knowledge systems

ACKNOWLEDGEMENTS

I give thanks and praises to the LORD Almighty for giving me the ability, health, wisdom, strength, and motivation to start and complete this study.

My special thanks go to my supervisor, Professor Innocent Pikirayi, for his expert guidance, continuous patience and understanding. I am grateful for the support I got from my friends and family. Finally, I deeply appreciate the love, patience, and unwavering support of my husband, throughout my studies.

LIST OF ACRONYMS

ACPC-	African Climate Policy Centre
AGRITEX-	Agricultural, Technical, and Extension Services
BBC-	British Broadcasting Corporation
CAFOD-	Catholic Agency for Overseas Development
CEDAW-	Convention on the Elimination of all Forms of Discrimination Against Women
CERD-	Convention on the Elimination of all Forms of Racial Discrimination
DFID-	Department for International Development
FAO -	Food and Agriculture Organisation
FEWS NET-	Famine Early Warning Systems Network
FGD-	Focus Group Discussion
IKS-	Indigenous Knowledge Systems
IPCC-	Intergovernmental Panel on Climate Change
IRI-	International Research Institute for Climate and Society
ISS-	Institute for Security Studies
MEA-	Millennium Ecosystem Assessment
MDG-	Millennium Development Goals
MLAWCRR-	Ministry of Lands, Agriculture, Water, Climate and Rural Resettlement
MPI-	Migration Policy Institute
NASA-	National Aeronautics and Space Administration
NCC-	National Consumer Commission
NGO-	Non-Governmental Organisation
NOAA-	National Oceanic and Atmospheric Administration
OCHA-	United Nations Office for the Coordination of Humanitarian Affairs

PACJA-	Pan African Climate Justice Alliance
SADC-	Southern African Development Community
SDG-	Sustainable Development Goal
SLF-	Sustainable Livelihoods Framework
UK-	United Kingdom
UN-	United Nations
UNDRR-	United Nations Office for Disaster Risk Reduction
UNDP-	United Nations Development Programme
UNFCCC-	United Nations Framework Convention on Climate Change
UNFPA-	United Nations Population Fund
UNIDO-	United Nations Industrial Development Organisation
USAID-	United States Agency for International Development
WHO-	World Health Organisation
WMO-	World Meteorological Organisation
WSP-	Water and Sanitation Programme
ZINWA-	Zimbabwe National Water Authority

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CHAPTER 1: INTRODUCTION AND BACKGROUND

1.1 Background

Anthropogenic climate change is considered to have a severe impact in Africa, especially in countries that have climate-sensitive economies (Awojobi, 2017:39). Environmental scientists believe that Africa is vulnerable to climate change owing to its high exposure and poor adaptive capacity (Sintayehu, 2018; Niang et al., 2014). Africa's dependence on rain-fed agriculture and its relatively extreme poverty rates often limits the adaptive capacities of the local population. Consequently, Zimbabwe has not been spared from the effects of climate change. The studies that were done in the country have highlighted the considerable impact of high temperatures and unpredictable rainfall patterns (Moyo, 2019; Brazier, 2017; Brown et al., 2012; Unganai, 1996). For instance, the average temperatures in Zimbabwe have increased by approximately 0.8°C from 1933 to 1993, which translates to a 0.1°C rise per decade (Unganai & Mason, 2002). The rainfall has shown a declining trend that is not statistically significant. However, several studies (Makarau, 1995; Unganai, 1996; Mason & Jury, 1997; Mazvimavi, 2010; Simba, Chikodzi & Murwendo, 2012) established that the decline of precipitation in Zimbabwe has translated to a decline of about 10% on average over 100 years.

The effects of climate change have been visible in the Mudzi Rural District, which is the case study area, and is located in the north-eastern part of Zimbabwe (See 5.3 for Mudzi case study). Chenga (2015) highlights that Mudzi Rural District's annual rainfall has hardly gone beyond 600mm since 1980. Mudzi district has an estimated population of 158,483 people and the majority of these people work in the agricultural sector, the changes in rainfall and in the temperatures make it particularly vulnerable to the impact of climate change (Zim stats, 2022; The Zimbabwe National Statistics Agency, 2013). In addition, the changing climate trends present insurmountable challenges in the lives of the rural populations. These include water scarcity, endemic poverty, and food insecurity (Mpambela & Mabvurira, 2017:32; Brazier, 2017; Intergovernmental Panel on Climate Change (IPCC), 2014). This, in turn, has major effects on the sustainable socio-economic development of the country and it is expected to continue if the climate change impacts are not addressed.

Although climate change is affecting all the communities in Zimbabwe, its impact is not homogeneous (Thomas et al., 2019; Gentle, Thwaites, Race & Alexander 2014; Coirolo & Rahman, 2014). Some communities experience greater impact than others. This is because climate change does not occur in a vacuum but amid communities that have different social, economic, and gendered dimensions (Rusmadi, Hadi & Purnaweni, 2018; IPCC, 2001). As a result, climate change exacerbates other threats to the social and natural systems, thereby placing additional burdens particularly on the poor (1PCC, 2014:31). Particularly vulnerable are the rural-based women whose livelihoods depend mainly on primary resources such as water as well as land and these are threatened by climate change, political and patriarchal systems (Denton, 2002; Resurreccio´n, 2013; Phiri, 2014:2545 and Garutsa, Mubaya & Zhou, 2018). Consequently, the IPCC (2014), argues that the women's heightened vulnerability is rarely due to a single reason, but rather, it is the product of diverse and interacting social processes that result in the inequalities in the socioeconomic status that is premised on gender, class, ethnicity, age, and (dis)ability. This, in turn, has led to a growing recognition among researchers that climate change is not gender neutral (Dimitrov, 2019:214; Rao, Lawson, Raditloaneng, Solomon &. Angula, 2019; Thomas et al., 2019). However, the nature of women's vulnerability to the effects of climate change is poorly understood in the literature. The failure to address climate change impacts on women, threatens to reverse the developmental gains across the various sectors and it worsens the vulnerability of the local systems and the national economy.

In the face of fluctuating and changing climatic conditions, the societies have demonstrated significant adaptability by employing a plethora of mechanisms to conserve water (IPCC, 2014). For instance, most of the water sources in the Mudzi Rural District, which is located in the north-eastern region of Zimbabwe are dry, yet the communities have managed to survive the vagaries of climate change over the years (Famine Early Warning Systems Network (FEWS NET), 2016:10). This is because the communities have managed to adapt to the impact of climate change through community-based measures to sustain human livelihoods (Rankoana, 2016; Bhusal, 2009). However, the developed mechanisms by the rural communities such as the Mudzi dictrict to conserve water need to be explored. Climate change adaptation is important to ensure sustainability.

1.2 Why focus on women?

Women have always constituted most of Zimbabwe's population. According to 2022 census report the population of Zimbabwe is estimated to be 15,178,957, of which 7,289,922 (48%) were male and 7,891,035 (52%) were female (Zim Stats, 2022). However, a higher proportion of the population in the country, that is, 8 751 000 (67%) resides in the rural areas, of which 4 550 535 are female and 4 200 464 are male (Food and Agriculture Organisation (FAO), 2017). Thus, the majority of the women living in rural areas form a great proportion of the agricultural labour force in subsistence farming, and they mainly grow food crops for household consumption. The FAO (2017: xii) states that the rural women in Zimbabwe work 16–18 hours a day, thereby spending at least 49% of their time on agricultural activities and about 25% on domestic activities. The women's dependency on rain-fed agriculture for their livelihoods along with other factors such as the lack of access to natural assets and patriarchy have led to several researchers (Glazebrook, Noll & Opoku, 2020; Chidakwa, 2020; Dube, 2017; Babugura, 2010; Dankelman, 2002) who wrote about gender and climate change, concluding that the women are the most vulnerable population when it comes to the impact of climate change.

Agriculture is a power-laden domain that is dominated by men, and this has historically affected the women's access to resources such as land (Bungu, 2019). For instance, Sub-Saharan Africa represents an average of 15% of women agricultural landholders (FAO, 2011). In Zimbabwe, there is evidence that of the 96% of Zimbabwe's agricultural land that was acquired under the land reform program which began in 1980, only 10% of that land went to women (Utete Commission, 2003). The inequality in access to crucial resources such as land excludes women from decision-making structures, as well as access to credit, funding, training, and the extension services that would enhance their capacity to adapt to climate change. Consequently, the women's ability to confront the climate change impact is limited.

The different roles played by women and men in society determine their vulnerability to the impacts of climate change (Chidhakwa, 2020; Rao, 2019). The impact of differing gender roles and responsibilities was highlighted by the research that was conducted in Uganda by the Mary Robinson Foundation for Climate Justice, which found that the climate change impacts were creating tension between the women and the men who respectively were predominantly responsible for food crops to feed the family and for the cash crops to earn an income (United

Nations Framework Convention on Climate Change (UNFCCC), 2019). In addition, the study also reported that in circumstances such as these, the women prioritise feeding their children as well as their male spouses and they reduce their own intake to the detriment of their overall nutrition and health. Given this reality, examining the vulnerability of women to climate change and the water management strategies being used by the communities, enables the understanding of the actual status of women in arid and semi-arid rural areas. This is a key basis for the formulation of policies and for the evaluation of the intervention strategies and measures.

It is also important to note that women's lack of climate change information increases their vulnerability to the effects of climate change. For example, in this study, the level of climate change information diffusion was evaluated, and the study found out that the level of climate change awareness is higher in men compared to women. A total of 87.5 % of the male respondents indicated that they got the information on climate change through periodic meetings with their AGRITEX officers, radio, newspaper, the school, and speaking with their colleagues at the bottle stores.

1.3 Adaptation to water management in the face of climate change

The target task of the seventh Millennium Development Goal (MDG) was to halve the number of the population with no access to safe drinking water and basic sanitary facilities by the year 2015 (Shaheed, Orgill, Montgomery, Jeuland & Brown, 2014). However, climate change negatively impacted the water sources (Brazier, 2017; IPCC, 2007), which made it difficult for most developing countries to attain the goal. Poor sanitation and lack of clean water increases the vulnerability of communities to the effects of climate change. It increases the exposure of communities to diseases. Currently, some studies have noted with concern that climate change is impacting water sources, especially in arid and semi-arid regions (Dolan, 2021; Frischen, Meza, Rupp, Wietler & Hagenlocher, 2020). Locally, the FEW NET (2016:10) highlighted that most of the rivers, dams, and some boreholes in the Mudzi Rural District, have dried. The drying of rivers and water sources occurs during the dry season. Given the economic crisis and the poor infrastructure in Zimbabwe, the appropriate response to these threats requires the government to work with local communities to formulate water management strategies. Dube (2012:654) argues that the community-based water resource management is the only avenue for most rural communities in Africa given the lack of capacity of many developing countries to provide clean water for rural populations. However, there is limited literature when it comes to the water management strategies that are used by the local rural communities to conserve resources. Thus, the entire endeavour of this study closes this knowledge gap through an in-depth exploration of the impacts of climate change on women and the sustainable water management strategies that are being used in response to climate change.

Water is at the heart of climate change adaptation, and it is a crucial link between the climate system, the human society, and the environment (Grimaldos, 2015:70). However, due to water scarcity that is fuelled by climate change, new sources of water are increasingly becoming difficult exploit. The situation has been worsened by poor infrastructure and the country's current economic crisis. For example, Bongani and Sithole (2020) highlighted that the quality of Zimbabwe Road infrastructure is ranked by the World Economic Forum at 116 out of 137 in 2018, and this is down from 101.Therefore, to achieve the sixth sustainable development goal (UN-SDG)'s of providing everyone with water and sanitation, there must be a tailor-made approach for each rural community. Hence, documenting the local water management strategies provides additional empirical evidence to enrich rural communities with the existing water management strategies.

1.4 The research problem

The decline in the amount of rainfall has resulted in the rampant drying up of rivers and dams in the Mudzi Rural District, thereby causing water shortages and negatively impacting the lives and wellbeing of the people living in the district (Chingwaru, 2016). For example, in 2016 and the preceding years saw major dams and rivers such as the Nyamuwanga and the Mudzi river respectively went dry (FEWS NET, 2016). This raised a red flag for an urgent solution to the water challenges in the Mudzi district. However, despite the water challenges, the communities in Mudzi have continued to survive in a water-scarce environment yet their survival strategies have not been documented in the literature to improve the national climate change adaptation response.

Amongst the most cited vulnerable population are women. For example, Mpambela and Mabvurira (2017); Chagutah (2010), and Gukurume (2013) all agree that the women living in rural Zimbabwe are particularly vulnerable to the impact of climate change because their economies are heavily hinged on rain-fed agriculture and climate-sensitive resources. Despite most climate change researchers agreeing that women are the most impacted by climate change, more information is needed to understand the unique experiences of the rural-based women to the effects of climate change. In addition, the literature on gender and climate change (Masika, 2002; Dankelman, 2002; Alston, 2013; Babugura, 2019; United Nations; 2022) has labelled all women as vulnerable without taking into consideration the social dynamics which may differentiate their vulnerability. Apart from being victims of climate change, the women's experiences in society are invaluable yet they are powerless in climate change decision-making processes and in policy formulations (Masika, 2002).

1.5 Aim and objectives of the study.

This study sought to investigate how women are being impacted by the effects of climate change and it highlights the water management strategies that are being adopted to adapt to the effects of climate change. This was accomplished through the following objectives:

- Examining the current state of the vulnerability of women to the effects of climate change and inadequate water supply in the Mudzi district.
- Assessing the impact of climate change on various groups of women and the impact of climate change on water sources in the Mudzi district.
- Strengthening the documentation of Indigenous Knowledge Systems (IKS) in sustainable water management strategies in Zimbabwe.
- Examining ways in which gender equality can be mainstreamed into climate change policies and programs to improve water governance in arid and semi-arid areas.

1.6 Research questions

The research sought to answer the following questions:

- What is the current state of women in terms of vulnerability to climate change?
- How is climate change impacting different groups of rural-based women?
- What are the various sustainable water management strategies and indigenous knowledge systems that are being used by men and women to combat the effects of climate change?
- How can gender equality be integrated into climate change policies and programs to ensure sustainable water management strategies?

1.7 Significance of the study

Zimbabwe regards climate change as a top priority in its development efforts (Government of Zimbabwe, 2015). However, the impact of climate change on women as well as the water management strategies that are devised by the rural communities are scant. Sizable literature exists (Tesso; 2014. Huyer, 2016; Jerneck, 2018; Babugura, 2019; United Nations; 2022) on gender and climate change at the international level, thereby suggesting the need to expand the research related to gender and climate change in Zimbabwe. The knowledge of how individuals are being impacted by and adapting to climate change is important for policy development at national and international levels. The policymakers need to know where gender mainstreaming is relevant, and this research serves to promote the dissemination of such information to raise awareness of women's vulnerability to climate change. Also, without an adequate baseline understanding of the unique gender-specific experiences of the climate change impacts, both the local and the global policies run the risk of creating maladaptive responses that fail to address everyone's experiences (Alston, 2013; Denton, 2002). This research fills a crucial literature gap in the country and provides evidence-based analysis that is aimed at increasing the understanding of climate change impact and its determinants.

Using the bottom-up approach, the research also documents the local water management systems that were used to adapt to the climate change effects for plausible policy intervention and to create resilient communities in the face of the impact of climate change. The IKS in water management has been obscured in the Zimbabwean water and climate change policies. Documenting the local-based water management experiences was done to improve the understanding of the local conditions which might lead to the intervention programs that are designed to assist the communities to achieve sustainable livelihoods.

In addition, documenting the local water management strategies provides a powerful basis from which the alternative ways of managing resources can be developed. Thus, the purpose of this study is to contribute to the knowledge, debate, dialogue, and the efforts that are associated with the vulnerability of women to climate change as well as the water management strategies that are used to combat the effects of climate change by the people living in semi-arid rural communities.

1.8 Thesis outline

The thesis comprises of eight chapters. **Chapter 1** introduces the study by highlighting how women have borne the brunt of the climate change. The chapter also demonstrate why it is important for local communities to make use of water management. **Chapter 2** engages with the literature to explore the concept of climate change and it explains the impacts of climate change at the global and the local levels. The chapter further discusses the impact of climate change on water sources and on women. The reasons for the differential impact of climate change on women are also explored with support of research. **Chapter 3** discusses the components of the vulnerability approach in relation to literature and the case study. The chapter explains the differential impact of climate change in communities. This gives an overview of why women are commonly viewed as the most vulnerable group of people when it comes to the effects of climate change.

The sustainable livelihoods framework and its components are explored in **Chapter 4**. The chapter also discusses the factors that constrain the rural communities to achieve positive livelihoods outcomes and provide ways to sustain their livelihoods. Moreover, the chapter is linked to Chapter 3 in that it continues to explore the reasons why the women are factored as the most vulnerable group when it comes to the effects of climate change. However, the chapter also brings the view that women are not only the victims of the climate change effects, but they are also the agents of change. Thus, the chapter also explores the adaptation strategies that women in the Mudzi district used to combat the effects of climate change.

Chapter 5 discusses the research methodology. It describes how the data for this study was obtained and it also highlights the procedures that were followed to obtain the data. The chapter describes, in detail, the methods that were used to explore the vulnerability of women to climate change and the water management strategies that were developed and used to conserve water.

Chapter 6 focuses on the research findings. The chapter presents the findings that were gathered using, the survey questionnaires, in-depth interviews, focus group discussions, and the observations that were made. The chapter begins by presenting the community profiles of the participants. The chapter then presents the findings of the vulnerability of the women that are living in Mudzi to climate change, and these are followed by a discussion of the water management strategies that are being used by the communities in the Mudzi District to conserve water.

Chapter 7 interprets and explains the research results and it links the research findings to the existing literature. The chapter's major highlights include a discussion on the local perception of climate change, the women's vulnerability to climate change, and the adaptation strategies that are being implemented to combat the effects of climate change.

Chapter 8 explores the implications of the research findings. It suggests the necessary recommendations that may be utilised to end the vulnerability of women to the vagaries of climate change. In addition, the recommendations for improving the current water management strategies are included in the hope that they may be included for possible future developments in the water sector.

CHAPTER 2: CLIMATE CHANGE AND CLIMATE CHANGE IMPACTS

2.1 Introduction

This chapter reviews the past and current literature that has examined the global and regional perspectives on climate change and its aftermath. The chapter assesses the effects of climate change, particularly on water sources and on the most vulnerable populations living in arid and semi-arid regions. This chapter starts by giving a brief background of climate change and it also examines the climate change concept. The second section describes the global and the regional perspectives of climate change. The final section describes the climate change impacts on women and on water sources. The chapter also identifies the research gaps that this thesis aims to address.

2.2 Background to climate change

The scientists have known about climate change for more than a century (Kolbert, 2018). The work that was done by Joseph Fourier (1825), John Tyndall (1861), Svante Arrhenius (1895), James Hassen (1988), and many other scientists triggered the research into what scientist see as the biggest threat to humanity and its environment. In 1972, the United Nations (UN)'s environmental conference was held to apply the basic endeavours of the protection and the improvement of the human condition, and to help all the individuals and their descendants (Shelton, 2018). This saw the emergence of the United Nations Environment Programme which, thus, convened the Intergovernmental Panel on Climate Change (IPCC) in 1988 under the United Nations to give a scientific perspective on environmental change and its financial as well as its political effects. At the Rio Summit in 1992, the UNFCCC was set up and it called for worldwide action to turn around the overwhelming impacts of climate change (Merkouris & Perreaut, 2017).

The UNFCCC later led to the birth of the Kyoto Protocol in 1997. In Kyoto, Japan, 160 industrialised countries pledged to reduce their greenhouse gas emissions as part of a global agreement on climate change. Since then, significant advancement has been made, both in terms of understanding environmental change and its impacts, as well as the ability of the governments to address and recognise the catastrophe that is being caused by the change. For example, the UN Climate Change Conference (COP26) which was held in Glasgow, Scotland, in November 2021 encouraged all countries to reduce their emissions and work together to adapt to the impacts of climate change. However, the governments continue to negotiate a further reduction of greenhouse gas emissions and they support climate change mitigation and adaptation in developing nations.

2.3 The concept of climate change

The change in climate has varied impacts that are already being experienced by humans. It is undeniable that the most vulnerable and the marginalised social groups encounter the greatest effects of climate change (IPCC, 2007). To understand climate change, one has to have the ability to differentiate between climate and weather (Brazier, 2019:1). The difference between weather and climate is a measure of time. Weather refers to what the conditions of the atmosphere are over a short period, and the climate is how the atmosphere "behaves" over relatively long periods (National Aeronautics and Space Administration (NASA), 2005). In the same vein, Le Treut et al. (2007:104) define climate as the average weather over a period that is measured in decadal terms, usually 30-40 years. It should be noted that climate change is widely debated and so are its meanings, causes, and impacts.

Brazier (2019:01) defines climate change as the shift in an area's long-term average weather conditions. Analogously, the IPCC (2007:20) further states that it is a shift in the state of the climate that can be identified by the changes in the average and/or the variability of its properties, and that persists for at least ten years. Thus, it refers to any shift in climate over time, whether due to natural variability or because of human actions. While the IPCC understood climate change to embrace both natural and human causes, the UNFCCC (1992:3), attest that climate change is a shift in the climate system that can be directly or indirectly ascribed to the activities engaged in by human beings which subsequently result in the alteration of the global atmospheric composition.

Some studies have shown that there is an ongoing increase in the number of warm days, and that the precipitation pattern is unreliable. They also state that the seasons are shifting, and the incidents of drought are on the rise while the water sources are declining (IPCC, 2007). In the same vein, Wang, Huang & Rozelle (2010) explain that climate change will generate continuing variability regarding the rise in sea level, and there will be increased temperatures resulting from the movement of climatic zones, as well as changes in the rainfall patterns. This has been supported by, the IPCC 2019 Climate Change Report, the U. N 2019 Climate Change Report, and the World Meteorological Organization (WMO) 2019 Climate Report, which all agree that the global average temperatures are increasing. Thus, understanding these climatic changes is a prerequisite in planning for the water management strategies and climate change mitigation.

The main driver of climate change is global warming which threatens the loss of environmental, economic, and social security through an increase in poverty, inequality, and freshwater shortages (Solomon, 2014:46, IPCC, 2007). Global warming is the long-term warming of the planet. NASA (2012) also emphasises that the terms “global warming” and “climate change” are sometimes used interchangeably but they refer to slightly different things. The difference is that climate change includes global warming, and global warming refers to the broad range of changes that are happening to the planet earth. The primary cause of global warming is the human actions that release carbon into the atmosphere, most notably the burning of fossil fuels to generate electricity and operate businesses (IPCC, 2021; IPCC, 2007). Apart from human activities, there are some natural processes such as solar energy variability, ocean currents, clouds, and albedo that are thought to be significantly contributing to climate change (Bast, 2010). Increasing the levels of Greenhouse Gasses (GHGs) such as methane, carbon dioxide, chlorofluorocarbons, water vapour, and nitrous oxide influences the earth’s radiation budget and the earth-atmospheric system must adjust thereby resulting in changes in the global climate (Shan, Hejing, Liuyan & Xing’en, 2013; Scafetta, 2010).

Although there has been a debate on what is causing climate change, there is a consensus amongst several scientific researchers that climate change is a result of natural and human actions (Yadav & Lal, 2018; Gornitz, 2009; Bast, 2010; Scafetta, 2010; NASA, 2012). Climate change has become a current state through which human life nowadays takes shape (Hulme, 2017). It is not enough to understand the causes of climate change as people have to understand its effects too (Millennium Ecosystem Assessment (MEA), 2005). Thus, the research on the impacts of climate change on humanity is vital to put in place integrated approaches for the adaptation and mitigation strategies to achieve sustainable development.

2.4 Perspectives on global climate change

Climate change is a worldwide environmental problem of the twenty-first century, which has become a major topic of global debate (Xinyuan, 2010; Mohanty, 2009:149). Despite the IPCC reports (IPCC, 2007; IPCC, 2021) providing straightforward evidence that climate change is caused by human actions and natural processes, Headrick (2019:48) points to the sceptics who, despite agreeing that global warming is happening, also claim it is a natural phenomenon. A recent feature of the debate in literature claims that climate change is a hoax. This is driven by politicians with a right-wing populist agenda such as Donald Trump. Contrary to these claims, the IPCC reports in 1995, 2001, 2007, 2014, and 2019 showed that climate change is happening fast and that there is an urgent need for adaptation and mitigation strategies (Headrick, 2019:44). Similarly, Oreskey (2018:31) further contends that the various means that are used to test and evaluate scientific claims concluded that the scientists are not wrong about the reality of anthropogenic climate change.

Technological advances such as the earth-orbiting satellites have enabled scientists to collect information about our planet and its climate on a global scale. The data collected over a few years reveal the signals of a changing climate (NASA, 2020). For example, the 2019 Annual Global Climate Report reviewed that the global annual temperature has increased at an average rate of 0.07°C (0.13°F) per decade since 1880 and more than double that rate (+0.18°C / +0.32°F) since 1981 (National Oceanic and Atmospheric Administration (NOAA), 2020). The scientists believe that the build-up of heat in the oceans is the greatest evidence of how rapidly our earth is warming up due to the heat-trapping gases that are released by the burning of fossil fuels.

According to Shankman and Horn (2017), the rising ocean temperatures (rising about 0.12 degrees Celsius per decade on average over the past 50 years) are the contributing factors to the constant and catastrophic weather events, for example, the hurricanes of 2017, Harvey, Irma, and Maria where warm waters played a role in the worsening of the storms (Shankman & Horn, 2017). However, the risk associated with the increased temperatures depends on the magnitude of warming, the geographic location, the level of development, and on how humans respond through the adaptation and mitigation options (Buis, 2019).

It is vital to note that the global climate is interdependent though not uniform which makes every country vulnerable to climatic variations (Xinyuan, 2010). Although every nation is at risk, Africa has been termed to be the most susceptible continent (UN Environment, 2020; FAO, 2019; Venkatesh, 2018; Samson et al., 2011; IPCC, 2007). Africa’s vulnerability has been attributed to its high exposure, widespread poverty, poor infrastructure, limited adaptive capacity, and its high dependency on rain-fed agriculture (Food and Agriculture Organisation (FAO), 2019; Niang et al., 2014). Although there are no precise mechanisms to manage global climate injustice, each nation must adapt to climate change at the local level to the country level to improve the lives of the local communities (Samuel et al., 2011).

The notion of injustice that is mentioned above is used to argue against the unjust burden of climate change impacts and costs. Climate justice is a way of seeking to address a triple inequality relating to vulnerability and mitigation (Goodman, 2009). Thus, climate justice is a concept used to alleviate the unequal burdens that are created by climate change. It recognises the development paradox that those who contributed least to greenhouse gas emissions will be most affected by climate change (Anderson, 2013). Hence, climate justice demands that the resources for tackling climate change must be equitably distributed. The resources include climate finance, among others. However, the next section will discuss how Africa is impacted by the effects of climate change.

2.5 Climate change in Africa

Africa is the second largest and most populous continent in the world. With minimal past and present contribution to the anthropogenic emissions of greenhouse gases, it is considered to be the most vulnerable continent to the effects of climate change (Awojobi, 2017:29; Niang et al., 2014; IPCC, 2007). The continent has seen increases in temperatures and the rainfall patterns have become more varied since the last century. For example, the mean annual rainfall has decreased in West Africa since the 1960s, while Southern and Eastern Africa have become more drought-prone, especially in the Sahel, around the horn of Africa, and in Southern Africa (Pan African Climate Justice Alliance (PACJA), 2009). Recognising the increasing catastrophic threats of climate change, most African countries joined the rest of the world in 2015 to adopt the Paris Agreement, committing themselves to limit climate change to well below 2°C above pre-industrial levels. The agreement entered into force in November 2016 (Shepard, 2019). Limiting temperature by controlling emissions reduces the risks and the dangerous climate change effects.

Even though Africa has dedicated itself to limiting climate change, Giordano and Bassini (2019) argue that the understanding of climate change in Africa is weaker than in any other continent. They attribute this to missing historical data. Little is known about the historical climate system in Africa, which, according to Dinku (2019:71) is scarcely even monitored or has missing observations in some regions. For instance, the British Broadcasting Corporation (BBC) News (15 December 2019) confirms that there are more reporting rain gauges in the United Kingdom (UK) county of Oxfordshire than in the entire Congo Basin. Nordling (2019:605) argues that having historical climate records is vital in understanding climate variability, trends, and the predictions, which improve the strategic adaptation response.

Nonetheless, most researchers now agree that the temperatures in Africa will rise faster than the global average, with the IPCC base scenario projecting a rise of approximately four degrees celsius by the end of the century (IPCC, 2007). Kotir (2011:587) confirms that Africa is already experiencing significant changes, as demonstrated by the changes in average temperature, the changes in the amount of rainfall and patterns, and the prevalence of frequent extreme weather conditions. For example, a reduction in the austral summer rainfall in Southern Africa has been reported over the western parts extending from Namibia, through Angola, and toward the Democratic Republic of Congo, during the last half of the 20th century.

However, the temperature changes vary across the continent. Particularly vulnerable to the effects of climate change in Africa are the regions that depend on natural resources and rain-fed agriculture, and the regions with poor financial, technical, and institutional capacity to adapt. For example, the rain-fed agriculture accounts for 96% of the overall crop production in sub-Saharan Africa hence any increase in the temperature is likely to result in crop failure (World Bank, 2015; Madeira, 2019). Mitigation and the adaptation to climate change are therefore inevitable. Climate-resilient societies have to be prevalent hence, the relevance of this particular study.

2.6 Climate change in Southern Africa

The Southern Africa Community Development (SADC) has 16 member states with various distinct climate zones. The SADC climate ranges from arid to sub-humid as shown in Figure 2.1 below. However, the arid climatic zone is more dominant in the region (Engelbrecht and Engelbrecht, 2015). The region highly depends on weather and climate for its socio-economic activities. Therefore, any drastic changes in temperature and rainfall due to climate change will have detrimental effects on sustainable development in the region.

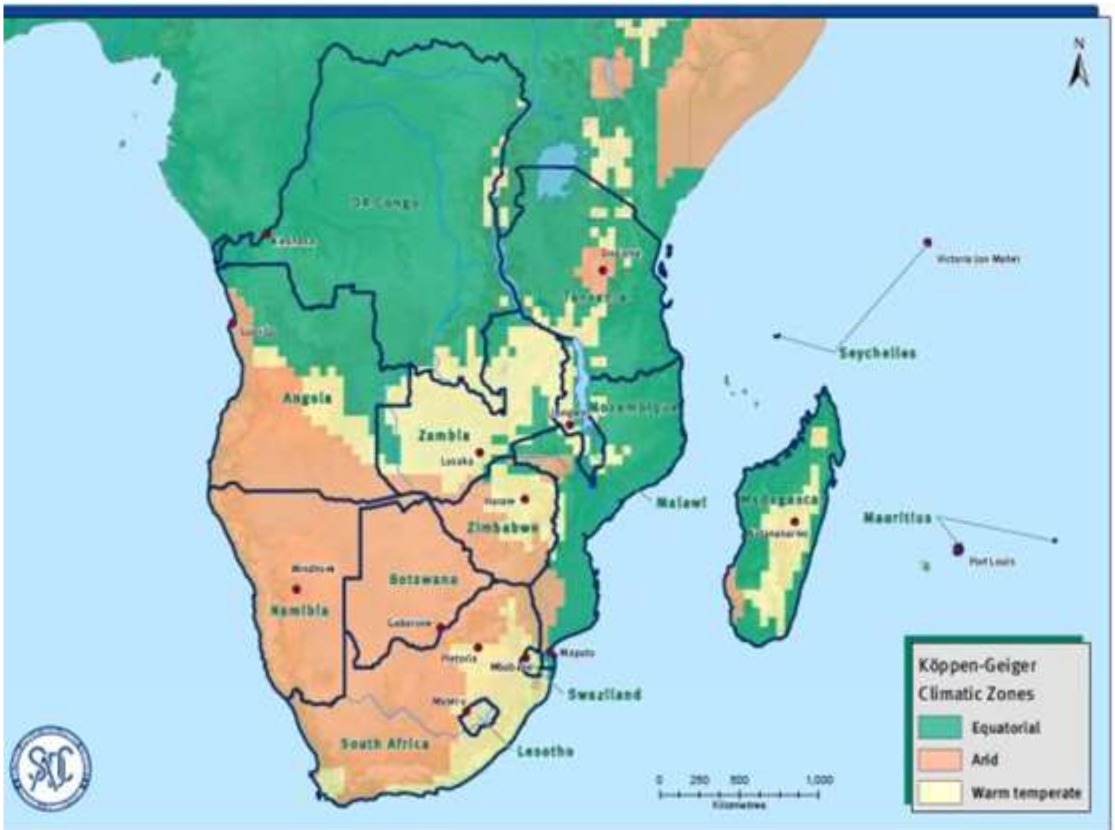


Figure 2.1: Köppen-Geiger climate classification for SADC

Source: International Research Institute for Climate and Society (IRI), (2017:1).

The Koppen- Geiger climate classification (Figure 2.1) is based on the long-term, monthly, seasonal, and annual means of rainfall and temperature. The classification is widely used in the studies of climate change and climatology (Engelbrecht et al., 2016). In this study, it has been used to highlight the various climatic zones in Southern Africa.

Southern Africa is at the frontline of the minimum temperatures rising faster than the maximum temperatures resulting in a notable decrease in the cold extremes and an increase in warm extremes. For example, the temperatures in the region have risen by 0.5°C over the past 100 years and are further expected to increase at a rate of 0.05°C per decade (Zimbabwe Climate Change Response Strategy, 2016).

In addition, Botswana's temperatures are rising at a rate of about 3°C per century and have the highest rate of temperature increase in the entire southern hemisphere of Africa (News Agency, 2019). Jury (2013:9) affirms that a warming climate will put additional stress on water resources. This will then have serious implications for farming as both livestock and crops are reactive to changes in temperatures and precipitation. Therefore, the indigenous water management adaptation measures that have been put in place at the local level in the arid and semi-arid regions of Southern Africa can reduce the strain on water sources.

The Office for the Coordination of Humanitarian Affairs (OCHA) (2019) states that most parts of the region in Southern Africa have been experiencing their lowest rainfall since 1981. This concurs with Morishima and Akasaka (2010) who analysed the rainfall data for the 1979-2007 period for Southern Africa and came up with the conclusion that indeed, the annual rainfall has decreased over the African continent from the equator to 20 degrees south resulting in shorter and weaker rainfall seasons in Southern Africa. This was then confirmed by the IPCC (2007) which documents that climate change will result in a decrease in rainfall. As an illustration, in 2019 Namibia received its lowest rainfall recorded in 35 years resulting in the drying of water points leaving 40% of its population household water and food insecure (FAO, 2019). This has, therefore, prompted several researchers to conclude that climate change will affect water quantity and quality. The adaptation to climate change is inevitable and there must be measures to document the local indigenous water management strategies for the people living in the arid and semi-arid region of Southern Africa as a useful resource for ensuring sustainable development in water management.

The SADC member states have cooperated in monitoring the climate and weather changes to foster the security of the region and strengthen regional integration. The region has committed itself to various international conventions and programs on climate change. For example, the Ramsar Convention on wetlands, targets the preservation of wetlands and provides solutions to the adaptation and mitigation of climate change (Fennessy & Lei 2018:10). In addition, the SADC Climate Service Centre and SADC Climate Change Strategy and Action also aim to address and respond to the impacts of climate change in line with global and continental objectives. Although the region is doing its best to come up with solutions to mitigate and adapt to the effects of climate change, the use of the top-bottom approaches raises critical questions about the future success of climate change mitigation and adaptation strategies (Leal-Arcas & Rafael 2011). Thus, consulting the most vulnerable people about the effect of climate change and on matters that affect them is important in coming up with sustainable adaptation and mitigation measures.

2.7 Climate change in Zimbabwe

Zimbabwe is situated in central Southern Africa. It is a semi-arid country with erratic and unreliable rainfall patterns as well as temperature variations (Ungani, 2009). The country has 39.6 million hectares of land area, and most of the country's agriculture (80%) is rain-fed which contributes to 67% of the total employment (World Bank, 2019). This makes the sector highly sensitive to climate change effects, thereby posing a serious threat to food, water, livestock production, and humans. However, the agricultural sector in Zimbabwe is dominated by women who are the mainstay of farm and peasant labour and whose access to land is impaired by the patriarchal societal system (Moyo, 2019). This makes women vulnerable to the devastating effects of climate change. Hence, a study that focuses on women's vulnerability to climate change is relevant given the percentages of women whose lives depend on rain-fed agriculture.

Zimbabwe is experiencing more hot days and fewer cold days than in the past (Brazier, 2017). For example, Brazier, (2015) reported that the country has recorded an increase in the average annual surface temperature by 0.4°C since 1900. The temperature increase has been more pronounced during the dry season. This has been evidenced by Unganai (1996:144) who in his study of historic and future climate change in Zimbabwe has concluded that the daytime temperatures in Zimbabwe have risen by up to 0.8 degrees Celsius from 1933 to 1993, which translates to a rise of 0.1 degrees Celsius per decade. The Zimbabwe Meteorological Service has also highlighted that the daily minimum temperatures have risen by approximately 2.6°C over the last century, while the daily maximum temperatures have risen by 2°C during the same period (Zimbabwe Meteorological Services (2014) in Phiri, Ndlovu, Mpofu & Moyo, 2021). Thus, an increase in temperatures and the unpredictable rainfall pose a major threat to the economy, the water sources, and the vulnerable populations (Brown et al., 2012: II).

Also, Unganai (2009:41) highlights that the rainfall in Zimbabwe is characterised by decreases in low-intensity rainfall events and increases in the frequency and intensity of the mid-season dry spells. This is evidenced by Zimbabwe's National Climate Change Response Strategies (2015:16), which state that the average annual rainfall in Zimbabwe is 650mm and the total amount of rainfall received during a rainy season has decreased by about 5% since 1900. Thus, there are more dry days that have been recorded during the rainy season. However, to cope with such climatic conditions, most people living in the arid and the semi-arid areas in rural Zimbabwe have continued to cultivate on the wetlands and the stream banks because of weak conservation control, and these practices create further environmental problems such as the siltation of the waterways (UNDP, 2017:04).

In response to climate change, the government of Zimbabwe has managed to domesticate some of the international climate change obligations. For example, the Zimbabwean government has managed to introduce climate change policies that are designed to make the country more resistant to climate pressures and they help to meet its international carbon-cutting pledges (Mukeredzi, 2018; World Bank, 2019). However, lack of inclusivity and use of the bottom-up approach to create climate change obligations has resulted in the continued suffering of communities in the Mudzi district from the devastating effects of climate change.

2.8 An overview of Zimbabwe's water policy

While this study does not attempt to provide a detailed historical background of the water resources in Zimbabwe, it contends that it is important to give a brief historical overview of the water reforms in Zimbabwe.

The New Water Act of 1988 which made the reforms that created Zinwa and its acts. The disproportionate access to water resources in Zimbabwe dates to the colonial period. Colonial rule was characterised by a racially skewed system in which Africans had an inequitable access to water and land (Mtisi, 2011:04). During the same period, the rural water infrastructure was neglected, which resulted in the imbalance between the urban and the rural water services (Water and Sanitation Programme [WSP], 2015:8). Despite gaining independence in 1980, post-colonial Zimbabwe continued to use the 1976 Water Act, which was intended to protect the interests of commercial farmers, who constituted 1% of the entire population of about 13 million (Manzungu, 2002). The legislation was later replaced by the Zimbabwean Water Authority (ZINWA) Act, which was enacted in 1998 to reform the water sector and redress the inequities in the access to water (Manzungu & Kujinga, 2002).

The Zimbabwe National Water Policy came into effect in 2013 and it aimed to improve the security and the availability of water in all the various users. The national water policy was publicly launched in 2013 on World Water Day, commemorated every 22nd March in the Victoria Falls (Mabiza, 2013:148). The policy sought to reverse the collapse of water revenues in the country, which had started in the 1990s. However, the policy was driven by economic rationale rather than the social one. Theoretically, the adoption of the policy should have resulted in the development of water resources to guarantee equity in the access to water and foster economic growth (Government of Zimbabwe Water Policy, 2012: ii). Nonetheless, the water revenue continues to collapse to date, partly because of the failure to maintain the dilapidated infrastructure and the economic meltdown that has been happening in the country for the past two decades (Mabiza, 2013:148). To add to the reasons for the collapse of water revenues, the Water and Sanitation Programme (2015:15) observes that the policy lacks the voice of the consumers, which is vital in providing checks and the balances to upgrade the management of services. Nonetheless, a combination of social, economic, political, and environmental reasons has been attributed to the collapse of water resources in Zimbabwe (Human Right Watch, 2021).

Against the background of the struggling water revenue in Zimbabwe, climate change emerged with its devastating effects on water sources. Particularly vulnerable is the rural population, which has inequitable access to water and inefficient water infrastructures (National climate policy, 2017:22; Mabiza, 2013; Mtisi, 2011). The United Nations- Water (2020) believes that water should be a solution to poverty and hunger, not a problem. Thus, the Zimbabwean Water Policy has motivated the research on climate resilience in the water sector (Zimbabwe Climate Policy, 2017:5).

2.9 Water as a resource

Water is essential for human survival on earth and the access to water is a fundamental human right. In this respect, Malinga et al. (2017:180) stress that water is undoubtedly the most critical resource that contributes to the socio-economic development of rural communities. However, most people are failing to get an adequate water supply, which is crucial for their agricultural activities (De Wit, 2006:1917; UN, 2019). If the risk that is associated with water scarcity is not urgently addressed, the results can be catastrophic. Fortunately, the water crisis is neither inevitable nor unsolvable (Sivertsen, 2017). Considering that the government of Zimbabwe has failed to service and maintain water infrastructure for more than two decades, the local communities need to take action to achieve sustainable livelihoods. It is, therefore, essential that the people living in the arid and the semi-arid rural areas adapt to the local water management strategies so that they may become sustainable, safe, and resilient to climate-related risk. However, these adaptation strategies have not been fully explored in either the literature or in Zimbabwe's water policy.

The lives of many people living in the arid and semi-arid rural communities are centred on the availability of water for both economic and social gains (Malinga et al., 2017:180). Water is undoubtedly a precondition for life, and it is crucial for sustainable development (UN-Water, 2019:7). For example, water sources such as ponds, seepages, and unprotected shallow wells are an important input for crop and livestock production (FAO, 2008:2). These water sources also play a pivotal role in the rural community's livelihood and well-being.

People living in Zimbabwe rely on multiple water sources due to the lack of a stable water supply. In the case of Zimbabwe, the rural communities have been faced with an inadequate water supply over the past years and currently, the United Nations rates Zimbabwe as water-stressed (Davies & Hirji, 2014; Malinga et al., 2017:181). This is attributed to the rapidly growing demand due to demographic growth, inadequate public investments in water infrastructure, socio-economic development, and the droughts created by global warming (Besada & Werner (2015:129). Regarding the population growth that is causing water scarcity, Davis, and Hirji (2014:33) argued that population growth, erratic rainfall, an increased temperature all contributes to water stress.

Davis and Hirji (2014: ix) observe that water is crucial to the Zimbabwean economy, as well as to the people's livelihoods, and their social well-being, yet its availability and reliability is a function of highly variable climatic conditions, political and economic factors. For example, 61.4 % of the population in Zimbabwe lives in rural areas and the majority of that population depends on rain-fed agriculture, which depends on reliable rainfall. The scarcity of water due to the change in climate results in food insecurity and a decrease in agricultural production (Zim stat, 2022; European Environmental Agency, 2018; FAO, 2019; World Bank, 2019). Given the reliance of many rural Zimbabweans on water, the lack of it implies severe effects on rural communities.

2.10 Impact of climate change on water sources

The change in climate is inextricably linked to water scarcity (De Wit, 2006:1917; European Environmental Agency, 2018; UN-Water, 2019:20). Similarly, Calow, Bonsor, Jones and O'Meally (2011: iv) also emphasise that water is the immediate primary medium through which climate change is felt by people, animals, and economies. However, the data from existing literature on the effects of climate change on different water users is inadequate (Calow et al., 2011:10). The provision of this data is key to building resilience to climate change.

Most studies that focus on the impact of water scarcity and on the users turned out to be based in urban areas (Chaminuka & Nyatsanza, 2013; et al., 2014; Pahwaringwira, Chaminuka & Muranda-Kaseke. 2015; Gambe, 2015). It is vital to know how the people living in rural arid and semi-arid areas are coping with water scarcity. It is, therefore, necessary to document the adaptation strategies of the local rural communities and to investigate the opportunities for scaling up the best adaptation practices by the communities (The World Bank, 2015).

Water scarcity is classified into two main types namely, the economic type and the physical type (Hanasaki, Yoshikawa, Pokhrel & Kanae, 2018). The economic type refers to the inability to use water resources despite their availability due to economic crises and inadequate infrastructure development. The latter refers to insufficient water to meet all the demands (Rijsberman, 2006). However, water crisis in Southern Africa is a combination of economic and physical water scarcity. The failure to deal with water scarcity results in the conflict over natural resources (Oki & Quiocho, 2020:416; Besada & Werner, 2015:121).

Bates et al. (2008), Assaf et al. (2012), as well as Kusangaya, Warburton, Van Garderen and Jewitt (2014) all deal with the relationship between climate change and water scarcity, and though they are from different regions and have used different methods in their approach, they all come to the same conclusion, that is, the change in climate is inextricably linked to water scarcity. While Assaf et al. (2012) and Kusangaya et al. (2014)'s studies are region-based focusing on Arab nations and Southern Africa respectively, Bates et al. (2008) make use of an interdisciplinary writing team that is led by three IPCC working groups to achieve a regional and tropical balance. Although most studies on climate change impacts have been primarily undertaken at macro and regional scales, this study focuses on a local district scale.

The observational records and the climate projections provide evidence that proves that climate change is causing water scarcity (Bates et al., 2008). For example, Lake Chad, was once one of Africa's largest freshwater lakes covering 45,000 square kilometres in 1960, but by 1988 it had shrunk to 10,000 square kilometres due to hot temperatures because of the change in climate and human activities (Ngoren et al., 2015:188; Oelkers, Hering & Zhu, 2011). Lake Victoria is experiencing a similar trend as that of Lake Chad (Urama & Ozor, 2010). Similarly, the Nyamuwanga Dam in the Mudzi Rural District was reported to be dry in 2016, thereby resulting in socio-economic challenges for the people in the district (The Herald, 2016). Also, Kariba's water level has been decreasing as a result of droughts and low inflows from the Zambezi River and its tributaries (RFI, 2022). However, these conditions are predicted to worsen in the 2030/2050 period because of a decrease of about 10% in rainfall in sub-Saharan Africa, thereby causing a decrease in water quantity and quality (De Wit & Stankiewicz, 2006:1918; IPCC, 2019; Misra, 2014:154; Zhu & Ringler, 2010:15).

To support the above claim, a study by Zhu and Ringler (2010:15) found that the changes in precipitation and in the temperature impact the availability of water and the impacts are most pronounced in the arid and in the semi-arid areas. This causes a decrease in drainage density, which eventually results in a reduced runoff, as well as in groundwater recharge, and river flow (De Wit & Stankiewicz, 2006:1917). For example, in the Zambezi Basin in Mozambique, Cambula (1999) (as cited in Kusangaya et al., 2014) observed a decline in the surface and subsurface runoff of approximately 40% or more under climate change. In a similar vein, the Zimbabwean Water Forum in 2014 found that there is a proportionately greater decline in runoff due to climate change than in precipitation all over Zimbabwe. However, they also argue that while the mean annual runoff is dependent on rainfall, the other factors such as land clearance, siltation, infiltration, and recharge rates can also affect runoff. Therefore, it can be concluded that the reduction of runoff and groundwater recharge under climate change coupled with an increase in population growth results in water scarcity.

The scarcity of water in the arid and in the semi-arid rural sub-Saharan Africa has negatively impacted the groundwater quality (Misra, 2014:154; Brazier, 2017). Murwira et al. (2014) and Brazier (2015) conclude that the water quality is already poor in some parts of Zimbabwe such as Mudzi district. Davis and Hirji (2014:x) advance this view by stating that the poor water quality in rural Zimbabwe is a result of the pollutants from artisanal mining, industrial discharges, and agricultural activities (concentrations of nitrates, fluorides, chlorides, and total dissolved solids (TDS). These effects may be mitigated by greater dilution, which varies according to the flow and the season (Macdonald, Calow, Macdonald, Darling, Gorge & Dochartaigh, 2009:698). However, if left uncontrolled, the water pollutants remove the water from safe consumption as surely as water scarcity does.

In addition, the poor water quality has a ripple effect on its users. For example, Odiyo and Makungo (2012) studied the water quality problems and water management in the rural areas of the Limpopo Province, of South Africa, and found out that the poor water quality has a detrimental effect on public health, and it increases the risk of epidemics since the rural communities are rarely given water treatments. This view is supported by Murwira et al. (2014:2) who attribute the 2008-2009 cholera outbreak, which claimed over 4,000 lives in Zimbabwe to water pollution.

There is a consensus in the literature that the burden of collecting water in the rural arid and semi-arid areas falls disproportionately on women. Thus, it is important to gain knowledge on how the women are affected by water scarcity because of climate change and to also understand how they are dealing with the situation. It is also vital to document their surviving strategies. Particularly of interest is their water adaptation strategies, which can be made an integral part of the sustainable development process.

2.11 Impact of climate change on women

Climate change does not occur in a vacuum; but rather in a society that has culture, religion, and gender roles. Its effects have exerted pressure on an already complex population with differential access to resources (Thomas et al., 2019:3), and this influences the extent of vulnerability across the population. This makes climate change a threat multiplier, through exacerbating the already existing problems in the communities, such as the gender gap, the water stress, inequality, and poverty (Spepard, 2019). Although climate change affects both women and men, the women are mostly affected, and this is always compared to their vulnerability (Dimitrov, 2019:214). This is mainly because the women are less able to protect themselves from the effects of climate change and they find it hard to recover (Amnesty International, 2019). In addition, it is important to note that institutions and policies are vital to the upkeep or vulnerability of women in Zimbabwe. If a country has a strong institution, the vulnerability of women to the vagaries of climate change becomes minimal.

The Ugandan and the Zimbabwean water policies acknowledge that the scarcity of water due to climate change has a stronger negative impact on women than on men and this is aggravated by the existing gender inequalities, including the restricted access to land (Ministry of Water and Environment, 2013). The women and girls in many African communities bear the primary burden of finding, collecting, and storing water (Rao et al., 2019). As climate change accelerates water scarcity, the women must walk long distances in search of water. Kakota, Nyariki, Mkwambisi, and Kogi-Makau (2011) conducted a household survey in Central and Southern Malawi districts on the causes of gender vulnerability to climate variability as well as household food insecurity and they found that water scarcity is associated with an increase in women's physical strain and the risk of gender-based violence as the women are forced to travel long distances in search of household needs.

The water shortages force people to abandon productive income-generating activities in search of water (UN-Water, 2019:51). Whilst some members of the rural population might be forced to migrate in search of water sources and greener pastures, the others will be left with no choice but to resort to drinking the contaminated water from the ponds and the streams (Oxfam, 2006). Drinking unsafe water further increases the burden of water-related diseases such as cholera and schistosomiasis (Mach, 2017).

The FAO (2008:2) notes that the households facing water shortages due to climate change or variability are more likely to be poorer than the households that are not facing such shortages. Molden, (2007:10) also adds that many of the malnourished hotspots are found in areas where water scarcity limits crop growth. This clearly shows that water scarcity is the largest contributor to food insecurity (Du Toit, 2011). The negligence of this will undermine the gains that are taken towards eradicating extreme hunger and poverty in Africa (Besada & Werner, 2015).

Hanne and Christian (2016) in their study found that the poor rains that are arguably caused by climate change had a negative impact on the fish farming that is done by women in Lake Chilwa Basin (Jorstad & Webersik, 2016: 983). A reduction in the rainfall resulted in a poor harvest as well as the collapse of the fisheries sector, and it also reduced income (Jorstad & Weberstik, 2016:983). Jorstad and Weberstik's (2016) findings are like Phiri, Ndlovu and Chiname (2014) findings that the climate change's effects threaten the women's livelihood, which is rain-fed, thereby resulting in increased impoverishment and food insecurity problems. Nonetheless, their findings do not specify which group of women is most impacted. In addition, Mpofu (2014) assessed the vulnerability of rural communities to climate change in the Lupane District of Zimbabwe. His findings mainly focused on the impact of climate change on agriculture. Mpofu (2014:009) found that climate change decreases the crop yield and the number of livestock, which eventually leads to food insecurity in the district. Mpofu's (2014) findings are similar to those of Phiri et al.'s (2014) results except that Mpofu's (2014) findings focused on the general population whereas Phiri et al.'s (2014) results focused on women, whose vulnerability was treated homogeneously.

The World Health Organisation (2014:04), states that the studies that were done in India have shown that during the periods of long-term weather shifts, the men in the rural communities opt to migrate while the elderly, the women, and the children are left behind. The women who are left behind have to walk long distances to find increasingly scarce water and they take up several jobs to provide for the family (Dimitrov, 2019:212; UNDP, 2017; Nelson, 2011:13). Alam et al. (2015) state that during the 2011 drought, most men in rural Kenya migrated from the rural areas in search of greener pastures and water, whereas the women were left behind and were now in charge of the households with limited resources. These women were not allowed to sell nor slaughter the livestock without their husbands' permission and they had to wait for their return. The women had to find quick solutions to feed themselves and their families. This then gave rise to the increase in trade and prostitution, which increased the cases of human immunodeficiency virus (HIV)/ acquired immunodeficiency syndrome (AIDS) (Abuya, 2015:79).

Serdeczny et al. (2017) argue that while migration can be seen as an adaptive measure to local environmental pressure, it can increase other new risks for the population that is already at the site of relocation. This can also cause the relocated area to be densely populated, thereby making it easy for diseases to spread and the environment can be degraded. A recent study by Mudefi et al. (2019:20574) revealed that if women are to migrate due to the negative effects of climate change in Zimbabwe, it is usually the young and single women from large families who do so. Responding to this, Dimitrov (2019:212) argues that these women will be faced with unhealthy situations such as poor sanitation and unclean drinking water when they migrate to urban areas. Similarly, Hanne and Christian (2016:985) argue that migration may be problematic as it puts extra constraints on the natural resources in the area where the people migrate to, and conflicts may arise between the locals and the migrants.

2.12 Climate change and health

Human health is inextricably linked to the weather. Any increase in temperature is likely to affect directly or indirectly some of the most fundamental determinants of health, such as air, water, and food, which will increase human health problems (IPCC, 2016; Brazier, 2017; WHO, 2014; McMichael et al., 2004). In Africa, the magnitude of climate change's health effects differs significantly according to communities and regions. The variations are a result of the geographical and micro-climate differences, the socioeconomic conditions, the quality of existing health infrastructure, the communication capacity, and underlying epidemiology (United Nations Economic Commission for Africa (UNECA), 2011).

The health concerns are heavily concentrated in the poor communities that have little adaptive capacity (WHO, 2014:06; Anstey, 2013:1). However, UNICEF (2014:40) advises that health concerns vary by gender. For example, some European studies have shown that during the 2003 European heat wave, most women were more at risk of dying than men (WHO, 2014:3). Similar studies across the globe have produced related results. Extreme heat because of climate change has been said to cause heat stress, heat exhaustion, fainting, heatstroke, heat cramps, and even the disruption of agricultural activities (Serdeczny et al., 2017). On the contrary, Pradyumna et al.'s (2018:23) study of the semi-arid region in India found that women were less vulnerable to the impacts of heat compared to men, based on their daily activities and roofing materials. Although this view is opposed to that of the WHO (2014), IPCC (2016), and Serdeczny et al. (2017), all the authors seem to agree that those from the poorer sections and from the lower castes are disproportionately impacted.

The WHO (2014) also states that the women's and the men's vulnerability to the impact of climate change is determined not only by the biological factors but also by the differences in the roles and in the responsibilities. For instance, most rural-based women in arid and semi-arid regions have the responsibility of fetching water. With the rising temperatures exacerbating the existing water shortages and food insecurity, the women are forced to travel long distances for long hours in search of water. This makes them victims of health disorders such as depression, malnutrition, anxiety, mental disorders, waterborne diseases (Dimitrov, 2019:212), and certainly fatigue. Alternatively, when water is scarce, the women do not have many options but to carry home contaminated water from unsafe sources (Serdeczny et al., 2017; Awojobi, 2017:43; WHO, 2014).

Brazier (2015:63) states that the use of contaminated water because of unreliable water supply is associated with diseases such as cholera, typhoid, and diarrhoea which exist as health problems in Zimbabwe. Cholera is a common disease in several Southern African countries. In the past 15 years, cholera outbreaks have been recorded many times in Zimbabwe. For example, from 4 September 2018 to 12 March 2019, a total of 10,730 cholera cases and 69 (0.64%) deaths were reported nationwide (Winstead et al., 2020). The outbreaks of cholera in Zimbabwe due to climate change and poor sanitation cause social distress, death, and illness. Despite climate change contributing to the cholera outbreaks, the insufficient health systems, the poor investment in the health sector, and the lack of resources, worsen the impact of the disease in Zimbabwe (Dube, 2019).

The increase in temperature also extends the habitats of the vectors of diseases such as malaria, which affects human health. The mosquitoes that carry many of these diseases tend to thrive in warmer, wetter climates (Ebi et al., 2005:3). In sub-Saharan Africa, malaria remains the most common parasitic disease and it is the main cause of mortality and morbidity among infants and pregnant women (Madziyire, 2016:16; Freeman, 1995; Blair Research Institute, 1996). For instance, the emergence of malaria in the highlands of East Africa is widely cited as an example of a vector-borne disease spreading to new geographical areas because of climate change (Wanding, Opondo & Olago et al., 2008; Sewankambo, 2009:16).

In Zimbabwe, Mashonaland East is considered as having a relatively high burden of malaria, accounting for 37% of the malaria cases (USAID, 2016). In their study, Ebi et al. (2005) found out that the changes in temperature and in the rainfall, patterns are likely to change the geographic distribution of malaria in Zimbabwe, with previously unsuitable areas of a dense human population becoming suitable for transmission. Madziyire et al. (2016:16) clearly indicate that the women in epidemic areas have a lower premonition to malaria, which results in severe infections and a higher mortality. In addition, the prevalence of parasitemia is greater in pregnant women than in their non-pregnant counterparts. This makes pregnant women three times more likely to get severe malaria, which may result in stillbirths, miscarriages, low birth weight, and preterm labours (Madziyire et al., 2016:17).

Despite the momentum that the Southern Africa region has gained regarding climate change, the women's impact on climate change remains overlooked in climate change policies (Babaguru 2010:02). Babuguru (2010:01) highlights that excluding the studies such as Banda's (2005) study in the Limpopo Province of South Africa and Sterrett's (2007) study in the Northern part of KwaZulu-Natal in South Africa, not much gender-based research has been done in South Africa to understand how climate change impacts men and women differently in the region. The gender differentiated impacts of climate change need to be acknowledged. According to Annecke (2010:1), the studies that look at men and women separately are required to be able to develop sound policies. Thus, the study ensures that the decision-makers and the key stakeholders alike understand the diverse types of vulnerability to climate change that the women face. The analysis of the vulnerability of women to climate change is done to promote the effective measures that protect the rural communities from the differential impact of climate change.

2.13 Conclusion

The effects of climate change are visible at global, regional, and local levels. The women are singled out to be the most vulnerable group to the impact of climate change. The women's reliance on climate-sensitive agriculture combined with their roles and responsibilities makes them susceptible to climate change. Accordingly, the policymakers and the development practitioners need to collaborate with the researchers to make informed climate change mitigation and adaptation strategies. However, not only does climate change affect the poor rural populations, but it also affects the available water sources. This makes it difficult for the women who have the role to fetch and store water. The lack of water has not only impacted the livelihoods of the rural communities, but it has worsened the vulnerability of women. Nevertheless, it is also important to understand how the communities are coping with water scarcity. This knowledge will assist in improving the climate change adaptation strategies for the people living in the arid and the semi-arid rural regions of Zimbabwe.

Although the literature has identified women to be the most vulnerable group to the effects of climate change, there exists a gap on how these women are being impacted by climate change at the local level. Thus, the next chapter will look at the vulnerability approach. The vulnerability approach helps the researcher to analyse the condition of women living in the Mudzi. The research answers will enable the policymakers and the development practitioners to find the best ways for climate change mitigations and adaptations to reduce the vulnerability of women.

CHAPTER 3: THE VULNERABILITY APPROACH

3.1 Introduction

It has been suggested in the literature that women are the most vulnerable population to the effects of climate change, however, few studies have explicitly examined the women's experience of climate change in rural Zimbabwe. In response to this gap, this research uses a vulnerability approach to examine the vulnerability of women to the effects of climate change and the water management strategies that are being used to combat the effects of climate change. The chapter examines the root causes of the differential vulnerability of women to the effects of climate change. Although everyone is impacted by climate change, the impacts are not uniform across rural communities. However, the chapter begins by exploring the concept of vulnerability followed by a discussion on the components of the vulnerability approach. The chapter helps one to have an in-depth understanding of the reasons that make women the most vulnerable group to the effects of climate change.

3.2 Concept of vulnerability

Vulnerability is derived from the Latin verb *vulnerare*, meaning "to wound" (Ford, Pearce, McDowell, Berrang-Ford, Sayles & Belfer, 2018; Smit & Wandel, 2006). The concept of vulnerability was first developed in hazard and disaster studies to describe how various groups of people in the society are differently affected by disasters or natural hazards (Adger, 2006; Smit & Wandel, 2006). Although vulnerability is defined in literature in various ways, the predominant view of vulnerability concentrates on the social, political, and economic dimensions of disasters that make people susceptible (Mcentire Colleen & Ekong. 2010). Moreover, Adger (2006) links the broad range of vulnerability definitions in the literature to the disciplines of their origin. However, this study has extensively used the term to mean the inability of women in Zimbabwe to cope with the changing climate.

The IPCC Third Assessment Report (McCarthy et al., 2001:21) defines vulnerability as "the degree to which a system is susceptible to, or unable to cope with adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity." This definition highlights three components of vulnerability in the environmental change context, which are: exposure, sensitivity, and adaptivity which is graphically depicted in Figure 3.1**.** Adger (2006:268) also defined vulnerability as, “the state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of the capacity to adapt”. Even though the IPCC (2007), Adger (2006), and other scholars in literature differ in their definition of vulnerability, they all agree that being unable to adapt to environmental changes makes one vulnerable. The definitions of vulnerability imply that vulnerability is the degree of exposure of a community to the effects of environmental change and its adaptive capacity to deal with that exposure. Thus, the women’s vulnerability to climate change can, for instance, be described in terms of exposure to increasing temperatures and the changes in rainfall, the sensitivity of women to environmental change, and the ability of women to adapt to the effects of this exposure and sensitivity.

Although the IPCC (2007) definition of vulnerability lacks precision in its relation to the concepts of exposure, sensitivity, and adaptive capacity, the concept of vulnerability has been a powerful analytical tool for describing the states of susceptibility to harm (Adger, 2006:268). Although it is difficult to assess all the known points of risk, identifying how and why human systems are affected by environmental change provides the government with the necessary knowledge to react to the threat. Consequently, this study assumed that the people with low adaptive capacity are sensitive to climate change effects. The next section will discuss the reasons why some people are more vulnerable than others.

3.3 The differential vulnerability to climate change

Many studies have confirmed states of differential vulnerability to climate change (Thomas et al., 2019; Gentle et al., 2014; Coirolo & Rahman, 2014). For instance, Thomas et al.’s (2019) review study highlights that while nobody can escape the impacts of climate change, some social groups experience greater impact than others. This view is similar to that of Gentle et al. (2014) who point out that climate change impacts different communities within a country in a number of ways that are not always uniform. Whilst the researchers agree on the differential vulnerability to climate change, their opinions on the causation of the differential vulnerability differ. For example, Thomas et al. (2019) attributes the differential vulnerability to climate change and to the role of culture in shaping vulnerability, the unequal access to resources, the unequal access to knowledge and information on climate risks, and the processes of governance, while Gentle et al. (2014:826) attribute it to the well-being status, the geographical location, gender, and the occupation of the communities.

The above causation of the differential impact of climate change points to societal inequality as a root cause. This view is supported by Coirolo and Rahman (2014) who posit that power and inequality in access and control over resources such as land are the drivers of differentiated vulnerability. However, these studies are limited to the contribution of age and disabled individuals attributing to the differential impact of the effects of climate change and they do not explicitly address adaptation. Despite the differing opinions on the drivers of vulnerabilities, any efforts to reduce unequal vulnerability require an understanding of why it exists in the first place (Adger 2006:2). Also, the diverse perspectives on the causes of vulnerability in communities raise questions about the future of vulnerability. Hence, the micro-level analysis of vulnerability may help in understanding the complexities and in designing adaptation at the local level (Gentle et al., 2014: 833). Thus, this study focuses on the Mudzi Rural District.

Mango et al. (2014:4) state that the Mudzi District is in a region with many incidences of drought and frequent long mid-season and in-season dry spells. As a result, the district has the highest levels of food insecurity in the country (Gustafson, 2016). However, food insecurity amongst the households is influenced by the age and the educational level of the head of the household, the size of the household, and its access to information and wealth. For example, in their study, Mango et al. (2014) found that the households with literate heads are less likely to be food insecure or anxious about food security compared to their counterparts. In Mudzi District, most of the households (52.4%) are female headed (Zimbabwe National Statistics Agency, 2013). However, these women have low educational attainment because of the cultural and socio-economic factors (Chigavazira & Zandamela, 2021). This study finds that n=101 (52.9%) of the total respondents, and n=28 (27.78%) has never been to school. However, although some of these women are not household heads, being less educated makes them prone to climate change vulnerability due to poor adaptation capacity. The less educated women might not find employment easily compared to the educated women. This then makes them prone to food insecurity due to a lack of income.

Furthermore, Kookana et al. (2016) posit that the groundwater scarcity in Rajasthan, Northern India contributed to the female students missing school or dropping out of school. This is because the women are responsible for fetching water and must spend hours walking long distances in search of water. Although the study was conducted in India, it mirrors what is currently happening in the semi-arid regions of rural Zimbabwe. However, it should be noted that poor education limits one's livelihood adaptation strategies. Thus, there is a need to address gender inequality in all the sectors of the communities to attain climate justice. However, it should be noted that the social construct also plays a key role in determining the susceptibility of individuals in communities. This is going to be explored in the subsequent section.

3.4 Social vulnerability

Social vulnerability provides the lens through which to view the differential impact of climate change in communities. Cutter and Finch (2008:2301) define social vulnerability as a measure of both the sensitivity of a population to natural hazards and its ability to respond to and recover from the impacts of the hazards. Social vulnerability can also be defined as the susceptibility of communities to the impact of a hazard and the ability of the communities to recover from it. Moreover, social vulnerability stems from the social, the economic, and the cultural factors that impinge on an individual's or the society's ability to cope with disasters (Mavhura, Manyena & Andrew, 2017). In other words, social vulnerability reflects the inequalities within the communities in the presence of environmental change.

The socially constructed roles in indigenous communities result in different vulnerabilities among men and women. The studies by Chidhakwa et al. (2020), Mpampela and Mabvurira (2017) as well as Denton (2002) concur that the vulnerability of women emerged because of the increased roles and responsibilities. Bunce et al. (2016) further argues that the contemporary gender role of women in developing countries typically involves agricultural responsibilities, while men and the youth in the community migrate to the cities in search of work, thereby resulting in women in these communities being directly affected by the changes in the agricultural systems. Although most researchers agree that the vulnerability of women stems from their roles, information how various social groups of women are being impacted differently by climate change is important in improving their resilience to climate change effects. Thus, this study fills this gap by providing ample evidence that some groups of the women in society are more prone than others to the effects of climate change. The study further provides that age, the level of education, the marital status, ability/disability, and the social status differentiate the vulnerability of women to climate change.

Recognising the nature of the vulnerability of the various groups of women can assist in designing the solutions and reducing the consequences.

Apart from the societal roles which make them vulnerable to the effects of climate change, rural-based women represent the majority of the world's poor. While the impact of climate change affects everyone, the people who are already burdened by poverty from the low-income households often suffer the hardest consequences, while having the least ability to cope. Hence, climate change and poverty are inextricably linked. In addition, among the women groups, the older people and the disabled are vulnerable because of their body strength being compromised. In Mudzi Rural District, it was observed that older women are usually left behind by their spouses to look after their grandchildren. This role comes with a lot of responsibilities including walking long distances in search of water and finding alternative sources of income in times of poor harvest. This also implies to the disabled population who have limited movement which inhibits them from adapting to the effects of climate change. However, Chang et al., (2015) argued that the social vulnerability indicators that are used in the literature are selected subjectively by the authors who base their choice on the reviews of related literature. In contrast, this study used the content-specific vulnerability variables that were given by the respondents that address the reality of the situation at hand.

The impact of climate change on biophysical properties (land, soil, and water) causes the social vulnerabilities that are discussed above. This study has shown that the climate change effects in the Mudzi District undermined the households' social position by causing the families to break down and split. This research has found out that it is usually men and the youth who opt to migrate to major cities such as Harare in search of employment. The rural outmigration of men and the young generation to neighbouring cities in search of employment presents a grave threat to the women who are left behind to fill the roles and the responsibilities gaps that are left by the migrants. While migration can be viewed as an adaptive response to the local environmental pressures, it can bring with it repercussions such as social disintegration among families. However, the women who are left behind may be less likely to respond to and recover from the effects of climate change.

3.5 Vulnerability approach

Recently, a few studies started linking vulnerability to the impact of climate change (Birkmann et al., 2021; IPCC, 2021; Sesana et al., 2019). The vulnerability framework conceptualised by Ford and Smit (2004) was used in this study to characterise the current vulnerability of women to the effects of climate change and to identify the various sustainable water management strategies that are being implemented to combat the effects of climate change. The framework aims to assist in analysing the community's vulnerability and its adaptation to climate change (Ford & Smith 2004:390). The vulnerability approach assesses the vulnerability of the marginalised local communities to the effects of external shocks and stresses (Turner et al., 2003). The vulnerability approach explains who and what is vulnerable to the multiple environmental changes that are underway. The answers to these questions assist in coming up with policy interventions to reduce the women's vulnerability to climate change. However, many of the vulnerability indicators cannot be quantified and the functions of the components can only be qualitatively described (Yohe & Tol, 2002:27).

The literature has shown that the communities' vulnerability to climate change is largely derived from the vulnerability of the physical, financial, and the social capitals, which is evidenced by a lack of alternative financial resources and low adaptive capacity (Zacarias, 2019). Nyahunda and Tirivangasi (2019) as well as Phiri et al. (2014) have carried out their studies on the impacts of climate change in rural Zimbabwe. The researchers all agree that climate change is mainly crippling rural-based women. This is mainly because the rural-based women are dependent on the natural resource base, which makes them prone to the vagaries of climate change (Nyahunda & Tirivangasi 2019). However, the impacts of climate change on women need to be explored. Scholars such as Dankelman (2002) suggest that there is a need to explore the link between climate change and women's vulnerability.

Although Ford and Smit's (2004) vulnerability approach look at both the current and future vulnerability, this research uses the vulnerability framework to look at the current vulnerability of women to climate change. The current vulnerability of women to climate change in this study was assessed by their degree of incapability to cope with the effects of climate change. Documenting the women's current exposure sensitivities aims to support policy intervention which is aimed at reducing vulnerability. In addition, the aim was to improve the academic knowledge of the current adaptive strategies that were developed by Mudzi District communities while situating this knowledge within the larger vulnerability framework. Components of climate change vulnerability

The IPCC's 2007 and 2014 reports categorised vulnerability into three main components. The components are climate exposure, climate sensitivity, and climate adaptation. Each of the components is going to be fully discussed below.

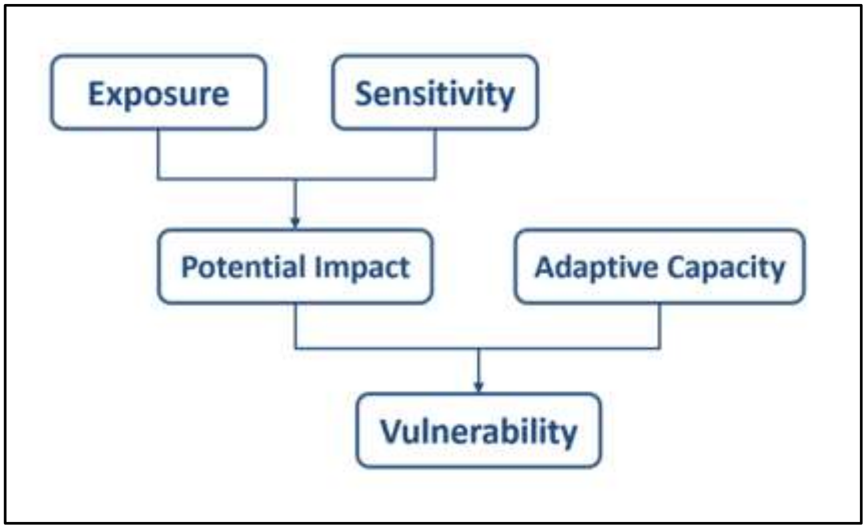


Figure 3.1: Components of climate change vulnerability
Source: Fellmann (2012)

3.5.1 Climate change exposure

The vulnerability approach recognises the inherent susceptibilities of the human-environment systems that are exposed to climate variability and change. Exposure is defined as the contact between a system and the climate (Babu, 2019). Exposure is external to the system. Ford and Smith (2004:393) understand exposure as a property of a community that is relative to climatic conditions. The community's vulnerability depends on its exposure to the risk (Yu et al., 2021). In this study, exposure can be understood as the nature of the climate-related risks that affect the lives of the women. The determinants of vulnerability to the effects of climate change include environmental conditions such as the access and distribution of resources, culture, technology, information, and wealth (Jørstad, & Webersik, 2016; Turner et al., 2003).

The literature has supported evidence that the impacts of climate change are unevenly distributed among and within the nations, the communities, and the individuals due to differential exposures and vulnerabilities (Dimitrov 2019; Tanyanyiwa & Mufunda 2019). The uneven distribution of vulnerability is also a result of inherent differences in the regions to withstand the damage that is inflicted by the changing climate (IPCC 2021). Understanding exposure is a prerequisite to understanding vulnerability (Monterroso & Conde, 2015).

Zimbabwe, like many developing countries, faces climate change in its major socio-economic development sectors. Chanza and Gundu (2020) as well as Brazier, (2017) all use a sector-based analysis to prove that Zimbabwe is already exposed to the climate change effects in its agriculture, water, health, and energy sectors. Brazier (2017), Brown et al. (2012) and Ungani (1996) further provide evidence that climate change has caused the average temperature to rise and the rainfall to be erratic and unpredictable. These effects of environmental change expose the rural communities to climate change vulnerability because of their reliance on climate-sensitive livelihoods. In support of this, Chigavazira and Zandamela (2021:298) reveal that 69.3% of the population in the Mudzi District work in the agricultural sector. Hence, any shift in the climatic conditions is likely to negatively impact the people's source of livelihood and it will deepen their vulnerability.

In Zimbabwe, Chigavazira and Zandamela (2021:295) reveal that between 2000 and 2020, there have been six successive droughts, that is the, 2002/2003, 2004/2005, 2007/2008, 2011/2012, 2015/2016, and the 2018/2019 periods. However, the period between 2015 to 2016 was worsened by the El Nino-induced droughts. The Mudzi District was among the most hit areas in the country (Mhofu, 2016). The El Nino drought led to the death of more than 10 000 livestock in Zimbabwe, which left many families vulnerable (Mpofu, 2019). In addition, considering that the Mudzi District is a semi-arid region, it was observed that the effects of the droughts devastated the crop yields and livestock production, thereby stripping the farmers of critical food sources and the means to generate income. Nonetheless, this study gives the meaning of vulnerability to climate change such that the results presented in this study would be meaningful to those wishing to reduce vulnerability.

3.5.2 Climate change sensitivity

Climate change-related sensitivity is the extent to which a region or a group of people is affected by extreme weather conditions, and it is associated with climatic variations (Babu, 2019; Liu, 2017). The human environment conditions of the system determine its sensitivity to any set of exposures (Turner et al. 2003). Yadav and Lal (2018) indicate that poverty, gender inequality, the lack of access to resources, and the heavy reliance on climate-sensitive agriculture increase one's sensitivity to the effects of climate change. In the same vein, Jayawardhan (2017:116) highlights that the class inequalities can make certain groups more vulnerable to climate change than the others due to the differing levels of protection and resilience. The poor women are more vulnerable to the effects of climate change than the women from wealthy families because they lack access to the resources that are essential to climate change adaptation (Yadav & Lal, 2018). For instance, as revealed by the findings of this study in Chapter 6, the people who have adequate financial resources may, if they so choose, pay someone to go and fetch water for them in times of water scarcity, whereas those who lack financial resources have no option other than to walk several kilometres in search of water. Thus, a lack of resources makes one unable to adapt to the environmental change thereby increasing their vulnerability.

Liu et al. (2017) state that the developing countries are more sensitive to climate change impacts than the developed countries because of their low adaptation capacity. For instance, the semi-arid conditions in the Mudzi District, are exacerbated by the projected higher temperatures and the erratic rainfall that have caused perennial water challenges thereby making it difficult for the local communities to have sustainable yields (Kawadza, 2014). In addition, the extreme climate change affects people differently. Onwutuebe (2019), Masika et al. (2002), as well as Jørstad and Webersik (2016) all agree that the rural-based women are encumbered disproportionately by the impacts of climate change due to the limited access and the control over the resources, which limit their adaptive capacity. While previous research work has shown that the rural-based women are sensitive to climate change, the current exploration of how these women are vulnerable to the effects of climate change has been overlooked in the literature. Thus, this study managed to fill this gap.

In this study, sensitivity captures the factors which differentiate susceptibility to the exposures among the women depending on livelihood conditions and gender roles. This study categorised the sensitivity of women into more and less vulnerable categories based on the women's experiences. For example, this study revealed that the women in the Mudzi District are predominantly responsible for collecting water. As the droughts lengthen, the women have to travel long distances to access water, thereby exposing themselves to the health risks that are related to the hot temperatures and the heat waves. However, the most impacted women are the elderly and the disabled who find it difficult to walk long distances in search of water. Due to their physical ability limitations, these women usually opt to carry small containers of water which makes them go multiple times to fetch water. These conditions have the potential to exacerbate the women's vulnerability.

The knowledge about the groups that are sensitive to climate change provides the policymakers and the development practitioners with a solid understanding of the current vulnerability of the groups of people to the effects of climate change. In addition, knowledge is also essential for the designing and the implementation of the interventions. While this study has made efforts to provide knowledge on how women are being impacted by climate change, the provided knowledge has to be translated into action.

3.5.3 Adaptation

Despite the women's disproportionate vulnerability to the vagary impacts of climate change, they are not merely victims. On the contrary, the women are also agents with important perspectives and indigenous knowledge, which can inform and influence the solutions to address climate change. Locally, the women are responding to the effects of climate change by implementing various adaptation strategies either individually or collectively. For example, Phiri et al. (2014) reported that the women in Tsholotsho, Zimbabwe, have adapted to climate change through various measures such as planting drought-resistant crops, water harvesting contour ploughing, crop rotation, and the reliance on remittances from the migrants. In the same vein, this study has shown that the women in the Mudzi District manage the water scarcity that is caused by the effects of climate change through measures such as water rationing, the drying of vegetables, and the recycling of water. Nonetheless, the repeated exposure to the environment assists the local communities to develop experience in how to manage the effects of climate change resulting in the increase of the adaptive capacity of the communities (Dey et al., 2018:338).

While the local communities in the Mudzi District have managed to develop some strategies to combat the climate change effects, their strategies and experiences need to be the foundation for climate change mitigation interventions. Apparently, the UN (2022) acknowledges that in Africa, the old women represent wisdom pools with their inherited knowledge and expertise that are related to indigenous environmental change mitigation and adaptation. Of particular interest as highlighted by the respondents in the Mudzi Rural District, is that the communities were only allowed to use gourd cups (*mikombe)* when fetching water at the well or spring. The metal and plastic cups were not allowed at the water source as they were said to make the water source dry up. In addition, the fetching of water was done during the day to reduce water pollution. It was observed that at night most people will not be able to see clearly when fetching water due to lack of light. However, it should be noted that the availability of such adequate and broad-based knowledge about climate change adaptation influences the decision-making that enhances adaptive capacity (Nyahunda & Tirivangasi, 2021).

Although the local communities are responding to climate change through a cocktail of adaptation strategies, not every strategy is sustainable. For example, while the farmers in the Mudzi District have revealed that they are shifting from growing short-season maize varieties to drought-resistant crops, Kupika et al. (2019) found that the rural farmers in the Chundu and the Nyamakate resettlement areas were cultivating in the wetlands to supplement agricultural activities. Dixon and Wood (2003) argue that although wetland cultivation contributes to livelihood security in the short term, in the long term there are concerns over the sustainability of this method. In the Chingombe community of the Gutu District in Zimbabwe, Chikodzi et al. (2014) found that the drying up of the Mutubuki wetland influenced the dwindling of the local livelihood, and it increased food insecurity, malnutrition, water shortages mostly during the dry season, as well as income loss. However, the wetlands are critical in addressing climate change. They are an important source of fresh water as they act as a filter, and they improve the water quality in the nearby rivers and streams. Hence, the mitigatory measures need to be implemented to achieve sustainable development in the arid and semi-arid rural communities. For example, Musasa and Marambanyika (2020) recommend that Zimbabwe should integrate the wetlands into the planning and implementation of the national development goals, as well as strengthen the legal and policy arrangements. The country must also increase investment in the wetland restorations.

Zimbabwe still needs strong institutions and interventions that support climate change mitigation and adaptation. For climate change adaptation to be effective and efficient, Singh et al. (2022) and Nellemann et al. (2011) argue that the women's voices and knowledge should be fully incorporated into the sustainable adaptation strategies. Moreover, gender equality needs to be mainstreamed in all the sectors to enhance adaptive capacity, especially for the rural based women who are mainly encumbered by the effects of climate change. This will enable the rural communities to achieve gender justice and equality in the area of climate change adaptation.

It is also important to note that the ability to adapt to environmental change is not uniform. It is well documented that people with limited natural, human, financial, physical, and social capitals find it difficult to adapt to environmental change. For example, Bunce et al.'s (2016) study revealed that having a strong social network of family and friends to rely on emerged as a key aspect of the women's adaptive capacity. This includes the support that one receives that includes but is not limited to remittances and food parcels from the family members and friends.

3.6 Importance of the framework

The vulnerability approach was used with local input to study the vulnerability of women to climate change and the water management strategies that are used by the communities in Mudzi to conserve water. The use of the vulnerability framework in conjunction with a bottom-up approach yields locally relevant responses to the effects of climate change, which promote more effective decision-making, planning, and management in the arid and semi-arid rural regions that are susceptible to climate change hazards (Dolan & walker, 2006). As such, the indigenous knowledge should be incorporated into research design and implementation. As a result, this provides locally relevant outcomes that could promote sustainable development in the areas that are susceptible to climate change hazards.

Additionally, Liu et al. (2017:209) state that to avoid reactive adaptation, it is vital to study the exposure and sensitivity of society to climate change to identify effective climate change adaptation policies and the potential threats of climate change. However, to achieve that, there is a need to include role of politics, the economy, especially social structures, and institutions, in shaping the exposures and vulnerabilities of communities (Turner et al., 2003). Having said that, the next chapter shall delve into the sustainable livelihood framework. The framework will circumvent the factors which differentiate the vulnerability of the groups of women to climate change and the sustainable water management strategies that are being used to combat the climate change effects. It is important to note that the vulnerability approach has its own weaknesses. For example, the vulnerability indicators cannot be quantified, and the functions of the components can only be qualitatively described. This makes it difficult to measure the degree of vulnerability.

3.7 Conclusions

Climate change has been characterised as a phenomenon that is negatively impinging on the rural livelihoods and the Zimbabwean rural people are not exempted. Thus, the vulnerability concept provides evidence that everyone who is exposed to climate change may be vulnerable in a way, yet some people are more vulnerable than others. The women’s vulnerability to climate change is shaped by the effects of climate change, the socio-cultural roles, and the responsibilities as well as the limited adaptive capacity. Consequently, the poor and the marginalised people are the most vulnerable groups since they have limited resources needed to adapt to the effects of climate change. The vulnerability requires that the women must improve their livelihoods to lessen their vulnerability to the effects of climate change. In addition, to achieve rural sustainability, the women need to be empowered so that they become part of the solution to their problems. However, the importance of using the vulnerability framework is that it recognises the inherent susceptibilities of the human-environment systems that are exposed to climate variability and change. The next chapter focuses on the sustainable livelihood framework.

CHAPTER 4: SUSTAINABLE LIVELIHOOD FRAMEWORK

4.1 Introduction

This chapter explores the Sustainable Livelihood (SL) approach that was developed by Chambers and Conway in 1991 and by the United Kingdom's Department of International Development (DFID) in 1999 to inform the research. The SL theoretical framework was used in this study to examine the vulnerability of women to the effects of climate change and the water management strategies that are being used to conserve water. The sustainable framework is used in this study because it is people-centred and it focuses on empowering the most vulnerable and the poor by strengthening their capacity to achieve secure livelihoods (de Haan, 2012; Mishi et al., 2020). This study made use of the sustainable livelihood framework, which integrates the vulnerability, the livelihood, and the institutional contexts which align with the study research questions. The framework assists in exploring the causation of the vulnerability of women to the effects of climate change. Also, the framework shows what needs to be done for vulnerable communities to have positive livelihood outcomes.

This chapter begins by discussing the livelihood assets that are critical for rural communities to have a positive livelihood outcome. Of particular interest to this study is water. However, it is important to note that all the livelihood assets discussed in this chapter are inextricably linked. Moreover, before the chapter concludes, it will discuss the limitations of the framework.

4.2 The Sustainable Livelihood Framework (SLF)

The SLF is an analytical framework, which is used to understand the numerous factors that can affect the choices around subsistence, and it assists in examining how these factors interact amongst themselves (UNDP, 2017). The Brundtland Commission (1987) introduced the SL in terms of resource ownership and the access to basic needs and livelihood security, especially in the rural areas. The DFID (1999) defines livelihood as the capability, the assets (including both material and social resources), and the activities that are used for the means of living. However, a livelihood is believed to be sustainable if it can survive various shocks and stresses (Scoones, 1998).

The SLF has five major sections which are vulnerability context, livelihood assets, transforming processes and structures, livelihood strategies, as well as livelihood outcomes (Scoones, 1998).

The framework addresses the five forms of livelihood capital which are: (1) Human capital, (2) Physical capital, (3) Natural capital, (4) Financial capital, and (5) Social capital upon which the people build their livelihoods (Serrat, 2017). These capitals are explained in detail in the next sections.

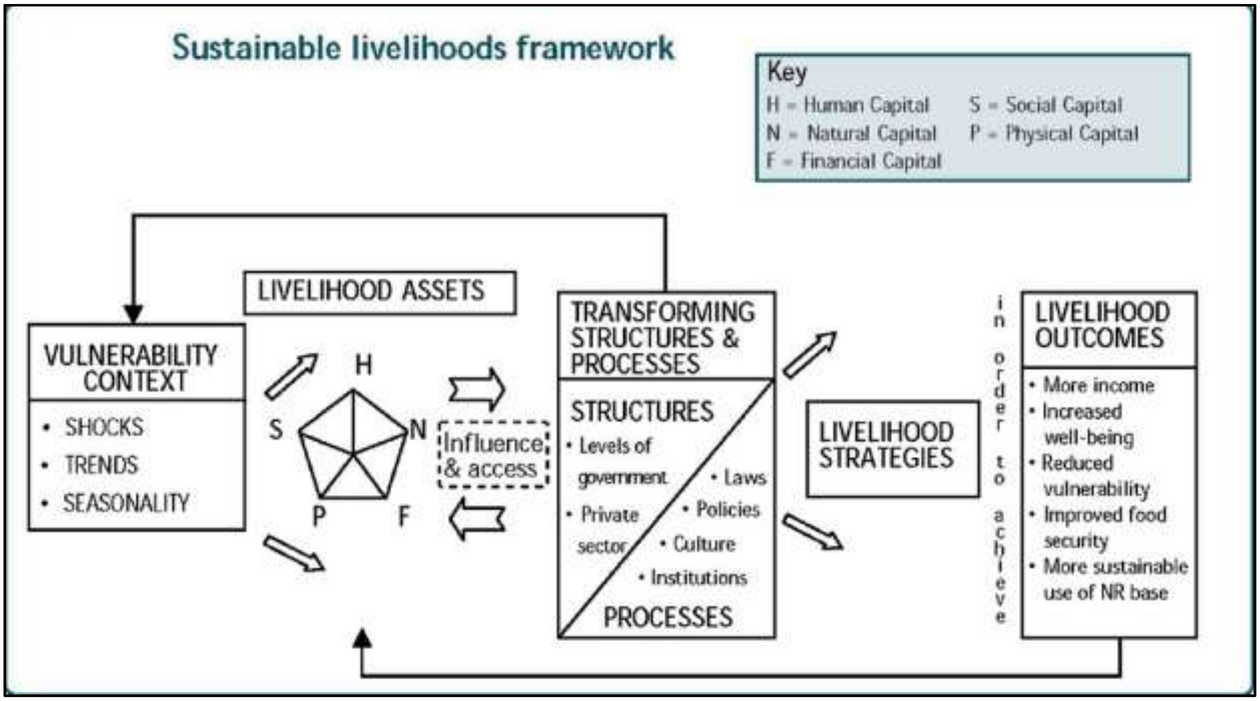


Figure 4.1: Sustainable Livelihoods Framework

Source: DfID (1999–2001).

Figure 4.1 shows a visual diagram of the sustainable livelihood framework. The Department for International Development (DFID) proposed a sustainable livelihood analysis framework (Kuang et al., 2019), which consists of five parts: (i) Vulnerability background, (ii) Livelihood capital, (iii) Structure and system, (iv) Livelihood strategy, and (v) Livelihood output. The DFID framework introduces the main factors that influence the livelihoods and the relationships among them (DFID, 1999). The arrows on the diagram represent a series of highly dynamic relationships. However, no arrow represents a direct causal link, but all of them indicate a certain level of influence.

The SLF diagram that is shown above (Figure 4.1) represents the core variables such as the vulnerability context, livelihood capital, structural and process changes, livelihood strategies and goals, as well as the typical relationships between them. The SLF capitals are explained in detail in the subsequent section.

4.3 Vulnerability context

The vulnerability context refers to the external environment in which the people exist (GLOPP, 2008). It includes shocks (such as weather, illness, death, and conflict), trends (such as national or international economic trends, changes in available technology, and political systems), and seasonality (such as seasonality of prices, and production cycles) (Kollmair & St Gamper, 2002). However, the trends, shocks, and seasonality in which the people have limited influence have a significant impact on the people's livelihoods and their assets (GLOPP, 2008). For example, from 2015 to 2016, Zimbabwe was affected by the El Nino-induced droughts which were responsible for environmental fragility, severe livestock deaths, and crop failure (Matunhu et al., 2022; Owusu et al., 2019; Catholic Agency for Overseas Development (CAFOD), 2018). Similarly, Owusu et al. (2019:618) carried out a study in Ghana on the effects of the 2015 El Nino on the smallholder maize production in the transitional ecological zones and found that the major impacts of the El Nino-induced rainfall failure and yield reduction were household food insecurity, loss of income, indebtedness, and deepening poverty. On the other hand, Mekonen and Berlie's (2021) study in the North-eastern Highlands of Ethiopia has shown that an important level of adaptive capacities such as infrastructure, asset accumulation, and social networks reduces the vulnerabilities of communities. The study also found that the elevated levels of exposure and sensitivity, combined with a low level of adaptive capacity, increase the households’ livelihood vulnerability. For example, in Zimbabwe, most of the people living in the rural areas are disproportionately impacted by climate change and variability as a result of their dependence on nature for their livelihoods (Nyahunda & Tirivangasi, 2019).

In the context of the Mudzi District, the findings of this study have shown that the climate change’s impact on the natural capital is, in turn, reducing crop yields which is the main source of livelihood in the district. Although the communities are facing livelihood threats such as climate change, drought, and inflation, the susceptibility is differentially distributed across the households depending on wealth, the ability to have alternative income, and the ability to receive support from the extended family (Devereux, 2001).

Like the vulnerability approach, the vulnerability in the SLF is determined partly by the risk factors that are generic to the groups of people who are connected geographically and partly by the risk factors that are specific to the individuals or the individual households (Devereux, 2001). However, literature has shown that access to livelihood assets is a major determinant of one's vulnerability to climate extremes (Tora et al., 2022; Jaka & Shava, 2018; Geiser et al., 2011).

4.4 Livelihood assets

The livelihood assets are required by the people to achieve successful livelihood outcomes (Tora et al., 2022). The sustainable livelihoods approach considers the assets that the poor people need to sustain an adequate income to live sustainably. In addition, the people's ability to escape poverty depends on the access to assets or the livelihood capitals (Mumuni & Oladele, 2016). The assets (human capital, social capital, natural capital, physical capital, and financial capital) determine the individual's or the community's livelihood outcomes. Moreover, the availability of the assets is essential in enabling the rural communities to adjust to the climate's variability and change (Mekonen & Berlie, 2021).

The current social realities in Zimbabwe indicate that while some people can secure livelihood assets, the majority are not. For example, the women face a serious gender gap in the access to productive resources. Ingwani (2021), Chiweshe et al. (2015) as well as Chigwenya & Ndhlovu (2016) all agree that there is inequality in the access to and control over land in Zimbabwe. Land is an important livelihood asset in Zimbabwe and most of the rural communities depend on it. However, there are economic and socio-cultural aspects that determine one's ownership of land. The limited land rights for women that are caused by some socio-cultural factors have serious implications which negatively affect sustainable development. Chigwenya & Ndhlovu (2016:215) argue that the limited access to land is the major cause of the high prevalence of the absolute poverty among women and their marginalisation in development. Moreover, the lack of livelihood assets such as land increases the women's economic dependency on men, and this limits their ability to adapt to climate extremes.

Whilst equitable access to land is a basic human right, there are many organisations that are fighting for women to be granted fair access to land in Zimbabwean rural communities.

Empowering the women through access to land is therefore critical in improving their social status and it will also enhance agricultural productivity and food security (Chigwenya & Ndhlovu, 2016).

4.4.1 Water as an important rural asset

Another important livelihood asset is water. Water is the most valuable asset in the world. Silva et al. (2020) reported that in 2010 the United Nations recognised the access to water and sanitation as a human right. The SDG 6 specifically aims to ensure water availability as well as its sustainable management and sanitation for all (Grasham et al., 2021). However, not everyone can easily access this asset. For example, the people living in the arid and the semi-arid regions have been cited in the literature as the most vulnerable groups of people to water scarcity. A study by Mkonda (2015) in the Mvumi wards in the semi-arid Dodoma Region in Tanzania, has shown that most of the respondents (63%) spent up to six hours a day fetching water. Undisputed, the time spent fetching water in the arid and the semi-arid regions is higher compared to the time spent in the non-arid or the semi-arid regions. For instance, Kunguma (2021) carried out a study in Riverside, in the Zvimba District of Zimbabwe, and found that the maximum time spent fetching water by women is 90 minutes per day. However, these studies reinforce the view that not everyone can easily access the water resources.

Despite some researchers (Musemwa, 2021; Nhapi, 2009) arguing that the water scarcity is caused by human-induced factors, Madzingeni et al. (2022), Zvobgo et al. (2022), and Schilling et al. (2020) among others, agree that water has become a new scarce resource mainly in Africa because of climate change. In Zimbabwe, the scarcity of water has been mainly attributed to the effects of climate change and variability, characterised largely by the increases in average temperatures and the decreases in annual rainfall (Madzingeni et al., 2022). The increasing scarcity of water for domestic use and food security inflicts excessive hardship on the rural populations whose livelihoods depend on water. Nonetheless, the community water management strategies should be considered for climate change adaptation in a wider context.

Water as a livelihood asset is inextricably linked with the communities' well-being (Tora et al., 2022). In Zimbabwe, there is a broad link between water and major economic sectors. Most Zimbabweans depend on rain-fed agriculture, and the sector employs the majority of the population (The World Bank, 2015). However, the effects of climate change are compromising the quality and quantity of water. A decrease in precipitation, for example, impacts the availability of water in the water sources and the increasing global temperatures cause increased evaporation rates, increased water temperatures, and decreased water quality (Adams & Peck, 2008). As a result, this has made water the most prioritised sector by African governments for the adaptation to the effects of climate change (Zvobgo et al., 2022).

According to the national water policy of Zimbabwe, water is not subject to individual ownership hence most rural water sources are communally owned. However, most researchers (see e.g., Aguilar et al., 2022; Mkonda, 2015; Kunguma, 2021) have indicated that the women play a key role in managing and maintaining the communal water supplies. As a result, water scarcity impacts the women mostly as they have the responsibility of collecting, using, and managing water in the households. A study by Musah (2013) has also shown that the scarcity of water puts girls at a higher risk of dropping out of school compared to the boys. This viewpoint contributes to the understanding of scarcity of water can contribute to the increased vulnerability of women.

4.4.2 Human capital

Lonska and Mietule (2015:2) define human capital as a set of a person's abilities and skills, having a direct impact on one's economic and social activity potential. Human capital is measured by one's education, their gender profile, skills, good health, and the knowledge that increases the productivity of their economic activity (Morse et al., 2009). The investment in human capital is vital to a country's development. The empirical study done by Rodrik et al. (2002) confirms that there is a link between the development of human capital and economic growth at both the micro and the macro levels. Also, human capital is the foundation of social capital creation (Fukuyama, 1997:20). However, the main trend affecting the situation of human resource capital across rural areas in Africa is climate change.

Human capital depends on the access to natural resources such as land and water, which are impacted by climate change. For example, agriculture is the predominant sector of the Zimbabwean economy, with approximately 70% of the population dependent on it for their livelihood and the women make up a larger percentage of the population of the labour share in agriculture (Dzvimbo et al., 2020). In Zimbabwe, the women produce 50-80 % of the agricultural food (ZimStat, 2012, FAO, 2013). However, unreliable rainfall and the increase in temperatures that are caused by climate change are impacting on the agricultural sector which most of the country relies on for livelihood. The most vulnerable group of people are women who make up a high percentage of the population working in this sector. However, the women's vulnerability is worsened by the lack of access to the natural resources such as the land and it makes it hard for them to adapt to the effects of climate change (Dzvimbo et al., 2020).

Human capital is commonly measured by one's education, gender profile, and skills. This has been supported by different authors who have argued that the level of education is strongly correlated to one's vulnerability to environmental change (Muttarak & Lutz, 2014; van der Land & Hummel, 2013). For instance, van der Land and Hummel's (2013) study in the rural West African Sahel, Bandiagara in Mali, and Linguère in Senegal showed that the respondents with a higher level of education are less vulnerable to the natural hazards. This is because they have more diversified economic activities beyond agriculture and hence, they are less dependent on the climate-sensitive livelihoods. This view concurs with Bombiak, (2018), Muttarak and Lutz, (2014) and Barefield, (2009) who highlight that formal education is considered as a way to acquire knowledge, skills, and the competencies that can influence adaptive capacity. Muttarak and Lutz, (2014) further explain that the highly educated people have greater flexibility and skills to take up a new job or they have better socioeconomic resources to buffer the income loss from the climatic shocks. Thus, education is linked with problem-solving skills. However, the rural population is not homogeneous regarding the access to formal education.

Due to the economic and socio-cultural factors in Zimbabwe, there is gender inequality in access to education. The girl children are the first priority to be dropped out of school in times of economic hardships (Dakwa et al., 2014). This affects the ability of the girl children in adapting to the changing climate. In this respect, Bombiak (2018:5) asserts that the people with lower levels of education are less professionally mobile and are not highly active in terms of developing marketable skills. However, the limit on the women's education inhibits them from being innovative technology boosters when it comes to climate change adaptation. Nonetheless, the investment in equal education is an opportunity for rural areas not only to reduce vulnerability to climate change but to develop high-quality human capital.

4.4.3 Natural capital

Natural capital is the element of nature that directly and indirectly produces value for the people (NCC, 2014: 21). The natural capital remains the basis upon which all the other capitals depend on as the drivers of choice for adaptation practices (Mubaya & Mafongoya, 2017). It comprises of forests, water, minerals, biodiversity, and land assets. The human beings depend upon natural capital to create livelihoods (Guerry et al., 2015). The availability and access to natural capital depends on the capability of an individual to access and utilise the resources (Mumuni & Oladele, 2016). On the other hand, the non-availability of natural capital weakens the resilience and coping mechanisms of the community members.

de Haan (2012:346) believes that the dependence of rural communities on natural capital makes them consider natural capital to be more important compared to the urban areas. This is because the natural capital acts as a safety net whenever disasters such as natural hazards and harvest failure strike (Nawrotzki et al., 2012). However, climate change poses a threat to the existence of natural assets. The studies by Mwadzingeni et al. (2022), Ojha et al. (2018) and Hulme (2017) provide mounting evidence that climate change is impacting on natural resources.

Access to natural capital such as land facilitates improvements to other livelihood assets such as financial capital (Pereira 2006). For instance, the rural community members can generate income through farming or activities such as basket weaving using locally collected reeds. However, the various socio-economic and political factors have contributed to the challenges that the women face with regard to the ownership and control of natural capitals in Zimbabwe (Thobejane & Murisa, 2015). For example, the Zimbabwean Constitution (Sections 3, 13, 17, 26, and 76) provides for gender equality and equal access to land and other means of production (Arisuntha, 2010). However, customary law and patriarchy make it hard for women to own land. Lacking the land rights as well as the access and the control of land means that the women are economically dependent on their spouses or their male relatives. Also, the lack of access to land makes it difficult for the women to adapt to environmental change. However, to achieve sustainable rural livelihood, there is a need for the equal distribution of natural resources.

4.4.4 Financial capital

Natural capital and financial capital are inextricably linked. The access to financial capital is regarded as a catalyst for rural socio-economic development. For instance, land is a major asset and the main source of financial capital for rural-based women. The limited access to land hinders the women from accessing credit facilities (Toro, 2016:78). This is because the people who own land usually use it as collateral security in acquiring bank loans. The failure to meet stringent collateral requirements significantly contributes to the acute levels of financial exclusion and poverty in the rural areas of Zimbabwe (Bote et al., 2014). Although the women constitute the majority of the labour force in agriculture, the majority of these women do not own land. This is the case with the women in the Mudzi District. However, the lack of land ownership obstructs the women's agricultural potential, which is already being disrupted by the economic quagmires characterised by skyrocketing inflation. The women's access to land can result in a positive effect on food security thereby leading to sustainable rural livelihoods. On the other hand, Chigonda (2018:107) argues that inefficient agriculture has forced a lot of people living in rural Zimbabwe to look into alternative sources of income such as fishing, selling crafts, brick, moulding, and selling firewood which all depend on the availability of natural capital.

Financial capital is seen within the sustainable livelihood framework as the financial resources that the people use to achieve their life goals (Mumuni & Oladele, 2016). He and Ahmed (2022:7) are of the view that the total amount of financial capital that is owned by a family directly determines the quality of the family's life and its ability to deal with risks. In addition, financial capital and social capital are inseparable. For example, in Ghana, the Ministry of Food and Agriculture (MoFa) states that the farmers with strong social capital have an advantage of accessing financial support from the local banks (Mumuni & Oladele, 2016). While some capitals may be vulnerable to certain shocks, it is easy for people with financial capital to be resilient and to adapt to the shocks.

4.4.5 Social capital

Social capital refers to the networks, groups, common rules and norms, trust, and the reciprocity that is needed for the people to survive in a community. (Piachaud, 2002). It is through these groups that one can maintain their social identity and receive emotional support, material assistance and services, information, as well as new social contacts (He & Ahmed, 2022). One striking fact, however, is that social capital is not homogenous in rural communities. For example, Abenakyo et al. (2007) assessed the levels and dimensions of social capital and how social capital influences other livelihood capitals. They found that the households with medium and high social capital enhanced agricultural problem-solving skills. In addition, they had the ability to test different technologies and bargain with middlemen for better prices. The increase in knowledge and skills is attributed to the interactions within and between the existing networks, which facilitate knowledge and information sharing.

The study by Abenakyo et al. (2007) also found that social capital also played a role in facilitating joint decision-making by empowering women to participate in making decisions over land and deciding on what to sell, borrowing money, and using money. As a result, social capital results in rural poverty reduction and it helps with local development. In support of this view, Khosla and Jena's (2020) study showed that the households that engage more with social capital are more likely to diversify their livelihood. This then reduces the probability of community members being chronically poor. For instance, the women from a higher social status can quickly adapt to climate change compared to the women from a low social status. Thus, strengthening social capital is a powerful way to improve rural livelihoods.

Social capital can fill gaps where the government falls short, thereby providing opportunities to the unofficial institutions that are needed for a society to function, as a complement to official institutions (Beekman et al, 2009). For example, a study done by Chanza et al. (2019) found social capital as a determinant for climate change adaptation in the Silobela District of Zimbabwe through community lending and saving clubs called mikando. This enabled the individuals to commit themselves to each other and knit the social fabric for mutual benefit. It is through these contacts that the people create social networks which make it easy to share knowledge and spread innovations. In addition, this study found that in the Mudzi District, there exists a water committee that is responsible for the water sources at the village and in the ward levels. The committee imparts knowledge to the villagers on how to conserve water and set up rules for everyone to observe. These rules enable everyone to have equitable access to water. Nonetheless, it is within this shared community responsibility that the rural communities interact and build the social capital that enables them to adapt to environmental change.

4.4.6 Physical capital

Physical capital refers to the means of production and the type of living that the communities need to maintain their livelihoods (Yang et al., 2021). This capital comprises of but is not limited to infrastructure which consists of access to roads, markets, transportation, shelter, water, energy, communications, as well as educational and health facilities. The physical capital plays a significant role in improving the economic and social well-being of people, which enhances development in a rural setting. Without physical access, the rural communities face much greater obstacles in obtaining health, education, and other social services (Gordon, 2019).

Road infrastructure is the backbone of rural development and sustainable livelihoods. However, poor road networks make it expensive for rural the communities to transport their agricultural produce to the market and to access agricultural inputs (Nyawo & Mashau, 2019). Consequently, this impacts the attainment of financial capital. Nonetheless, the improvement of physical capital such as roads can lead to improved mobility, which saves time and sustains agricultural development. The rural communities will be able to have quick access to inputs, raw materials, and the market at reduced prices thereby leading to an increased income and sustainable rural livelihoods.

Most rural communities in Africa consider the number of houses as an important indicator that is used to measure physical capital. Xiong et al. (2021) in their study, found out that housing was significantly positively correlated with sustainable livelihood ability. For example, the size of the building area of a house can reflect the economic ability of the households. In addition, good physical capital such as houses can be used as collateral when borrowing money from the bank. On the other hand, poor-quality houses are a sign of poverty, and this affects one’s access to bank loans, leading to increased poverty.

4.4.7 Overview of livelihood assets

The possession of the above-mentioned capitals plays a significant role in the life of rural households. The assets allow the people to, survive, as well as to engage in markets and participate in various activities within a community. Although there are diverse types of livelihood capitals, the capitals are intertwined. For instance, Nawrotzki et al. (2012:15) denote that, the higher levels of proximate natural resources are associated with higher levels of financial, human, and social capital. Also, the humans depend on these capitals for sustainable livelihoods. Any impact on one capital is likely to affect the other capitals. On the other hand, the lack of access to the livelihood assets is considered one of the key issues underlying poverty, which leads to resource-related social tension (Geiser et al., 2011; FAO, 2008). The most daunting fact is that there is no quantitative measure for these capitals and the distribution of the capitals is not uniform, which differentiates the vulnerability of people. Most rural people, particularly the women, are handicapped by inadequate assets as well as the low and volatile returns on them. Thus, they lack the capacity to absorb the abrupt climate shocks resulting in increased vulnerability. Thus, the capital explained above has an impact on the overall livelihood output.

Unlike the vulnerability approach, the sustainable livelihood approach explains how the capitals sustain communities and how the lack of this capital makes them vulnerable to climate shocks. Moreover, the link between the vulnerability approach and the SLF in terms of asset ownership is that the two approaches agree that the people without assets are the most vulnerable to climatic shocks. In addition, it is difficult for them to adapt to environmental change. In the case of the Mudzi District, this study found that the women who do not own natural assets such as land are more vulnerable to the effects of climate change when compared to the ones who own land. The respondents in this study reported that the lack of land ownership hinders the farmers' ability to use their land as collateral for credit. This negatively affects their ability to adapt to the effects of climate change. In addition, the married women were also reported to be less vulnerable to the climate change effects compared to widows as they can get financial support from their spouses in times of poor harvest. However, the vulnerability approach and the SLF do not put into consideration the cultural and traditional factors which might limit one's ownership of assets. For instance, the women mostly acquire land through inheritance or marriage but lack the legal rights to land ownership, yet the ownership rights determine the adaptive capacity. This increases their vulnerability by limiting their ability to adapt to environmental change. Moreover, the role of policies and institutions also play a significant role in determining the adaptation of local communities as discussed in the next section.

4.5 Policies, institutions, and processes

The institutions and policies determine one's access to livelihood assets. They are the vehicles for facilitating the increased resilience of livelihoods and providing adaptation strategies to improve livelihoods (UN, 2020). The literature categorises the institutions into three; private, public, and civic, all of which are in turn either formal or informal institutions (Agrawal & Perrin, 2008). The institutions encompass on one hand, tangible governance, and organisational structures (formal), while on the other hand there is, uncodified cultural and traditional norms. Nyahunda and Tirivangasi (2021:2423) opine that the success of adaptation depends upon the nature of existing formal and informal rural institutions.

At the global level, institutions have been instrumental in guiding the countries to undertake climate action. For instance, most countries, including Zimbabwe, have come up with climate policies and national response strategies to combat climate change and its effects. Although Zimbabwe managed to come up with a climate change policy and a national climate response strategy (Government of Zimbabwe, 2015; Government of Zimbabwe, 2016), it should be noted that ensuring the needs of the vulnerable, the marginalised, and the remote communities is still a challenge for the country (Chanza & Gundu-Jakarasi, 2020). However, these implementation gaps have been attributed to capacity limitations in institutions, finances, as well as social and technical/human resources.

In addition, institutions can be criticised for neglecting the use of bottom-up approaches to include the marginalised groups in policy formulation. The most poignant factor is that the water policy in Zimbabwe, though it stresses the sustainability of water sources, does not include the local water management strategies that are being used by the local communities to conserve water (Government of Zimbabwe Water Policy, 2012). As such, this study aimed to fill this gap.

Institutions (Department for Agricultural Technical and Extension Services (AGRITEX), Ministry of Environment, Climate, Tourism, and Hospitality Industry) are key mechanisms in facilitating the adaptation for the local communities (UN, 2020). Mubaya and Mafongoya (2017) carried out research on the role of institutions in managing the local-level climate change adaptation in the semi-arid area of Zimbabwe and found that the local institutions shape the impacts of climatic shocks on the communities. Likewise, in Uganda and Ghana, the informal institutions were founded to help in enforcing the rules for the common good such as social and environmental protection, the construction of soil and water conservation structures, and the management of natural resources such as water sources and rangelands (Abass et al., 2018; Twinomuhangi et al., 2019). These views strengthen the assertions made by Hinkel (2011) that the countries with modern social, private, and public institutions have a high adaptive capacity level than those with no or those who have low functional social institutions.

In so far as the institutions and the policies determine the adaptive capacity of the communities, the weak institutions and policies are the main causes of the poor implementation of climate action. Mugwagwa et al. (2015) argue that inadequate financial and human resource support are some of the factors that contribute to having weak institutions. The other factors that have been highlighted in the literature that cause weak institutions and policies include lack of political will, the insufficient inclusion of grassroots voices, and the limited attention to gender and inclusion (Pradhan et al., 2012; Edidah et al., 2017; Mubaya & Mafongoya, 2017; UN, 2020). The lack of gender inclusion hinders the adaptive capacity of women, thereby increasing their vulnerability to the effects of climate change. Consequently, the lack of inclusive policies results in unsustainable policies that do not reflect the realities on the ground (Taonameso et al., 2022). As such, the government needs to provide support for the adaptation to climate change, including crafting, and implementing policies that help reduce the people's vulnerability and build their resilience.

4.6 Livelihood Strategies

The livelihood strategies are the activities that are carried out by the people to achieve their established livelihood objectives (He & Ahmed, 2022:3). They are seen as a way the communities interact with resources and institutions to construct a way of life. The strategies are influenced by the biophysical, political, economic, socio-cultural, and the psychological components (Walker et al., 2001:297). However, the people's ability to choose the livelihood strategies is closely related to their capital endowments and access to capital (Huang et al., 2022). Thus, the total amount of a person's livelihood capital directly or indirectly regulates his or her choice of a livelihood strategy.

In Zimbabwe, the people who are limited in livelihood strategies are the poor population with limited assets, which often hinders their adaptive capacities (Chanza et al., 2019; Nyahunda & Tirivangasi, 2021). Surprisingly, the knowledge gaps continue to exist on how the various groups of people in the communities are impacted by the effects of climate change. Against this backdrop, this study fills the gap by examining the women's vulnerability to climate change and the water management strategies that are being used by the communities in the Mudzi District to conserve water.

The exposure of the rural communities to the effects of climate change has induced people to employ an array of livelihood strategies across the region. This indicates that the rural communities are not passive victims of the vagary effects of climate change, but they are responding to it through a plethora of adaptation and mitigation strategies (Nyahunda et al., 2019). For instance, Khatiwada et al. (2017) investigated the livelihood strategies of the rural households in rural Nepal, and their results showed that 61% of the households diversified their income to non-farming sources. The non-farm economy is categorised into three major sectors: trade, manufacturing, and service. The additional categories include formal employment (teachers, health workers) and private employment (casual workers) (Ellis, 2000; Haggblade et al., 2007). However, not all the non-farming livelihood strategies have high returns. A study by Fikru (2008) pointed out that the non-farm activities (handicraft, weaving, tannery, and blacksmithing) carried out in Ethiopian communities have low returns and are usually undertaken supplementary to agriculture as a survival strategy. Similarly, in the Mudzi District, in times of crop failure, the respondents indicated that they get their income from selling wild fruits and doing casual work. On the other hand, the lack of access to non-farm and off-farm activities is perhaps a major cause of the low coping and adaptive capacities of households in times of food security crises (Bazezew et al., 2013).

Furthermore, a study carried out by Mishi et al. (2020) in the Eastern Cape of South Africa, viewed migration as a non-farming livelihood strategy that is used as a climate change adaptation strategy. They highlighted that most of the households in the rural Eastern Cape are female-headed and the men and tend to migrate to the cities in search of employment as an adaptive measure. Moreover, it was indicated that the households who have migrant members continued engaging in farming and received remittances as livelihood strategies. At the local level, given the current high unemployment rate in Zimbabwe, migrating to cities in search of work is nearly impossible. Rather, the people in Zimbabwe migrate to other countries in search of work to send remittances back home. For example, the 2020 UN data cited by the Migration Policy Institute (MPI) (2021) showed that Zimbabwe was the largest origin country accounting for 24 % of all the immigrants in South Africa. However, not everyone has the freedom to migrate to nearby cities or countries.

In the Mutoko District of Zimbabwe, Mugambiwa (2018) found that the women face cultural restrictions on mobility when climate change-induced risk strikes. In this same vein, this study found that half of the women who indicated that they were married had their husbands working away from their families. The women are left behind with the role of taking care of the household and the children. This is because culture requires the women to be confined to their homes and take care of their families. Consequently, the male outmigration for wage labour increases the women’s workload and their responsibilities. However, the sustainable livelihood framework must be criticised for overlooking the culture and traditions that exclude the women from pursuing alternative livelihood strategies such as migration to combat shocks such as climate change.

What should be noted is that there are determinants that impact one’s livelihood strategies. Bayu’s (2019) study indicated that the women’s age, marital status, and educational status determine their participation in non-farming activities. For example, a lack of education limits one’s employability in the formal sector. In light of this, a study by Ellis and Allison (2004) has shown that the household heads that have attained some levels of education have diversified their livelihood options through salaried work, self-employment activities, and employment in different occupations. On the other hand, the people who lack education are the most vulnerable to climate change due to limited opportunities to diversify. In the Chivi Rural District area, Jaka et al. (2018) demonstrate that most rural-based women in Zimbabwe lack access to education due to the socio-economic inequalities and marginalisation. Similarly, in the Mudzi District of a total of 101 women respondents, 27.78% (n 28) have never been to school. This inhibits the women from embarking on alternative livelihood strategies which warrant sustainable adaptation.

Understanding the household livelihood strategies is pivotal in minimising rural poverty and in achieving the SDGs (Muzah, 2018; Khatiwada et al., 2017; Walker et al., 2001). It can also offer insights to the policymakers and the development practitioners as to what can be done to effectively improve the rural communities. Nonetheless, the livelihood strategies such as water conservation are useful for the rural households to maintain sustainable water consumption (Xu, 2017). The conservation of water reduces water shortages with minimal capital. In the Mudzi district, communities make use of water rationing and recycling to conserve water. This has managed to sustain the communities' livelihood in times of water scarcity. However, there is limited evidence to show how the rural households in Zimbabwe provide for and sustain their livelihoods. This might be a result of most studies focusing on the livelihood strategies at the macro level.

4.7 Livelihood outcome

The livelihood strategies that are explained above aim to achieve livelihood outcomes. The livelihood outcomes are the gains from the livelihood strategies that are pursued, and these vary across the strategies and the households (Carney, 1999 in Khatiwada et al., 2017). The livelihood outcomes include increased income, increased well-being, reduced vulnerability, improved food security and environmental sustainability (He & Ahmed, 2022). These outcomes are the product of a cumulative impact of assets and the livelihood strategies of other components of the framework (DFID 1999; Farrington et al., 2002).

The rural livelihood outcomes are generally influenced by the biophysical, the socioeconomic, and the institutional factors. For example, the access to credit, the communication systems, the market facilities, and the extension services are the institutional factors that affect the livelihoods outcome of the rural poor (Bazezew et al., 2013). Nevertheless, understanding the outcome of the rural-based communities allows the policymakers to formulate effective interventions to secure the livelihoods of the rural communities.

The rural-based women are the key players in ensuring the sustainability of the household livelihood outcomes. Despite the women operating under significant constraints such as inadequate institutional support, the lack of access to land, and the sociocultural constraints, the women have managed to pursue the multiple livelihood strategies to maintain household food security. In support of this, the results from a study conducted in rural Sri Lanka by Kalansooriya and Chandrakumara (2014: 4) revealed that the women are responsible for growing the food crops and they are responsible for making food available in the household to avoid sudden food shortages. In the same vein, in the Mandeni local municipality in KwaZulu-Natal, South Africa, Mpanza and Mbatha (2021) discovered that to secure food security, the women make use of home gardens as a source of food, and they also depend on purchasing food from wholesalers and supermarkets. Other than food crop growing, Kalansooriya and Chandrakumara (2014) found that the women were taking advantage of their indigenous knowledge and the traditional practices of preserving food such as drying vegetables and fish. The food would then be consumed during the times of food scarcity.

In continuation, because of the effects of climate variability and change, there is increasing domination of non-farm sector income over farm income in rural households. The rural-based women engage in off-farm activities to increase income and improve food security. In the Mudzi District, Mutami and Chazovachii (2012), found that market gardening, pottery, traditional beer brewing, sewing, crocheting, as well as the buying and selling of small commodities, provided the extra income that is needed during the off-farming seasons and in times of drought. The increase in income does not only ensure food security, but it also contributes to the improvement of the human wellbeing and reduces vulnerability in times of shock and stress.

What should be understood is that the sustainable livelihood outcomes are not uniform, and they do not always result in a positive outcome as portrayed in the framework. The lack of resources, limited skills, level of education, the size of the household, age, and the marital status all contribute to differentiating livelihood outcomes (Agarwal, 2018; Nhemachena et al., 2018). For example, Baloyi et al. (2018) argue that most women are suffering from food insecurity due to limited access to arable land and cultural constraints, which reduce their potential productivity and suppresses their participation in decision-making and policymaking. In addition, Bolarin and Adetokunbo, (2007) reveal that the food insecurity incidences increase in proportion to household size, especially in female-headed households. The latter factor might be a result of a high dependency ratio, which causes an increased demand for food, while the former factor indicates that the dependency is mainly on the head who is either widowed or unmarried. Moreover, Titus and Adetokunbo (2007) also found that there was a decline in food insecurity incidences in households with heads who were over 70 years. This was attributed to the fact that as one gets old, he/she will have less dependency and they typically have adult children who are expected to be part of the labour force that might contribute to the food production. Also, the older people are likely to receive income from their adult children in the form of remittances, which increases the household food security. On the other hand, the food insecurity incidences decrease with an increase in income, access to resources, and the level of education (Baloyi et al., 2018; Khatiwada et al., 2017; Kalansooriya & Chandrakumara, 2014).

Furthermore, the rural communities' utilisation of natural capital contributes to environmental sustainability as a livelihood outcome. For example, the practices of water harvesting and growing drought-resistant crops in rural communities all contribute to conserving water and sustaining the available water sources. In light of the above, a study conducted in Votua Village, Fiji by Singh et al. (2022) revealed that the women have a vast knowledge of marine species. This knowledge helped the women to observe that there was a decline of *Kawago* (scientific name lethrine nebulosus) because of the changes in the environment. As a result, the women started monitoring and evaluating their harvest to maintain the coastal and mangrove species stocks to levels where they could produce sustainable yield. However, these livelihood strategies that the communities embark on enable them to achieve positive livelihood outcomes which contribute to environmental sustainability.

Additionally, the Zimbabwe government has also taken action to achieve environmental sustainability by putting in place policies such as the national climate change policy and the Zimbabwean climate change response strategy, which provide mitigations and adaptation strategies to climate change effects (Nyahunda & Tirivangasi, 2021). What should be underscored is that the role of the local indigenes in environmental sustainability is overlooked in the Zimbabwean climate change policy. This is mainly because the use of indigenous knowledge in sustaining the environment has not been wholly embraced by the scientists and the policymakers. Also, the way climate change information is disseminated does not suit the literacy rate of most rural communities (Ndlovu et al., 2020). This might weaken the implementation of the climate change policies resulting in a negative livelihood outcome.

4.8 Limitations of the sustainable livelihood's framework

The SLF is undeniably helpful in the understanding of rural livelihoods and their sustainability (Jaka & Shava, 2018). The framework also helps to organise the factors that constrain or enhance livelihood opportunities and shows how they relate to one another. McDowell (2002:7) opines that the SLF is dynamic, and it is a holistic approach that lifts people out of poverty and enables them to cope with the current as well as the future stresses and shocks to enhance sustainable livelihood outcomes.

However, the sustainable livelihood framework has its limitations. The framework can be criticized for its attempt to address the diverse reasons for vulnerability and the ways to address it in a single diagram. By so doing, it does not put into consideration that society is not static, and people's lives are complex. For instance, the approach does not put into consideration the gender dynamics within the household and the community regarding access and ownership of livelihood assets. Thus, the framework fails to consider the societal power dynamics, as it relates to gender. Although it is often argued in the literature that the SLF should not be used as a rigid prescription for interventions or research, de Haan (2012) argues that a uniform approach does enable meta-conclusions to be drawn. Nonetheless, the SLF provides a wider and better understanding of the opportunities for development activities and their likely impact whilst placing people and their priorities at the centre of analysis (Nzama, 2021).

Njagi (2005:27) argues that the central idea of people having access to assets is not enough. This is because the people with assets that do not contribute to their income or cash flow remain poor and vulnerable to the shocks and stresses. In addition, the framework does not put into consideration that the livelihood opportunities and the distribution of resources in rural communities are often influenced by the informal structures of social dominance, political parties, and power within the communities themselves (Krantz, 2001). The distribution of resources according to who is who in society discredits the SLF as an approach that is people centred.

However, the feasibility of the SLF and its ability to help deliver real change for the people in the developing world is questionable due to the limited resources that are available in Zimbabwe's rural areas to support development interventions. Also, the communities' willingness is often not supported by their ability. For instance, Moriarty (2002:6) gave an example that the communities might be willing to have access to quality water, but they might not be able to pay for it, hence, they will rather continue fetching water from less-safe sources of water. Moreso, Morse et al. (2009) argue that putting the SLF into practice is not easy as it may often appear since it requires extensive resources to sustain the vulnerable population to adapt to the environmental change.

All the criticisms of the SLF that are outlined above are certainly valid. One should note that the contribution of the SLF to vulnerability to shocks and stresses as well as its success are still being tested. Although the SLF requires extensive resources to implement its success, when implemented it has direct implications for achieving sustainable rural development and sustainable development goals, which is a global development agenda issued by the United Nations in 2015.

4.9 Conclusion

A sustainable livelihood framework is a versatile and effective method that is capable of covering the vulnerabilities, the capacities, and the livelihood issues extensively. The framework is significant for developing countries such as Zimbabwe, where the rural communities experience the highest levels of exposure and sensitivity combined with a low level of adaptive capacity. Consequently, this increases the households' livelihood vulnerability. Nonetheless, one of the positive aspects of the SLF is that it focuses on the factors that make the livelihood of communities vulnerable and it provides ways to manage and sustain livelihoods. The knowledge about the vulnerable communities to climate extremes is vital for the policymakers and the interventions to develop area-based adaptation strategies for sustainable development.

In addition, the continuous improvement in human capital through education, training, and the empowerment of women in increasing rural economic growth plays a significant role in the adaptation to environmental change. Acquiring human skills development gives the vulnerable groups an option to venture into non-agricultural professions to enhance climate change adaptation.

Overall, adopting a sustainable livelihoods approach has several significant implications. Although its approach is people-centred, there is a lack of inclusivity in the areas of resource allocation, formulation, and the implementation of policies. Thus, there is an urgent need to draw productively from the other areas that have succeeded in implementing the framework for the effective adaptation to climate change. The following chapter discusses in detail the methodology that was adopted for the study, and it describes the data sources that were used for the study.

CHAPTER 5: RESEARCH METHODOLOGY

5.1 Introduction

This chapter discusses the research methodology that was used to explore the vulnerability of women to the effects of climate change and how communities in the Mudzi District are adapting to water scarcity. A case study of the Mudzi District in Zimbabwe was used to obtain the answers to the study's research questions. Moreover, to achieve the study objectives, the study employed a mixed methods approach to gain sufficient insights into the phenomena under study. The mixed methods that were used were largely qualitative. This was done to incorporate the knowledge and the observations of the respondents in the Mudzi District. The mixed methods approach was also used to validate and enhance the accuracy of the findings. This chapter gives critical evaluations of the methods that were used to obtain the data for the study.

5.2 Research method and design

The study used mixed methods (qualitative and quantitative) which is largely qualitative in nature to explore the research questions. The primary data collection techniques were qualitative, while the quantitative data collection techniques played a secondary supportive role to augment the qualitative data. Creswell and Clack (2018:11) postulate that the mixed methods research approach provides a more detailed picture and an understanding of the problem under review or investigation than either the qualitative or quantitative method by itself would yield. The reasons for using the mixed methods are to triangulate the data and to get a better insight and understanding, as well as an explanation of the results of the study. The closed-ended questionnaire items were used to collect the quantitative data, while the in-depth interviews, the focus group discussions and the open-ended questions in the questionnaire were the sources of the qualitative data. Thus, the use of the mixed-method approach allowed the researcher to explore in-depth the divergent viewpoints on the vulnerability of women to climate change and the sustainable water management strategies that are being used to combat the effects of climate change in the Mudzi Rural District.

According to Merriam (2009), the purpose of research from an interpretive paradigm is to describe, understand and interpret the phenomenon under investigation. From this perspective, the reality is multiple, context-bound, and as seen by the participants in the study (Creswell, 2007; Merriam, 2009; Mertens, 2010). For example, Creswell (2007:18) contends that the researchers should 'conduct their studies in the "field' where the participants live and work to get as close as possible to the participants. Such interactive closeness is seen as an important context for understanding what the participants are saying and doing. To this end, a more personal, and interactive mode of data collection using qualitative methods such as interviews, focus-group discussions, and observations would be predominant in this worldview (Mertens, 2010).

Even though the mixed-method research approach has several advantages, there has been some criticism of its use. The traditionalists have argued that the two paradigms are incompatible as they have different epistemological and ontological origins (Guba & Lincoln, 1988; Sandelowski, 2001), while the others such as Johnson and Onwuegbuzie (2004:19), as well as Ivankova, et al. (2006:4) have highlighted its time-consuming nature and requiring more resources to implement than the other singular approaches. Despite these inherent constraints, the developmental researchers (Creswell & Clark, 2018; Malmquvist et al., 2019) and others have continued to use the approach fruitfully and productively in studies requiring the complementarity of views and the triangulation of data.

The study adopted a descriptive research design (McMillan & Schumacher, 2010), using the case study method (Merriam, 2009). A descriptive study asks the question 'what is?' or 'what was?' and describes the current or past status of something (McMillan & Schumacher, 2010). A case study is an in-depth exploration of a bounded system, which could be an activity, event, process, or individual based on extensive data collection (Creswell, 2008). The case study method allowed the study to be conducted in a natural context, and within a specific time and boundaries (Creswell, 2008). It also provided for the women's water management strategies to be investigated using multiple methods of data collection.

The case study research also has some methodological limitations. Its lack of generalisability or transferability of findings because of the few cases involved leaves it open to criticism (Merriam, 2009; Rule & John, 2011). In addition, with multiple-case research, the researchers tend to look for similarities and ignore differences (Rule & John, 2011). Despite the inherent shortcomings, the developmental researchers (Brazier, 2019; Moyo, 2019) continue to use the case study method effectively in most studies owing to its strengths, such as providing a rich and detailed description of the case in a natural setting (Merriam, 2009). For this reason, the case study method was considered suitable for this study. The method allowed the researcher to have a close examination of the vulnerability of women to the impact of climate change and the sustainable water management strategies that are being implemented to combat the effects of climate change. Thus, it allowed the researcher to produce rich in-depth information on the women's cases involved in their natural settings using multiple sources of evidence (Yin, 2011:11). For example, this study went beyond the exploratory functions of noting that the women’s roles are making them more susceptible to the effects of climate change to providing the agricultural and domestic water conservation strategies that are being used by the communities to counteract the climate change effects. A discussion with the participants revealed that climate change has affected humans and the livestock’s well-being by decreasing the quality and quantity of water, thereby increasing food insecurity, and the women’s workloads.

A questionnaire survey of 190 participants was used to collect the quantitative. In-depth interviews and the focus group discussions were used to collect the qualitative data. These instruments provided data on how the diverse groups of women are impacted by climate change, the different water conservation strategies used by the communities in Mudzi, and the ways in which gender equality can be mainstreamed into the climate change policy.

5.3 Study Area

The Mudzi District lies in north-eastern Zimbabwe in southern Africa (Latitude: -17.04711 Longitude: 32.65279) (see Figure 1) (Mutami & Chazovachii, 2012). Mudzi is mainly rural, with Kotwa as its district centre. It is a predominantly flat terrain with few hills and valleys (Nyikahadzoi, 2013:47). It is a semi-arid zone, in a savanna biome, at an altitude of 500-900 metres above sea level (Nyikahadzoi, 2013). It covers 4,075 square kilometres (1,573 sq. mi), all of which is communal land (Mudzi Rural District Council, 2017). The predominant soils are ferric luvisols (Mango et al., 2014; Misi, 2013). The major rivers in Mudzi include Rwenya, Nyamusanzara, Mudzi, Nyagoto Kudzwe, Mazoe, Nyahuku, and Vhombozi (Takura, 2017).

According to Mutami and Chazovachii (2012:368), the Mudzi Rural District receives an annual rainfall ranging from 400mm to 650mm; with average temperatures of about 26˚C. According to

Chenga (2015), Mudzi is a marginalised district, which is gradually turning into a desert. In 2016, Mudzi only received half of the rainfall it normally receives in a normal year, and planting started 20-30 days later than normal due to the late arrival of rains (FEWS NET, 2016). However, the erratic rainfall and the hot temperatures have impacted on crop productivity, and they have reduced the animal pasture (Mango et al., 2014; Misi, 2013). In a normal year, the poorer households do not produce enough to make ends meet and they usually rely on a mix of self-employment and local labour to make the necessary food purchases (FEWS NET, 2021).

The communities in Mudzi derive their livelihoods from crop cultivation, gold panning, animal husbandry, and formal employment. The major crops grown in the district include maize, millet, sorghum, cowpeas, and groundnuts. Because of the frequent long mid-season dry spells, the people in the district have resorted to planting mainly drought-resistant crops (Mango et al., 2014). Due to the poor rainfall distribution and water scarcity, most of the boreholes and deep wells are dry for about nine months every year (Chenga, 2015) which affects the irrigation schemes as well as the community and the household gardening activities. This also increases the vulnerability of the water users. Figure 5.1 shows the map of the Mudzi Rural District Council.

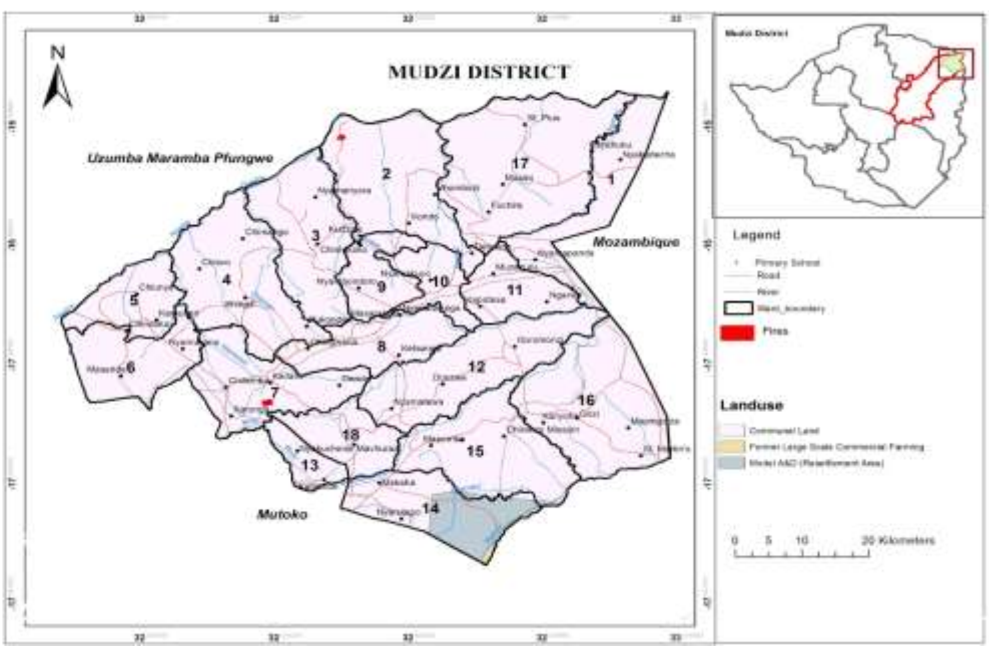


Figure 5.1: Map of Mudzi rural district

Source: Environmental Management Agency, December 2016 (edited by the researcher).

5.3.1 Wards and villages in the Mudzi district

The Mudzi Rural District is subdivided into 18 wards, manned by 18 councillors and six chiefs (see in Figure 5.2). Based on the 2012 national census, the Mudzi District had over 30 000 households, with a population of over 130 000, of which more than 69 000 are women (Zimstats, 2012). Despite the women being the majority in Mudzi (as shown in Figure 5.2), they are marginalised in so many ways, and are also vulnerable to the effects of climate change (Chidakwa et al., 2020). This study focuses on the women's vulnerability to climate change.

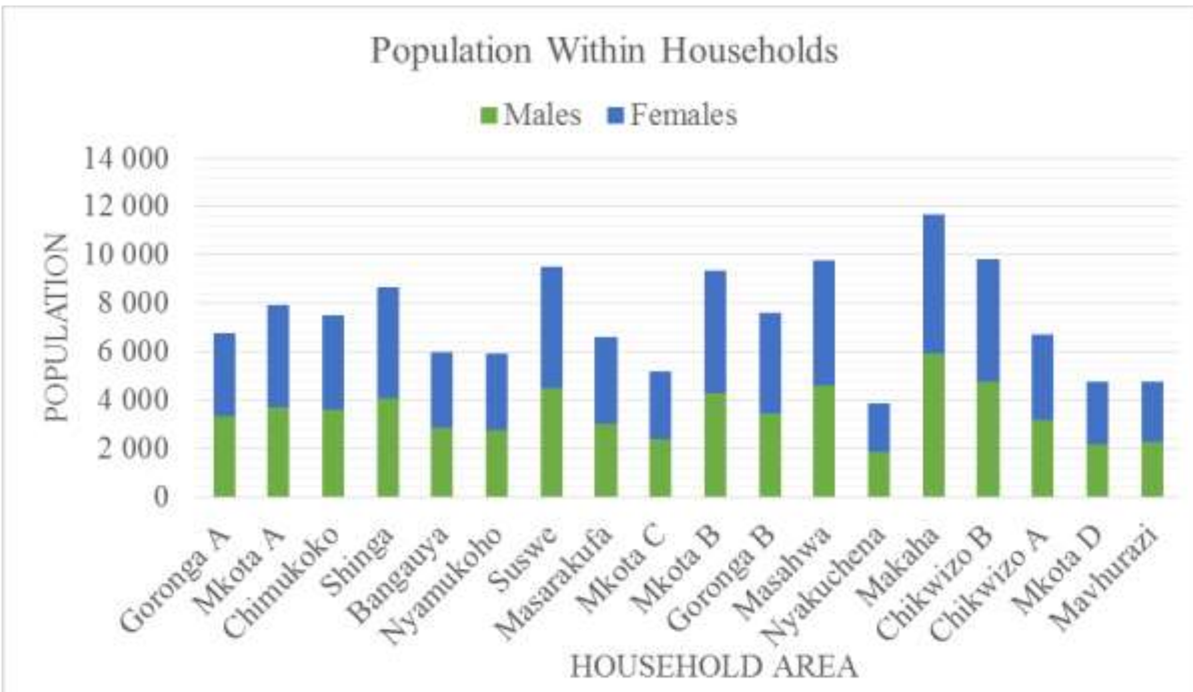


Figure 5.2: Population demographics of Mudzi District (CSO census 2012)

Source: Central Statistical Office (CSO) 2012.

5.4 Entering the study area/ Gate pass

As a former teacher in the district (2014-2018 period), the researcher was familiar with the study area. Being an insider-outsider made it easy for the researcher to engage with the community in ward 6 and seek assistance whenever it was deemed necessary. The was not the same with other wards such as 4 and 5 where the researcher was regarded as an outsider. Upon the arrival in Mudzi district, the researcher immediately notified the local headman in Chikwati village. The researcher gave the headman a permit letter granted by the District Administrator to carry out the study in the district. This was followed by a short meeting, which lasted for about 20 minutes. When the meeting with the headman ended, the researcher managed to seek accommodation at the local secondary school where she used to teach. The first week of the field research was intended for the pilot study.

5.5 Pilot study

A pilot study was conducted in the Mudzi district in July 2019 to determine the reliability indices and the validity of the instruments including the practicability of administering the research instruments (Cohen et al., 2007) within the constraints of a semi-arid area.

5.5.1 Purpose of the pilot study

Specifically, the purposes of the pilot study (Cohen et al., 2007) were:

- To test the validity and the reliability of the research instruments.
- To assess the logistics feasibility of administering the research instruments and improve the procedure for the main study, if necessary.
- To gain feedback on the design and the methodology for administering the main study.
- To establish the approximate duration to administer the research instruments.
- To test the clarity and comprehensibility of the instruments' items and the instructions given to participants.

Another reason why a pilot study approach was to ensure validity, reliability, and trustworthiness. The interview guide, the questionnaire survey and the developed FGD guide had to be tested to see if there are challenges that are likely to arise. Snowball sampling was used to select the pilot study's participants. The sampling method was chosen because it is a simple, flexible way of recruiting participants. The researcher got the referral of the potential participants of the pilot study from the village head, the teachers at Nyamukoho Secondary School, and from the former students at Nyamukoho Secondary School. In total, ten participants from Chikwati Village were selected, that is three males and seven females ranging from 30 years to 76 years. Ten participants were needed to improve the quality and efficient of the main study.

The participants were given written consent forms and information about the research study, which contained the details about the aims of the pilot study and its relationship to the main study. The participants were notified that they would be asked to provide the researcher with critical feedback on the pilot instruments that were used. They were also informed that voice recording would take place and that the recording was for evaluating the effectiveness of the instrument in obtaining useful responses. This was in keeping with the Ethics Clearance protocols obtained from the University of Pretoria. It was made clear to them that this information would be used to assist the researcher in making improvements and for clarification on the research instruments. The participants agreed to take part in the pilot study as they believed that such research studies would stimulate development in their district.

The first instrument to be tested was the in-depth interview guide. The face-to-face in-depth interviews were scheduled to last approximately 45 minutes with an additional 15 minutes for feedback. The respondents' informal feedback added valuable information in the way the actual in-depth interviews were going to be carried out. However, the pilot in-depth interview took longer than what was anticipated (about 1 hour 15 minutes) which resulted in the removal of some of the questions which were not deemed necessary after the content analysis of the findings.

Second to be tested was the questionnaire. The questionnaire survey was done by all the ten participants. The researcher distributed the questionnaires to the participants. The testing of the questionnaires was done to see if the ordering of the questions was correct and to check if the language/ terminology on the questionnaire could be easily understood by the respondents. The use of the pilot study enabled the removal of ambiguity on the questionnaire survey, and this made it easy for the respondents to understand and easily respond. However, there was a challenge with one respondent whose questionnaire was used to light up the fire by her grandchild. This changed the actual study's distribution of the questionnaires. The participants were given time to fill out the questionnaire (refer to Appendix A) which were collected immediately after they had been completed. For the participants who were not able to read, the questionnaire was read to them out aloud and they would provide the answers which were filled on the questionnaire by their chosen assistants. After conducting a pilot study for the questionnaire, a pilot study for the FGD was conducted with seven women who were aged between 30 years to 88 years to test the FGD questions guide. The FGD was conducted at Nyamukoho Secondary School and lasted approximately 90 minutes. The only problem that was found during the piloting of the FGD was that there were two females who were dominating the discussion. The problem was later corrected by prompting the other members of the FGD to give their views on how climate change has impacted them.

After reviewing the findings from, the pilot in-depth interviews, the questionnaire survey, and the FGD guide, the researcher added questions to the interview guide as well as on the FGD and also withdrew some questions on the questionnaire survey. This assisted in shaping the quality of the research. For example, more open-ended questions were added to the questionnaire after the researcher realised that some of the closed questions that were initially put on the questionnaire were not yielding adequate data (refer to Appendix A questions 19, 21, and 25). The alterations were also made to the open-ended questions on the questionnaire. The changes to the instruments included removing double-barrelled questions to make it easy for the respondents to answer each question in-depth and independently. In addition, the questions on the past traditional water management strategies were added to the in-depth interview guide and the FGD guide after discovering that they formed the basis of the current water management in the district. Nonetheless, the analysis of the pilot results facilitated the identification of the weaknesses that needed to be addressed in the final research instruments. The final research instruments were later revised in light of the results of the pilot study.

5.6 Population and sampling methods

The target population of this study comprises of purposively selected key informants from the Ministry of Lands, Agriculture, Water, Climate and Rural Resettlement (MLAWCRR), the Ministry of Health and Childcare, the Ministry of Women Affairs, Community, Small and Medium Enterprises Development, the local leaders, and the men and women above the age of 18 years who have been living in the Mudzi Rural District for the past 15 years. This was to hear from the respondents who have experienced changes in the climate with its corresponding effects on women. The respondents from the Ministry of Lands, Agriculture, Water, Climate and Rural Resettlement, included two Agritex officers and an officer in the Department of Climate Change Management. The respondents from the Ministry of Health and Child Welfare included an officer from the Department of Environmental Health and two nurses. The key informant from the Ministry of Women Affairs, Community, Small and Medium Enterprises Development was an officer from the women's affairs department. The local leaders included two headmen from different wards. All the key informants work and reside in the Mudzi District a key informant from the climate change management department.

This study is largely qualitative and for that reason, the non-probability sampling methods were used to select participants. Snowball sampling and purposive sampling methods were used to select the participants for this research. A purposive sampling method was employed to obtain an adequate representation of all the groups in the district. Using snowball sampling, the village heads in Wards 3, 4, and 5 (see Table 5.1) assisted the researcher in identifying the people who were willing to take part, who in turn suggested the others who might be willing to be involved. Also, interacting with the community members enabled the researcher to get referrals for the potential participants who met the criteria for the questionnaire survey, the in-depth interviews, and the FGDs.

After going through a series of consultations with the District Administrator's office in Kotwa (Mudzi's growth point) the researcher was provided with relevant information for the potential key informants of this study. Thus, the study made use of the snowball sampling method for its questionnaire survey and focus group discussions. The purposive sampling method was used to select the key informants and the in-depth respondents of this study. In total, the researcher managed to have 190 participants above the age of 18 years from Wards 4, 5, and 6 as indicated in Table 5.1. The average age group was 46 with most of the participants in the 51-60 age range.

The reason for selecting the men and women above the age of 18 years was to hear from the respondents who have experienced changes in the climate with its corresponding effects on women. Also, the participants who had shown knowledge and understanding of the climate change and water management strategies in the questionnaire survey were further selected for in-depth interviews or the FGD. This was done to yield rich responses and to save time. However, the study did not completely rule out the people who were less knowledgeable on climate change as their views were also useful for this study.

Table 5.1: List of wards and villages in Mudzi district from which the participants were selected.

Ward	Villages
4	Bande Chari Kabasa Tirivangani
5	Bekikia Chindoko Kanemanyanga Kamusori
6	Chikwati Mutsvaire Seven Mupesa

5.7 Data collection instruments

The data for this study was collected using questionnaires, in-depth interviews, and focus group discussions. The objective was to obtain a broader understanding of the vulnerability of women to the effects of climate change and the sustainable water management strategies that are being adopted by the arid and the semi-arid rural communities to combat the effects of climate change in the Mudzi District. All the respondents in this study were asked to sign a consent form before participating in the study. For the participants who were unable to read the consent form, it was read out loud to them, and they were then given a form to sign if they agreed to participate. The researcher handed the questionnaire to the participants at their homesteads. The participants were given time to fill in the questionnaires and they were collected once they were completed. Also, the in-depth interviews were conducted at the informants' homesteads to minimise the informants' traveling costs and also to avoid them walking long distances. The FGDs were held at the local schools in the three wards which were deemed to be central for all the participants to meet.

5.8 Questionnaire surveys

A detailed semi-structured questionnaire was administered face to face and completed by the 190 participants in Wards 4, 5 and 6. The villages of the wards that were visited are shown in Table 5.1. The respondents consisted of 101 females and 89 males ranging from 18 to 60+ years with most of the participants in the 51-60 age range. The participants were required to read the consent form before signing it to show their approval to participate in the study. The consent form explained the aim of the study, any risks associated with the questionnaire survey, and there was also an explanation of how the data will be used.

The semi-structured questionnaire consisted of closed and open-ended questions. The questionnaire was designed to solicit socio-demographic information (closed questions), climate change, gender relations and water sources, as well as management information (open-ended questions). The closed-ended questions allowed the respondents to choose the answer from a range of opinions in Section A of Appendix A whilst the open-ended questions allowed the respondents to state and explain their answers for Sections B and C of Appendix A with high flexibility (Singer & Couper, 2017; Schonlau & Couper, 2016).

Administrating the semi-structured questionnaire survey face to face enabled the researcher to answer and clarify any questions that the respondents might have pertaining to the questions in the questionnaire. It also ensured a return rate of the questionnaires, and the researcher was able to give the respondents assurance about their confidentiality. In addition, the face-to-face administering of the questionnaire survey enabled the participants to focus on filling their questionnaire with limited distractions.

After the completion of the questionnaire survey, the data was entered into a spreadsheet. The frequencies of the data were then noted. For example, the variables for the level of education of the respondents were coded: 1. ☐Never 2. ☐Primary 3. ☐ Secondary 4. ☐ College 5. ☐University 6. ☐ Other (specify)…………then the frequencies command calculated how many women or men have never gone to school or have attained tertiary education. The data gave an overall numerical image of the respondents. The numerical data was then turned into graphs, tables, and descriptive statistics for the readers to understand the results.

Some of the open-ended questions in the questionnaire were categorised and the participants were able to respond in their own words. The researcher scanned for the recurrent themes and words in the open-ended responses which were relevant to the overall research question. The responses were then grouped into conceptually ordered themes.

An effort was made to ensure that the data from the questionnaire survey was analysed accurately. The information that was collected from the instrument complemented the data that was obtained through direct observation, in-depth interviews, and through the focus group discussions. This was done to ensure that the validity and reliability of the study were not compromised.

5.9 In-depth interviews

The participants for the in-depth face-face interviews were purposely selected using the assistance of the local leaders and the villagers in the district. This study needed various groups of women and men from all the socioeconomic classes, age groups, marital statuses, and abilities. The villagers in the district assisted the researcher to locate women with disabilities, widows, married women, and single women. In addition, the tool used to select the participants assisted the researcher in locating the people who had in-depth knowledge about the district and have witnessed the shift in climatic conditions which has prompted the communities in the district to conserve water. In addition, the inputs that were provided by the various groups of men and women enabled the researcher to find out how various groups of women are being impacted by the effects of climate change in the context of a semi-arid region.

The identified respondents were notified of the interview schedule two days before the commencement of the interviews. This was done to allow the chosen participants to prepare themselves and to limit disturbances during the course of the interviews. To reduce the participants incurring unnecessary transport costs, the in-depth interviews were conducted at the participant's households. Before the commencement of each interview, the researcher explained to the participant the overall aim of the study. The participants were told that the aim of the study was to investigate how women are being impacted by climate change and also to document the water management strategies that are being used in the district.

The participants were asked to read the consent form before signing to signal their willingness or refusal to participate in the study. For the participants who were unable to read, the researcher read the consent form alou0d for them. After reading the consent form, the participants were asked if they had any questions. Most of the participants did not have any questions pertaining to the consent form and they showed signs that they understood its content.

The interviews were conducted in Shona which is the vernacular language of most people in Zimbabwe. The interviews started with frequent questions on the past weather patterns and the farming activities in the district. The questions were asked to have a general overview of the past climatic conditions and to build rapport and trust with the participants. After the general questions, the interviewer read out the interview questions from an in-depth interview guide (see Appendix B) and the interviewee would respond verbally to the questions that were being asked whilst they were being voice-recorded. The respondents were voice recorded so that the researcher could concentrate on listening to their responses. This also ensured that all the interviewees' responses were captured.

In total, 30 in-depth interviews were conducted. The researcher conducted 10 in-depth interviews in each of the wards shown in Table 5.1. The age of the interviewees ranged from 35 to 93 years. The female participants consisted of widows, divorcees, the disabled and the unmarried women. The interview durations varied from one respondent to another. Typically, the interviews lasted between 60 and 90 minutes. The interview was transcribed on the same day to enable follow-up research if there were information gaps, and to use as a backup in case of technical failure. This was also done to accurately code and quote the participants accurately. However, it is worth mentioning that the use of the local language, Shona, created a close relationship between the researcher and the interviewees, which may have improved the quality of the collected data.

All the transcribed interviews were coded from 001 to 030 and were examined in one document. A thematic and content analysis was carried out to identify the key concepts which arose in the interviews. These concepts were highlighted. Each highlight represented a particular theme. For example, yellow represented the impacts of climate change on the women. These were further categorised into old women, women with disabilities, married women, single women, and widows. The aim of grouping the data into themes was to identify the key concepts that were presented in the data. The use of thematic content analysis provided insightful research findings that were aimed at meeting the trustworthiness criteria.

When the identified key themes reached a point of saturation, a narrative of the research findings was developed. The narrative account was written in combination with the findings from the in-depth interviews and the focus group discussions. This was done to build a coherent justification for the study themes and to enhance the accuracy of the findings. In addition, the findings contained verbatim quotations from the participants which are presented in italics. The quotes are used to provide evidence of the vulnerability of women to climate change and to highlight the communities' perceptions of climate change. Also, code numbers were used in the quotes to maintain the anonymity of the participants. Some of the expressions are translated into the English language whilst the others are left untranslated to avoid losing meaning.

Wenden (1982:39) defends her use of in-depth interview guides in her thesis by saying that it allows for in-depth probing whilst focusing on the aims of the study. Similarly, Young et al., (2019:17) state that the interviews are flexible, and they allow trust-building, as well as an accurate way of obtaining in-depth information. Whilst the in-depth interviews are used as a tool in this study, some researchers have criticised them citing a lack of transparency in the choice of questions and bias in terms of sampling (Young et al., 2018:17). However, in this study, in-depth interviews were carried out to better understand the water management adaptation strategies and the vulnerability of women to the devastating effects of climate change. The conducted interviews were used to obtain some information from a wide range of stakeholders and to validate the results that were gained from the other approaches (questionnaires and focus groups) that were used in this study.

The in-depth interviews provided an opportunity to capture the information that was difficult to obtain through the use of questionnaire surveys and focus group discussions. Also, the in-depth interviews further provided an opportunity to identify the possible challenges that the women encounter as a result of climate change and variability.

5.10 Key informant interviews

The in-depth interviews with the purposely selected six key informants were also conducted. The informants included the officers from the Ministry of Lands, Agriculture, Water, Climate and

Rural Resettlement (MLAWCRR), the Ministry of Health and Childcare, the Ministry of Women Affairs, Community, Small and Medium Enterprises Development, and the local leaders in the district. The key informants were selected based on their subject area and the knowledge of the study area. The recommendations for the potential key informants were made to me by the district administrator in the Mudzi Rural District and the community members living in the district. After consulting the district administrator, the researcher visited the potential key informants with the letters of permission to carry out the research. The consent forms were given to each key informant and the appointments to carry out the in-depth interviews were scheduled.

The in-depth interviews were carried out at the key informant's workplace except for the ones with the local leaders which were carried out at their homesteads. The interviews took place between August and December 2019. The procedure of carrying out the key informants' interviews and the analysis of the data is similar to the one that was done for the in-depth interviews in Section 5.9.

The key informants were vital in this research as they shared their knowledge and provided insider perspectives. The in-depth interviews with the key informants were taken as a cross-reference to the data that was obtained from, the questionnaires, the in-depth interviews with the participants, and the focus group discussions.

Kennedy et al. (2008) in McKenna et al. (2013:119) state that key informants are unquestionably important in providing rich data on the community and in assisting the researcher to make additional contacts. McKenna et al. (2013:120) suggest that the identification of the key informants as experts does not mean that their views are superior in all aspects. Nonetheless, several researchers agree that the service that is provided by the key informants in the communities is essential to community engagement research (Kennedy et al., 2008; Morris, 2009; McKenna et al., 2013).

5.11 Focus Group Discussions (FGDs)

The focus group discussants in Wards 4, 5, and 6 were selected with the help of the local traditional leaders and the community members using snowball sampling. The participants that the researcher was referred to by the village heads also referred the researcher to other suitable participants. The tool to select the participants enables the men and the women from various age groups, from socioeconomic backgrounds, and with abilities to be represented in the FGDs. For example, to get hold of the women with disabilities into the FGDs, the community members referred the researcher to the people who suit this criterion.

A notice was sent out to the potential group members in advance to enable having a high turnout. A total of six focus group discussions were carried out in Wards 4, 5, and 6 at the local schools and at the AGRITEX offices in the district. In each ward, two separate male and female focus group discussions were carried out with the participants and each FGD had 7-12 members.

The focus group participants were grouped according to gender to give each group a chance to express themselves freely and to freely exchange their views on equal footing. Each FGD had a diverse representation of social stratification, age, and ability. For each FGD, the aim and objectives of the research were explained, and the participants were given room to ask any questions for clarity. Before the start of each FGD session, the participants were asked to read and sign the consent form as a way of approving that they are participating in the study. After signing the consent forms, the participants were requested to provide ground rules for the FGD session.

A discussion guide was used by the moderator to guide the discussion and to ensure that all the topics are covered. The moderator also prompted everyone to participate freely and to exchange anecdotes. The Shona language was used as the dominant language in which the participants could easily express their views. The discussions started off with the participants' views on the climate and the rainfall trends for the past years. If there were changes, the participants were then asked if the changes had impacted them and how.

The respondents who took part in the FGDs were mostly in the 51-60 age range and had been in the community for the previous 10 years. The respondents were believed to possess rich knowledge concerning climate change in the Mudzi Rural District. All the respondents participated voluntarily, and their identities are confidential. However, the female FGD in ward 6 had an elderly woman who dominated the discussion. This resulted in other female respondents hesitating to respond to the questions addressed. It also made the FGD long. To ameliorate the problem the researcher had to probe other participants so that they also respond to the questions being addressed.

The FGD lasted for 60 to 90 minutes. All the proceedings from the FGDs were recorded for transcription purposes and analysed. The discussions allowed the researcher to understand the differentiation impacts of climate change on different categories of women and to obtain indigenous knowledge-based information on the water management strategies. The data was analysed using thematic content analysis in the same way the in-depth interviews were analysed (Refer to 3.9). The data from the FGDs was also used to triangulate the data from the in-depth interviews and the questionnaire survey to build a coherent justification for the study themes.

5.12 Non structured transect walks and field observations.

Spending time in the Mudzi Rural District enabled the researcher to know more about the community (the vegetation, agricultural activities, type and quantities of water sources, vulnerable groups in the district, water management strategies, etc.). However, the experiences and the observations were recorded in a field notebook for analysis. The researcher had the opportunity to witness and observe some of the local practices that are being done to conserve water. The field observations and the transect walks were done under the guidance of an environmental health officer who helped in the identification of the route and who assisted in the discussions on the existing environmental conditions.

The transect walk allowed the researcher to explore and become familiar with the community and its inhabitants. During the transect walk, the researcher managed to get an opportunity to ask questions whenever she saw anything that struck her. The questions were answered concerning the observed existing environmental conditions. The transect walks made the researcher experience the distance covered by most women when fetching water and how the communities are conserving water in their villages in the era of water shortages. The transects walks also validated what the participants had been saying in the FGDs, in the questionnaire surveys, and in the in-depth interviews.

The tool also gave the researcher an understanding of the experience of the real situation under study. The researcher was able to observe the physical environmental impacts of climate change and variability, (dried water sources, the declining water volume in dams and rivers, the extent of drought conditions) community vulnerability to climate change, the adaptation strategies, the livelihood practices, land-use, and the conservation practices. The information that was gathered from the transect walks and the field observation was a way to increase the validity of the study as the transect walks and field observation helped the researcher to have a far better understanding of the phenomenon under study.

5.13 Triangulation

This research made use of triangulation to ensure the confirmability and credibility of the study. Triangulation is a strategy for improving the validity and the reliability of the research or the evaluation of the findings (Noble & Smith, 2015). Patton (2001:247) advocates for the use of triangulation by stating that triangulation strengthens a study by combining several methods. This research used triangulation by making use of diverse informants and by using questionnaires, in-depth interviews, observations, focus group discussions, and transect walks which according to Johnson (2007:284) will lead to more valid, reliable, and a diverse construction of realities. However, the major goal of triangulation is to overcome one's personal biases and the intrinsic deficiencies to make a single-method study hence increasing the validity of the study.

5.14 Ethical considerations

This study was approved by the University of Pretoria Ethics Review Committee. Further approval was also given by the Ministry of Agriculture, Water, Climate and Rural Resettlement; the Mudzi District Administrator, and the local village leaders in the Mudzi Rural district. Once the permissions were granted, written informed consent was sought from the individual participants before data collection.

The consent had the contact details of the researcher in case the participants needed clarity on any issues about the study. Even where this permission had been given, consent was orally taken again on the day of the interviews to verify the participants' willingness to participate in the study. Further permission was also requested from the participants for data recordings during the in-depth interview sessions and the focus group discussions.

The participation in this research was voluntary. This means that the prospective informants had the right to decide voluntarily whether to participate in this study without risking any penalty or prejudicial treatment. The participants were assured that the gathered information would be used for research purposes only and they were allowed to ask questions before signing the consent form.

They were also advised that they could terminate their participation at any time during the study. In addition, the participants were told that the study was for academic purposes only, and the results of the study might be published in academic journals. The researcher also made it clear to the participants that the study was purely optional, and no incentives were to be given for partaking in the study.

Nevertheless, the participants were treated with respect, and their decisions were respected. According to Creswell (2003: 64), the researcher has an ethical obligation to protect the participants within all possible reasonable limits from any form of harm that may emerge from the research project thus the respondents were thoroughly introduced to the purpose of the study and their expected roles. The participants were also assured of the safety and anonymity of the information they provided. In addition, the collected data will be stored in a password protected computer to ensure that research data is secure. The hard copies of the data collected will be stored in a locked cabinet to ensure data security.

5.15 Limitations of the study

As this work is a case study, the findings are limited in their relevance to the communities outside of the Mudzi Rural District. However, these findings may be less relevant to the women living in the urban areas. While the results represented a diverse cross-section of communities in the Mudzi Rural District, there were few respondents under the age of 30, which may have resulted in missing key generational differences in a country with a youthful population. Furthermore, due to increasing poverty, the study failed to find a few women from the high-income classes. Despite this group of women being less, the respondents reported that the women from the high-income classes are the least impacted. This is mainly because they have various means to adapt to the changing climate. For example, the women from the high-income class can afford to pay someone to fetch water for them whereas the women from the low-income classes must travel long distances in search of water.

5.16 Challenges

Varied challenges were encountered during this research. The research was carried out at a time when Zimbabwe is facing an economic crisis, which hindered the smooth flow of data collection. The high inflation rate, the poor road networks, together with the fuel shortages in the country made it difficult for the researcher to move from one village to another. The poor road networks resulted in the researcher hiring a vehicle or a motorbike each time she had to do in-depth interviews. This was time-consuming and it was compounded by high transport costs. At times, the hired vehicle would break down, which would force the researcher to walk long distances on hot sandy roads. However, with a bit of persistence and patience, the researcher was able to collect sufficient data for the study.

5.17 Data analysis

Data was analysed using thematic analysis with descriptive statistics. Braun and Clarke (2006) identify a thematic analysis as a method for identifying and analysing the patterns of meaning in a dataset (texts). The thematic analysis allowed the researcher to approach large data sets more easily by sorting them into broad themes. However, the conclusion of thematic analysis is the identification of a saturated set of themes (Ando, et al., 2014). The goal of using a thematic analysis according to Neuendorf (2019:213) is to develop a story from the collected qualitative data. From the analysed data, the method provides insightful research findings that are aimed at meeting the trustworthiness criteria.

On the other hand, the quantitative data that was extracted from the questionnaires was analysed using Microsoft Excel. The tool allows the use of data using descriptive statistics and its computational ability and graphical functions make it easy for data analysis (Quirk, 2016). Microsoft Excel was chosen because it is easy to access since it is widely used, and it is relatively simple to use. The collected data such as the gender, age, relationship status, level of education, and the years spent residing in the district provided a profile and an overall numerical image of the respondents. The numerical data was then turned into graphs and tables for the readers to understand the results.

5.18 Conclusion

The study's selected methods enabled the researcher to explore the vulnerability of the women to the effects of climate change and how the communities Mudzi are conserving water. The selection of the Mudzi District as a case study approach enabled a detailed exploration of the research objectives as stated in Chapter 1. The use of the Mudzi District as a case study offered and detailed data as described in the next chapter. The participants played a significant role in providing a detailed insider perspective on the questions they were asked to respond to. However, throughout the research process, the ethical considerations were observed to safeguard the research participants. The participants' decisions were respected. Moreover, the use of various methods enabled triangulation which increased the accuracy of the findings. In addition, the use of various methods to gather the data enabled this research to come up with the research findings. Thus, the next chapter describes the results that were obtained during the processes that are highlighted in this chapter.

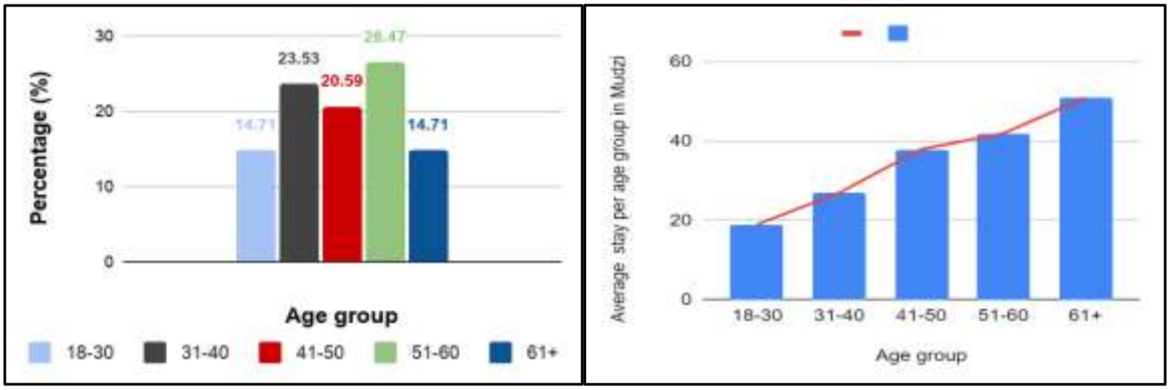
CHAPTER 6: RESEARCH FINDINGS

6.1 Introduction

The chapter discusses the findings on the effects of climate change and the sustainable water management strategies that are being used to conserve water in the Mudzi district. The chapter is arranged according to the research questions of the study. The chapter begins by presenting the demographic and biographical information of the respondents. This was done to extract the characteristics of the population in the Mudzi District and to identify the characteristics of the vulnerable groups to the impact of climate change. The community's observation of the changing climate was also explored to understand how the communities in the Mudzi District perceive climate change. Furthermore, to answer the research question on the impact of climate change on various groups of women, the chapter explores the roles of women in society. This was done to see if there is a link between the roles of women and their vulnerability to climate change. In addition, the factors that make diverse groups of women vulnerable to the effects of climate change are discussed. Following this is a discussion on the water management strategies that are being implemented to conserve water in the Mudzi District. The chapter then concludes by exploring how gender equality can be mainstreamed into a climate change policy to reduce the vulnerability of women to the effects of climate change.

6.2 Respondents' profile

Women and men with diverse life experiences and social backgrounds participated in the study to capture a wide range of views and experiences. The data was collected from both male and female respondents to ensure accurate data collection and to limit potential biases. A total of 190 (n=190) people participated in the study. The average age of the respondents was 46, with the majority in the 51-60 age group as shown in Figure 6.1(a). This is because the young population tended to migrate to big cities in search of job opportunities. The 51-60 age group has to stay behind because they have invested a lot in their land and regard themselves as too old to start new opportunities or to migrate to neighbouring areas. However, the data about the age of the respondents is important to determine which age group in the study was more vulnerable to the impact of climate change. The respondents in this study have an average stay in the Mudzi rural district of 35.4 years and the correlation of the age groups and their number of years living in the district is shown in Figure 6.1(b).



(a) (b)

Figure 6.1: (a) Age group distribution as a percentage of the total number of respondents. (b) Age group of respondents and number of years living in Mudzi correlation.

From the women who responded, who make up n=101 (52.9%) of the total respondents, n=28 (27.78%) has never been to school, n=39 (38.89%) have only reached the primary level and n=34 (33.33%) has reached secondary education and none of the women respondents have attained tertiary education. Of the n=89 (47.1%) male respondents, only n=6 (6.74%) has never been to school, n=22 (24.72%) has reached primary school, the majority n=56 (62.92%) have been to secondary school, and n=5 (5.56%) have attained tertiary education. The 27.78 % of the women who have never been to school might be linked to the gender bias that the females face in attaining education. The reason for probing the educational qualifications of the participants was to determine whether the level of education may be correlated with the women's vulnerability to climate change. According to Sinyolo (2014:153), a higher level of education is often associated with more opportunities for generating income, which enables a relatively easy adaptation to climate change. The results of this study indicate that the women have lower levels of education thereby making it difficult for them to adapt to the effects of climate change. This is worsened by the women’s dependency on subsistence agriculture which is sensitive to climate change.

The majority of the women n=62 (61.11 %) are married, n=28 (27.78 %) are widows and n=11(11.11 %) are divorced. Further analysis has shown that of the 61.11% of women who indicated that they are married, half of them have husbands working or living away from their families, thereby leaving the women with the responsibility of taking care of the household. The average number of children of all the respondents is 4.56. However, some of the female participants n=33 (33.11 %) lived with their grandchildren. All the male respondents have indicated that they own land, which is not the case with n=84 (83.33 %) of women who indicated that they do not own land and the land that they work on is registered in their husbands' names. Despite most of the women not owning land, most of them are agro-pastoralists and subsistence farmers who depend on their children or relatives in the city to subsidise their income. Although efforts were made to include the women from a variety of socio-economic backgrounds, most of the women and the men who were surveyed and interviewed live in low-income households, and their household income is determined by their agricultural yields and the subsidies from their children and their close relatives.

6.3 Local perspective of climate change

The community members living in Mudzi all agree that the climate is changing. All the participants in the FGDs and in the in-depth interviews have indicated that long back they used to have plentiful rainfall and the sun was not as hot as it is now. Also, it was reported that in the 1960s there existed water sources that did not dry up. However, these water sources have long dried up indicating a change in the climate. In addition, tree phenology and the behaviour of certain animals were also reported to play a significant role in predicting climate change. For instance, in an in-depth interview in Ward 6, a participant reported that a certain sound produced by some birds such as the fish eagle indicated that the rain was about to start. This alerts the community members to start preparing for the season. The study also found that the flowering of the new leaves of the *muonde* (fig tree) also indicates near rainfall onset. The use of Indigenous Knowledge Systems (IKS) in forecasting climate change is important in preparing the adaptive and the mitigation measures.

In light of the above, the participants were asked what they think is the cause of the changing climate. The participants in Ward 5 in the FGD held with female respondents reported that the changing climate is a result of people no longer valuing the African traditional culture.

"Vanhu vakusiya tsika nemagariro avo zvichizokonzeresa kusanaya kwemvura".

In Ward 6, the male FGD reported that climate change is caused by the increase in population which then forces people to cut down trees. As a result, this has caused some of the wetlands to dry up. Although the community members agree that the climate is changing, they differ in their perceptions of what is causing the climate to change. Most of the elderly participants above the age of 60 believed the change in climate is caused by the community members who are no longer valuing the traditions and the cultural beliefs in the district. When asked for an example of a situation when a person is not valuing the tradition in the district, most participants gave an example of *makunakuna* which is taboo, and it is when a brother is involved in a sexual act with his sister. This is believed to make the ancestors angry, and they stop the rainfall.

Unlike this study, most of the studies that have looked at climate change have mainly focused their perception of climate change based on scientific data (IPCC, 2021; Brazier, 2017; Unganai 1996; Brown et al., 2012) whilst overlooking the perception of the local communities on climate change. The local IKS of climate change is a vital source of information that will serve to assist local communities to adapt to the effects of climate change.

6.4 Exposure: Observations of a changing climate

Consistent with the research across the globe, (IPCC, 2021; Bunce et al., 2016; Liu et al., 2017) the people living in the Mudzi Rural District are experiencing a considerable environmental change. The surveyed participants were asked about their observations on the patterns of rainfall and temperature over the past 2 to 3 decades. All the respondents indicated that they have experienced long-term shifts in temperature, and the amount as well as the distribution of rainfall over the past few decades.

''We are aware that the climate has changed. Temperatures have increased and the rainfall intensity and distribution are no longer good. The areas that used to have water no longer have water'' (Interviewee #011).

The discussions with other respondents revealed that the district used to receive rainfall from September to April. The rainfall termed *gukurahundi* (the early rains which wash away the chaff at the onset of spring) would begin in August followed by the September rains which are termed *as bumharutsva*, literally meaning, the rain that cleans away the dry and burnt grass.

''The rain which used to fall in mid-September shifted towards the end of October and it shifted again to November. We are currently starting to receive the rains in December. By the end of

February, the rains would have stopped. This is a rapid change and it's evident to us that the climate is changing" (Interviewee #18, middle-aged woman, Mudzi Rural District resident).

The respondents' observations are consistent with the views of Unganai (1996) and Makarau (1995), who conclude that the rainfall in Zimbabwe had decreased by 10% or 100mm between 1900 and 1994. To further support this view, Chamaille-Jammes et al. (2007), Dimes et al. (2009) and Brown et al. (2012) suggest that climate change is already making an impact in Zimbabwe. In support, they all cited the increasing temperatures which are mostly pronounced during the dry season, and the erratic rainfall distribution across the country. Recently, the evidence of poor rainfall distribution has been experienced in the Mudzi Rural District as shown in Table 1. This indicates that the views of the respondents agree with the observations in the published literature.

Figure 6.2 shows the rainfall distribution in the Mudzi Rural District. The rainfall has been poorly distributed from 2012 to 2019, except for the 2016/17 season, which experienced above average and evenly distributed rainfall. The poorly distributed rainfall in Zimbabwe implies that there is an increase in the food prices and food insecurity. In addition, it reduces the income from the agricultural-related activities (International Medical Corps, 2020). The respondents also pointed out that the temperatures have increased gradually in the district because of climate change.

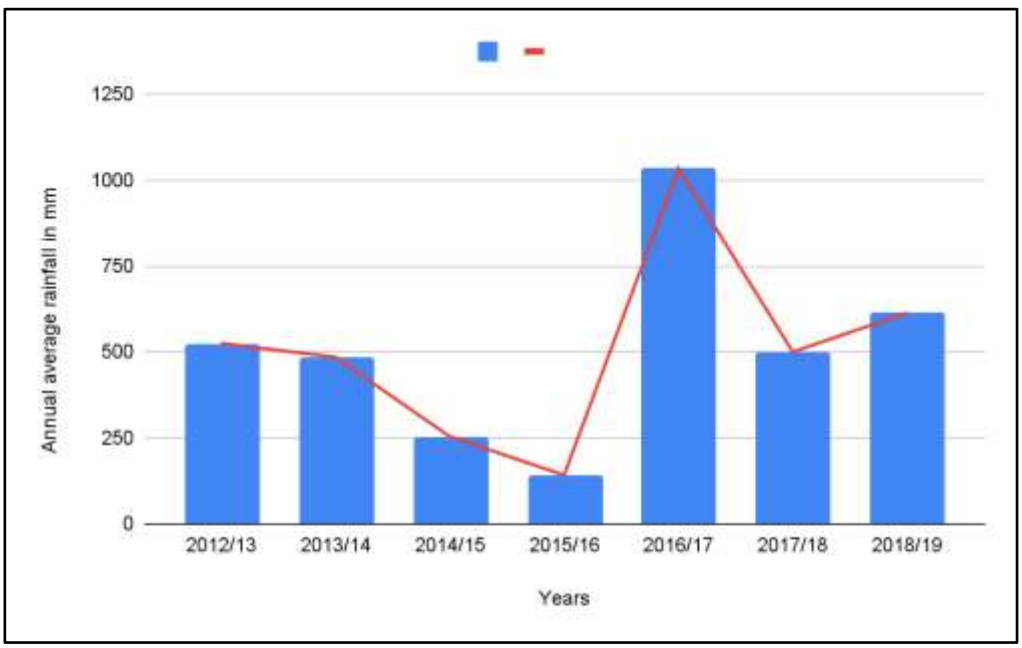


Figure 6.2: Rainfall distribution for Mudzi district as of 16 November 2019

Source: Agritex Department, Mudzi District Rainfall Records (2012-2019)

"The temperatures have increased. Usually, October and November were the hottest months, an indication that it was going to rain. Currently, the temperatures get very high, yet we do not receive any meaningful rainfall" (Interviewee # 09).

The temperatures and rainfall have been used as proxies for detecting climate changes (Kusangaya et al., 2014). The respondents' views concur with the other studies conducted in other parts of Zimbabwe (Unganai, 1996; Brown et al., 2012; Chanza & Jakarasi-Gundu, 2020). For instance, Gwimbi (2009) found that 60% of the surveyed farmers believed that there has been an increase in temperatures over the years. Maddison (2007) studied 11 African countries and was informed by the farmers that the temperature had increased whilst the rainfall had decreased. Similarly, the evidence from Brown et al. (2012:3) has shown that Zimbabwe has experienced an increase in hot days since 1950 with daily minimum and maximum temperatures rising by approximately 2.6 and 2 degrees over the past century. However, most of the researchers that are mentioned above have carried out their studies at a macro level in Zimbabwe. This has left missing or little data at the micro level.

The results showed that the livelihoods of the people in the Mudzi Rural District depend on agriculture. Any shift in rainfall patterns and temperatures affects their food security and the provision of water. During the FGDs, when asked how the increase in temperatures and the shift in rainfall pattern affects them, the respondents stressed the low agricultural yields, water scarcity, crop diseases, morbidity, and mortality of humans and livestock. These effects lead to food insecurity in the district and ultimately affects the livelihoods of the people living in the district.

6.5 Roles of women in the Mudzi Rural District

This study finds that the women's roles and responsibilities shape the differential vulnerability to climate change. For example, most of the women who were interviewed reported that they spend at least more than 8 hours working in the field and walking long distances to fetch water, which exposes them to extreme heat resulting in stress and other health-related illness. The women's risk to the effects of climate change in the Mudzi District increases directly proportional to their age, capability, as well as to their economic and marital status. This finding is consistent with the IPCC Fifth Assessment Report, 4 which recognised the differentiated impacts of climate change due to age, class, gender, ethnicity, and (dis)ability.

The findings from the questionnaires, the FGDs, and from the in-depth interviews have shown that women constitute most of the population in ward 4, 5 and 6 with an essential role in fetching water for drinking, cooking, cleaning the house, laundry, and bathing. This daily utilisation of water calls for the women to visit the water sources several times. As a result, women use more water than men for their practical gender needs such as cleaning the house, cooking and bathing the children (Makoni, 2015).

The survey results show that 76.47 % (n= 145) of the respondents indicated that women are the ones who have the role of fetching water for domestic purposes, 5.88% (n=11) indicated that children have that responsibility, whilst 17.65% (n=34) have indicated that the whole family has that responsibility. It is interesting to note that most of the men in the survey did not specify that they have the role to fetch water, but rather indicated that the whole family has the responsibility of fetching water. This indicates that men do not consider fetching water as their primary role. During the male only FGDs, it was reported that the men can only assist women in fetching water in extreme water scarcity conditions. In the female only FGDs, the men's role in water collection was less visible and this enhanced the women's vulnerability to water stress.

The findings from the questionnaire survey indicated that 41% of the respondents fetch water from nearby shallow wells dug by the local communities for easy access of water during the rainy season. When the water level drops, the community members then make use of nearby boreholes, dams, and *mufukus* (wells dredged on riverbanks and river sand channels) as their alternative reliable sources of water. However, not only do women have to walk long distances to fetch water, but they also have to walk at least 4 kilometres in search of firewood for cooking and keeping warm in winter. Moreover, women who have stable incomes indicated that at times they have to pay other people to fetch water for them. Although the practice is strenuous on the ones doing the job, it reduces the labour of the ones who are paying for the service. The cost of carrying water was reported to be one US dollar per two 20-litre buckets.

Children at a young age in the community are socialised into these roles by their families. Similarly, Babugura (2009), Glazebrook (2011), as well as Jorstad and Webersik (2016) all deal with women and climate change. They carried out their research in different African countries and have all indicated an interrelationship between the women's roles and their vulnerability to climate change. While their studies do not specify which category of women is impacted the most, all the authors agree that the gender roles disproportionately increase the women's vulnerability to climate change.

The discussions with the female respondents revealed that the women are involved in income-generating roles to sustain the livelihood of their families. The income-generating roles indicated in Figure 2 are mostly rain-fed and seasonal, thereby making it difficult for the women to have constant financial resources for their household needs. Due to the marginal and the seasonal profits from the income-generating roles, most of the women are financially dependent on their husbands. To ameliorate the problem, one respondent was recorded as saying that in a time of low yields, she turned to basket weaving or *maricho* (casual employment) to supplement her income. The other women have also reported that they turned to beer brewing, fruit gathering, or cooperatives stokvels (informal credit unions/saving clubs).

6.6 Sensitivity: The current state of women to the impacts of climate change

The findings from the FGDs, the in-depth interviews, and from the questionnaires all concur that women are the most impacted by the effects of climate change. The vulnerability to climate change is attributed to the socially constructed gender roles of women, tradition, and culture. For example, the domestic and income-generating roles of women (farming, selling fruits and vegetable) make the women susceptible to climate change vulnerability. For instance, the women in all the FGDs have reported that the burden of walking long distances in search of water and the stress of providing food for their families amidst crop failure due to climate is detrimental to their health. This finding concurs with Tesso (2014), Alam, et al. (2015:11), and Rao et al. (2019) who state that societal gender roles differentiate access to resources and information, which then exacerbates the vulnerability of women to the impacts of climate change. Although the participants all agree that the women are the most vulnerable to the impact of climate change, they did not completely rule out the effects that climate change has on the men and the children.

In Ward 5, the focus group reported that the scarcity of water increases the distance the women have to travel to fetch water which is physically and mentally distressful. During the wet season, the women fetch water in local wells, ponds, and streams. The minimum time indicated for fetching water during the wet season was 20 minutes per single trip. However, the time increases as the water table drops. The maximum time for fetching water during the dry season was indicated as six hours. Most female interviewees mentioned that the scarcity of water from August to mid-December creates congestion on water sources thereby causing the time spent fetching water to double. As a result, most women struggle during the dry season to ensure a constant supply of water. If the distance to a quality water source is far, alternative poor- quality water sources are sought to save time. Also, the more time the people spend on water transportation from a source to a house, the less water they consumed to the detriment of their physiological and hygienic needs (Omarava et al., 2019).

Figure 6.3 presents the average time taken by the women to fetch water in all the selected wards. The findings are based on the period the research was carried out (August 2019- February 2020). The sample population in Ward 6 is (n)= 66, Ward 5 (n)=61 and Ward 4 (n)=63

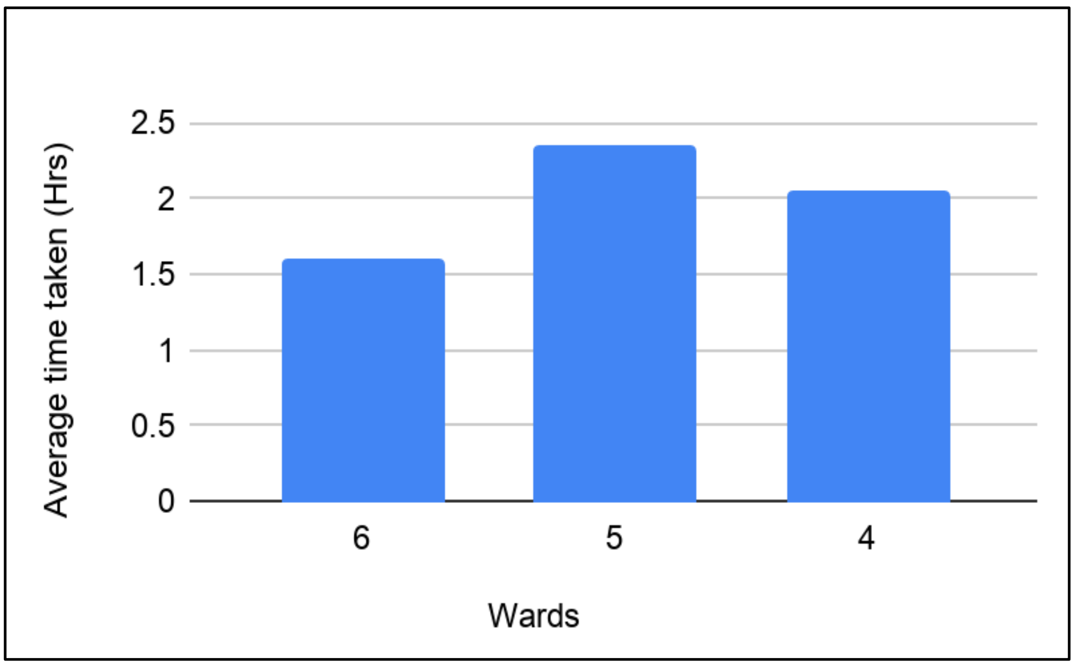


Figure 6.3:Average time taken to fetch water in the selected wards.

The discussions with the respondents reveal that their average time to fetch water is determined by the distance from the water source, the season, the congestion at the water source, and the efficiency of the water source. Whilst carrying out the study, it was observed that the Joromani village in Ward 4 does not have a functional borehole. During a women's FGD, the respondents stressed that they wake up around 2 a.m. to fetch water in the nearby villages. Waking up early enables women to avoid the mid-morning to afternoon scorching sun and to stand in long queues for a long time. It also enables them to return home early to do their daily domestic chores. When asked why it takes so much time to fetch water, a respondent in a female FGD reported that the borehole is in another village and there are usually long queues of people waiting to fetch water, which is something that the community has never experienced in the past. Also, as a result of many people pumping too much water from the borehole in an area facing inadequate rainfall, the borehole delivers less water, and the community members are left without any option but to wait for the borehole to recharge. Not only does the scarcity of water increase the women's workload, but it also limits the opportunities to assume the non-traditional activities (Flegel et al., 2009). In addition, the use of less-than-optimal water in addition to using poor quality water sources has serious implications on human health.

6.6.1 Human health

The women FGDs reported that climate change affects their health and well-being. The women's roles and responsibilities in the community make them more exposed to the heat than the men (Figure 4). During the women's FGDs in all the wards, it was reported that the women walk an average of two hours carrying 20-litre buckets of water and as a result, they often suffer from headaches, as well as back and chest pains. The elderly members of the women's FGD reported that they often suffer from painful legs as a result of walking long distances. Due to the poor income from the agricultural produce, most of the women are unable to access health services as well as adequate nutrition, which intensifies their vulnerability to the effects of climate change.

The discussions with the women revealed that to avoid walking long distances in search of water, they often fetch water in contaminated nearby water sources, or they share water sources with animals. This may result in them and their children getting sick with waterborne diseases such as diarrhoea and cholera. The UNICEF (2019), classified Mudzi Rural District as a cholera hotspot for the period of 1998- 2018, with 3 692 cases and 275 deaths. This amounted to an infection rate of 3,1 % of the district's population and a death rate of 7.4%. The WHO (2019) and Tawodzera (2016:58) observed that water scarcity is a leading cause of disease outbreaks such as cholera and diarrhoea. The women's susceptibility to cholera and diarrhoea can be explained in the context of their roles, which expose them to contaminated water. A few interviewees have reported that the financial constraints inhibit them from seeking quick medical attention. This increases the burden on the women who are responsible for the caregiving role and may increase the mortality rate of women in Mudzi.

A key informant in Ward 6 reported that as a result of the increased temperature in the district, malaria is becoming rampant. The key informant's view is supported by other respondents who reported that climate change has increased the cases of malaria in the district. The previous observations made by Matawa and Murwira (2013) as well as by Ebi et al. (2005:375) projected that the changes in the temperatures and in the rainfall are likely to alter the geographic distribution of malaria in Zimbabwe, with previously unsuitable areas becoming suitable for transmission, thereby resulting in illness and death. The key informant also added that the women in the district are more likely to suffer from malaria as a result of climate change. This view has been evidenced by Mundagowa and Chimberengwa (2020), as well as by Madziyire et al. (2016). Mundagowa and Chimberengwa (2020), found that 52% of the malaria rapid tests in rural Zimbabwe were women while the latter reported that the pregnant women are three times more likely to get severe malaria, which will result in stillbirths, miscarriages, low birth weights, and preterm labours. This implies that the women have to spend the little money they probably do not have for treatment, thereby leaving them in huge debt and increased poverty. The sick family member's chores will strain the close family members (usually the women who take on the role of nursing the sick) who have to take on the labour on top of their own. Due to illness, the women end up not doing productive activities, which reduces their income.

6.6.2 Land ownership

Most women in the district indicated that they do not own land n=84 (83.33%). During the FGDs with the women and from the interviews with the key informants, it was reported that the women are not directly given land. The land is allocated to the male head of the household by the headmen of the villages in consultation with the Ministry of Lands, Agriculture, Water, Climate, and Rural Resettlement. The survey has shown that two-thirds of the women who have indicated that they own land have inherited the land from their deceased husbands. If both are dead, the land will be inherited by their male child. However, if there is no male progeny, the land will be given to the brother of the deceased person or the eldest female child. The older male children are likely to inherit property from their parents because they are considered to be the rightful heir to family property (Toro, 2016:82). In addition, one of the respondents in a male FGD argued that the girls could not inherit the land because they get married and leave the household to live with their husbands. However, the basis for doing so was a result of the patriarchal system. However, this contradicts the law of inheritance which provides equal inheritance rights for men and women.

The land is a crucial asset for, food production, for the access to productive resources, and for sustainable development (Chigwenya & Ndhlovu, 2016:215). However, the lack of land ownership among the women in Mudzi may increase prevalence of poverty, low productivity, and lack of financial resources, which impede sustainable development. Moreover, with most of the surveyed women being landless, they are likely to depend more on men for security and provision, thus increasing the rise in social and gender inequalities. Moreover, it was also reported by the respondents in the Ward 6 female FGD that owning land influences decision-making and income distribution in the household.

Owning land is linked to further educational and financial services, which makes it easy for the people to adapt to the effects of climate change (Merrow, 2020). This could be linked to the fact that the inadequate resources for climate change adaptation make the vulnerable population susceptible to climate change effects (Garutsa et al., 2018:8). For example, the respondents from the FGDs and the interviews reported that the women in Wards 4, 5, and 6 constitute the greater population that works in the fields (cultivating, weeding, harvesting) and yet only 16.67 % of the total females that were surveyed indicated that they own land.

6.6.3 Crop failure

An Agricultural Technical and Extension Services (AGRITEX) officer stressed that as a result of climate change, the district has shifted from maize-production to drought resistance grains such as sorghum (*sorghum bicolor* [*mapfunde*]), pearl millet (*Pennisetum glaucum* [*mhunga*]), and rapoko/finger millet (*Eleusine coracana* [*rukweza*]). The informants also reported that this shift has impacted a lot of women since growing small gains is strenuous and labour intensive compared to the maize crop. Similarly, it has been observed that the drought-resistant crops have high labour costs for land preparation, weeding, harvesting, bird scaring, and grain processing compared to maize (Phiri et al., 2019:10).

The climate-induced crop loss has been cited as a major threat to the livelihoods of people living in the Mudzi District. The respondents in all the wards reported that climate change is affecting their crops, which results in household food insecurity. Due to the late onset of rainfall, the respondents have highlighted that they are now planting their seeds in mid to late December, which has resulted in extreme yield losses. “The high temperatures and poor rainfall are causing stunted and wilted crops in the field; our gardens are dry, and we cannot afford to buy fresh vegetables” (Interviewee #27). However, many of the respondents agreed that the extreme environmental changes have made hunger to be a common problem in the district. As a result, the community members are forced to find alternative sources of income to provide food for their families.

As a result of crop failure, women respondents in an FDG in Ward 5 reported that they are unable to pay for their children’s education and they are forced to go into areas that would have received adequate rainfall and do *maricho* (casual job) for income. However, not all the women will be able to have adequate income from casual work. The respondents in FGDs indicated that lack of adequate income pushes them to drop their children from school. Respondents also indicated that in most cases the girls are the ones that are likely to be dropped out of school. This is because there is a belief that the girls will eventually get married, and their husbands will take care of them. As a result, this inhibits the achievement of sustainable development Goal 4 of quality education and Goal 5 of gender equality (Pradhan et al., 2017). Thus, there is a need for policymakers and development practitioners to mainstream gender equality into climate change programs to ensure the sustainable livelihood of rural communities.

In a time of poor harvest, some of the female interviewees reported that they usually get income from selling wild fruits. However, as a result of high temperatures, decreasing amount of rainfall, and shortening rain seasons, the production of wild fruits such as *masau* (*ziziphus mauritiana*) and mangoes, which play an important role in augmenting household income in the district, has been severely affected. The fruits play an important role in the community’s diet and income. The fruits are usually gathered by the women and children and are then sold in urban markets. One interviewee highlighted that the fruits can also be barter traded for foodstuff, clothing, or maize meal in areas that are not severely impacted by climate change. With the low production of wild fruits, it means the community may face food insecurity and they may have no alternative income. This implies that they will not be able to pay for their children’s school fees, thereby resulting in mainly female children being dropped out of school. This would be linked to the fact that most female respondents never reached secondary education.

The six FGDs that were conducted reported that having many dependents in a household was linked to high food insecurity. The participants argued that the elderly women are usually left behind with their grandchildren whilst the younger generation migrates to the cities in search of alternative livelihood options. This does not only cause family disintegration, but it also puts considerable stress on the elderly women who have to find ways and means to feed their dependents in times of crop failure. However, the crop failure, coupled with hyperinflation and failed agricultural and economic policies in Zimbabwe inhibit the attainment of the sustainable development Goal 2 of ending hunger by 2030 (Mollier et al., 2017). Thus, there is a need to strengthen agricultural research and development with a focus on the most vulnerable population. This can be done by including the concerns and ideas of vulnerable groups in climate change policies and programs.

6.6.4 Livestock

One interviewee highlighted that the ruminant livestock such as goats and cattle are valued for their contribution to household income through meat and milk production. However, it appears that the erratic rainfall has caused severe grazing land shortages, which has negative effects on the reproductive and productive performance of the livestock. According to an FGD in Ward 5, during the dry periods of September to November, all the nearby surface water sources dry up as a result of the uneven distribution of rainfall and reduced rainy days. Consequently, the domesticated animals will not have any nearby surface water sources to drink from. This is problematic as the women are compelled to fetch water from the boreholes and put it in basins for the animals to drink. This role is strenuous and labour intensive considering that the women involved in this task have other daily chores to accomplish. However, this role is quickly abandoned in times of extreme water scarcity to conserve water. During the same period, the water point committee prohibits the members of their community from watering their livestock using the communal borehole. During a focus group discussion, a participant was recorded saying,

"...by October, Nyapfunde dam will be dry. Our cattle will be drinking muddy water from the dry dam. Cattle will be collapsing as a result of thirst. When we slaughter the collapsed cattle, their intestines will be filled with mud and they will be dry" (#10 female focus group participant, Ward 4).

The climate change increases water scarcity and affects grass production thereby leading to the starvation of livestock, thirst, poor health and may ultimately result in their death (Ward 5 focus group discussion respondent # 06). As the cattle move wider in search of water and forage, they become prone to the spread of diseases such as foot and mouth as experienced during the 2014/2015 and 2015/2016 drought seasons in Zimbabwe (Chanza & Jakarasi-Gundu, 2020:4). This then has negative implications on the food security and the livelihood of the rural-based people in Zimbabwe.

6.7 Differential impact of climate change on women

To rigorously examine how the different groups of women are being impacted by climate change, the in-depth interviews and the FGDs were carried out with different groups of women from different age groups, social classes, marital statuses, and educational levels. The results were analysed using the thematic content analysis and the findings have shown that the vulnerability of women to climate change is not uniform. The vulnerability of women to climate change in this study is differentiated by age, disability, marital status, number of dependents, and the availability of financial resources. The findings from the FGDs and the in-depth interviews have shown that women living with their husbands and those who are supported by their working children or relatives in the cities were regarded as the least vulnerable. These groups of women have been said to be the least impacted since they can afford to adapt to the effects of climate change. For example, these women can afford to pay other women or men with ox-drawn carts to fetch water for them. On the other hand, the elderly, the handicapped, and the widows with many dependents were reported to be the most vulnerable groups of women to the effects of climate change.

The migration of men and young women to urban areas in response to the effects of climate stress leaves behind the elderly females who would be caring for the migrant's children (Few et al., 2015:38). Due to additional responsibilities and roles, the elderly women in Mudzi have expressed that they are forced to travel long distances in search of water, which puts additional strain on their wellbeing.

In an interview, one elderly woman reported that her legs are often sore as a result of walking long distances to fetch water. The researcher later observed that it is often difficult for the elderly women to find someone to assist them to pump water from the borehole. Most of the elderly women have to wait for several minutes for someone to come and assist them. One elderly woman in the Ward 5 women's FGD stressed that she normally has to wait at the borehole for up to 30 minutes or even longer before she gets someone to assist her to pump water. After getting assistance to pump the borehole the elderly woman indicated that she also required assistance to put the 20-litre bucket on top of her head. She also stressed that she often faces challenges with children running away from assisting her since they do not want to be bothered. As a result of the challenges that the elderly women encounter in trying to fetch water, most of them are forced to limit their water consumption, which has detrimental effects on their well-being. Although several researchers have shown that consuming less water negatively impacts the overall well-being of a person, the impacts are severe in older women compared to the general population (Mentes, 2006; Benton, 2011; Białecka-Dębek & Pietruszka, 2018). A recent study by Bethancourt et al. (2020:3137) has shown that the older women face an increased risk of cognitive decline as a result of lower hydration levels compared to their younger counterparts. However, Bethancourt et al. (2020) did not show similar results on the older men.

The respondents also considered the disabled women to be disproportionately vulnerable to the impact of climate change and variability. The World Health Organization (1980) defines a handicap as “a disadvantage for a given individual that limits or prevents the fulfilment of a role that is normal” and disability, on the other hand, is defined as “any restriction or lack (resulting from an impairment) of ability to perform an activity in the manner or within the range considered normal for a human being”.

The disabled participants who were interviewed were all unemployed and had lower levels of education. These respondents depend on subsistence agriculture for their income. However, under conditions of climate change and variability, the interviewees stressed that they encounter considerable challenges, which include insufficient financial resources, limited mobility, and heat stress. It was observed that the heat stress affects disabled people more because they spend more time in the fields and making trips to the borehole. The respondents emphasised that the effects of heat stress impact their well-being and their capacity to cope with the environmentAs a result, the women in similar situations are left impoverished and unable to cope with the situation.

In a focused group discussion in Ward 4, a handicapped woman expressed that climate change has induced additional workload and this has become part of her daily reality. The woman explained that as a result of her underlying condition, she has to make multiple trips with a five-litre container, which is inadequate for her daily household usage. When asked if any people usually assist her, she explained that she often finds it difficult to get assistance from the people in her village since everyone else will be preoccupied with their own chores. This finding implies that climate change is increasing the existing inequalities among people, with disabled women being more affected as a result of being less resilience than their counterparts.

To support the above-mentioned stance, the WHO (2011) has shown that 20% of the poorest people worldwide have some form of disability and 82% of persons with disability in developing countries live below the poverty line. In light of this view, Lewis (2017:5) further illustrates that the disabled persons are often left behind when women of their same age migrate to the cities in search of employment. This then causes an increased hardship on the disabled women, leading to the deterioration of their quality of life.

The widows living with their grandchildren were among the groups of women who are regarded as the most vulnerable to the impact of climate change. As indicated in 5.1, the widows constitute 27.78% of the 89 respondents in this study. The participants reported in an FGD that as the heads of the households, they struggle to support themselves and their dependents in the absence of their deceased husbands, especially when their source of livelihood, that is, farming, is not yielding much. In support of this view, Horrell and Krishnan (2006: 6) in their study on poverty and productivity in female-headed households in Zimbabwe, found that the female-headed households are considerably poorer than their male counterparts. They also found out that the households headed by the widows have a total income that is just over half that of the male-headed households. This is also the case with widows in Mudzi district. Hence, widowed households are amongst the most vulnerable to the effects of climate change due to the lack of adequate resources to adapt to the phenomena.

In the absence of their deceased husbands, the women assume the male roles and responsibilities in addition to their own. Most men in Mudzi take care of cattle and goats while women look after poultry. One female participant in an FGD highlighted that she is now taking care of the cattle, a role that used to be for her late husband. This role has been regarded as constraining and labour-intensive. Despite having limited resources and knowledge, the women in Mudzi are left without much choice but to put up with the extra roles to ensure that their families are well looked after. The increase in the workload, however, negatively affects the women's overall well-being.

The women living with their spouses were reported to be the least affected by climate change in both the female and the male FGDs, and in the in-depth interviews. The main reason for being less impacted was that the couple can easily assist each other and can adapt to environmental change. The male participants in Wards 5 and 6's FGDs reported that in times of a severe water crisis, they often assist their spouse in fetching water. This leaves the women without spouses more vulnerable as a result of a lack of assistance.

Despite 61.11 % (n=62) of the women indicating that they are married and are staying with their spouses, one male participant in a male FGD in Ward 5 reported that the men are quick to run away from their homesteads when there is no food in the household. It was also stated that the men often go for artisanal mining in Makaha or the Benson mines, leaving behind their wives to take care of the children. This puts an extra burden on the women, who in addition to the domestic and income-generating roles have to exercise the roles of an absent husband. One respondent reported that at one point her absent husband appropriated the money generated by her for his consumption. This is because the migrant husbands might take a long period of time to settle in new cities and start generating remittances to their rural families.

One male participant in the Ward 6 FGD expressed the view that in the absence of men, women bear the heaviest consequences of environmental change as they struggle to fulfil cash income and food requirements to support their children. As a result, the women are forced to venture into prostitution, which can increase life-threatening diseases such as HIV/AIDS. In most cases when the women get sick, it becomes difficult to fully support their families financially and this increases their susceptibility to the adverse effects.

The participants also identified educated women as the least impacted by the effects of climate change. Analysis of the survey indicates that none of the female participants had acquired any tertiary qualifications by the time the study was conducted. Interestingly, the 27.78% who indicated that they have never been to school are above the age of 60 years (refer to Section 6.2) and this group is among the elderly who are one of the most vulnerable groups to the impact of climate change and variability. In addition, there was a clear correlation between the level of education among the participants and their perception and belief about the causes of climate change. For example, it was more likely that the elderly people would state that climate change was a result of people not respecting their ancestors or it was a punishment for the sins they committed. Those who have reached secondary level education were likely to state deforestation, pollution, and industrialisation as the causes of climate change. Despite the participants' level of education, all of them agreed that the climate is changing.

The survey showed that there was a correlation between the level of education and the number of children. The women who have never been to school and those who have attained only a primary level education had more children compared to those who have reached secondary level. Having many dependents makes these women struggle to feed their families because of financial constraints. The participants in a female FGD in Ward 4 reported that the women with several children turned to struggle the most in keeping their children at school. In addition, the girls are more likely to be removed from school and are less likely to continue their education, which results in early child marriages and later having many dependents resulting in a vicious cycle of the inter-generational vulnerability of women.

The studies by the World Bank and the Centre for Global Development have found that educating women and girls is one of the most cost-effective ways to reduce vulnerability and enhance adaptability to protect the people’s livelihoods from the effects of climate change (McLusky & Sessa, 2015). Similarly, Gasperini and Acker (2009) justify the latter view by stating that educated people have better health, food security, job prospects, coping mechanisms, and resilience in the face of adversity. Wamsler et al. (2012) also established that education plays a more determinant role for the women than for the men concerning their capacity to adapt. Although the studies show how formal education can improve the resilience of communities to the impact of climate change, they overlook the importance of local informal education and knowledge, which enhance the people’s ability to cope with climate change.

However, it was also observed that the women are not simply victims of the effects of climate change. The rural-based women in Mudzi are also agents of change and have unique knowledge and capabilities which can contribute to the climate change adaptation strategies. As a result of the scarcity of water due to climate change, the community members have resorted to indigenous knowledge in water management for sustainable livelihood in the district.

6.8 Water sources

The analysis of the questionnaire survey revealed that there are at least seven water sources in the study area, including wells, boreholes, dams, springs, rivers, ponds, dams, and *mifuku*. The common water sources used by many respondents include wells, boreholes, dams, and *mifuku* as shown in Figure 6.4. The interviews with the respondents have shown that the quantity and quality of water in these water sources have been declining due to an increase in temperatures and a decrease in the amount of rainfall. It was also observed that most of the water sources in the study area were dry or had a low volume of water (rivers, streams, dams, and wells) during the period of August to mid-December. Most of the perennial rivers have become seasonal as a result of climate change and variability. The decrease in water availability has led to a rapid increase in the water demand and a reduction in agricultural production.

The scarcity of water in Mudzi induced the changes in water habits and it has enabled the communities to utilize IKS and other adopted water management strategies to conserve water. The IKS strategies have been initiated using the down-to-top approach, thereby making the local community largely involved. As a result, there is a sense of ownership, and the communities strengthen their responsibility over the management of the resource.

The study found that during the rainy season, the respondents indicated that they rely on water harvesting and surface water sources such as streams, shallow wells, and rivers. Most of the respondents (47.1%) indicated that they make use of wells as a primary water source as shown in Figure 5. However, most of the wells, streams, and rivers contain water only for a few months during the rainy season, and during the peak of the dry season, the water users shift to other sources of water such as boreholes, *mifuku,* and dams. The shift to other sources of water generates competition on the available water sources and it increases the time spent fetching water. In addition, the shift to other sources of water results in the high dependence on the boreholes in the district. This then encourages the villagers to conserve water sources.

It was observed that Mudzi has imbalances in water availability and water demand. For example, Ward 6 is better endowed with water resources compared to Wards 4 and 5. Such imbalances imply that the available water resources will become insufficient earlier in Wards 4 and 5 thereby resulting in women walking long distances to neighbouring villages in search of water.

(a) Well

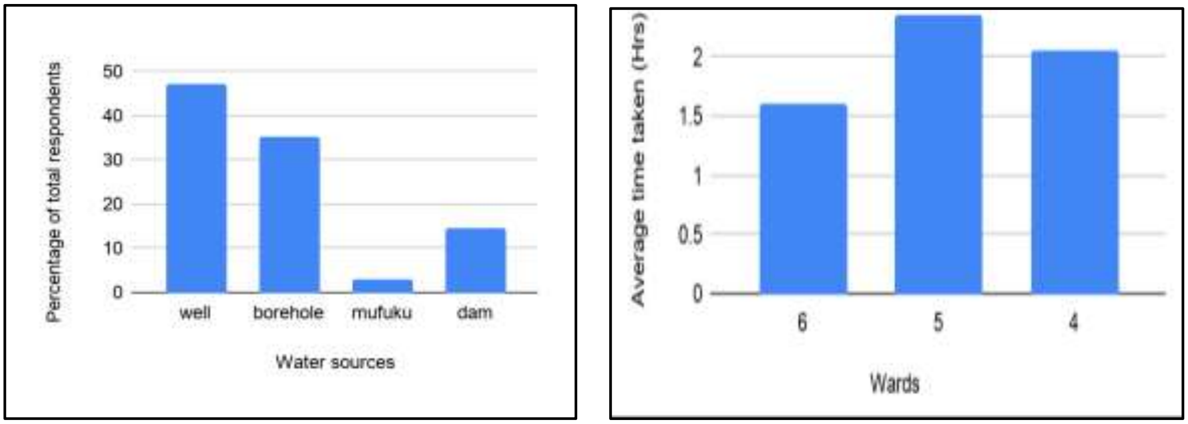
(a) Mufuku

(b) Chisero dam

(d) Borehole

Ward 6, August 2019

Figure 6.4: The main sources of domestic water in the Mudzi District



(a) **(b)**

Figure 6.5: (a) Common water sources at the household level. (b) The average time to fetch water.

The imbalances in water availability are evidenced by the ratio between the number of available water sources to the population and the difference in the average time taken in fetching water in the three wards studied.

Also, some villages in the same ward reported being more severely affected than others. For instance, due to high water demand, the women in Jeromani village, Ward 4, reported that they tend to wake up as early as 2 a.m. to queue for water in the neighbouring villages. The women in Ward 4 probably tend to fetch water early in the morning and late in the afternoon to avoid the sun's heat and to reduce their consumption of water whilst travelling to and from the water source. This local knowledge is applied by the villagers in response to the water scarcity that is caused by the effects of climate change and variability.

6.8.1 The water point management committee

A key informant in Ward 4 reported that as a way of conserving water, there are water point management committees at the ward level, and to a lesser extent at the village level. The committee typically consists of a chairperson, a vice-chair, a treasurer, and general committee members who are chosen among the villagers. The water point management committee is responsible for mobilising community members, gathering resources, and ensuring the maintenance and repair of the water systems. For example, when a borehole breaks down, they mobilise the funds for its repair. During an in-depth interview, another key informant revealed that the majority of water committees consist of at least 70 % women, who are the main custodians of water in the district.

The responsibilities of women in the committee include cleaning around the water sources, preventing seepage of greywater into the borehole, and managing the water sources. However, about 30 % of the men who form part of the committee were said to have the role of fencing around the water sources to prevent livestock from contaminating the water sources, thereby ensuring proper runoff.

To conserve water, the water point committee together with the community members in each ward have developed some rules that govern the use of water sources in their wards. For example, the community members are prohibited from using the borehole water for construction, horticulture, and animal husbandry purposes between the period of August and mid-December when the water table is at its lowest. The rules restrain the people from the excessive use of water, thereby allowing everyone to have equitable amounts.

In response to water scarcity as a result of the effects of climate change, the communities in the studied wards have developed a timetable for water users to fetch water. The timetable is used to ensure all the community members come at the same time to minimise the exploitation of water. The community members in Ward 5 have reported that they make use of secure locks on some of their boreholes as a strategy to conserve water and reduce the exploitation of water by the community members. However, it was later on revealed that the water committee is currently considering not locking their boreholes as there might be visitors or passers-by who might want to drink water from these boreholes. Giving water to visitors is an important tradition in Mudzi. As a way of welcoming the visitors, they are first given water, based on the assumption that they have walked long distances resulting in energy loss and dehydration. The next section will discuss the role of boreholes in the Mudzi district and the ways the community conserve water from this source.

6.8.2 Boreholes

The boreholes in the Mudzi Rural District are used by the community members in times of water scarcity, and they are optimally managed sustainably. The boreholes in the district provide safe and sufficient water for the needs of the households. Brazier (2017: 37) elaborates that the boreholes tape into aquifers, which makes them more reliable compared to the wells. A key informant reported that the Non-Governmental Organisations (NGOS) such as World Vision have made a tremendous effort in constructing and maintaining some of the boreholes in the district. All the boreholes in the studied area use manual hand pumps such as the one shown in Figure 6.6 and are community owned. Even though the boreholes are community-owned, it was observed that the community members who stayed close to the boreholes had more power over the management of the water source compared to those who stayed far from the borehole. The power is mainly derived from looking after the water source.

The boreholes in the district help the communities to meet their daily domestic water demands. During the rainy season, some of the boreholes support gardening projects which are usually abandoned at the peak of the dry season. Using the data gathered (Table 6.1), on average a single borehole serves about 321 people per day. A person requires a minimum of 40 litres per day during the rainy season. During the peak of the dry season, a person is limited to one bucket (20 litres) per day as a strategy to conserve water and to allow equitable the distribution of water.

As shown in Table 6.1, the total number of functional boreholes in Wards 4, 5, and 6 amount to 84 serving approximately 27 000 people. The respondents in the study said that some of the boreholes were no longer in use as a result of breakdowns, the lack of spare parts, and a decrease in the water table. The number of non-functional boreholes in the three wards amounted to 33, which is quite a substantial number to increase water insecurity. However, a combination of regulations and changes in habits enables the communities in the district to conserve water.

Table 6.1: The correlation between the number of boreholes and the population in the study area.

Administrative Ward	4	5	6
Number of villages	33	42	45
Number of households	2 085	2 017	1 474
Number of functional boreholes	27	27	30
Number of non-functional boreholes	17	6	20
Population	10 425	8 570	7 993

Source: District Agritex officers for Wards 4, 5, and 6.

Figure 6.6: A borehole in Seven Village, Ward 6, Mudzi Rural District (August, 2019)

6.8.3 Protected wells

Wells are a common water source that provides natural water storage and are prevalent in the Mudzi Rural District. The wells are dug as a means of providing water for domestic and agricultural use. However, most of the wells are not deep enough to ensure water security throughout the whole year. The wells are usually dug close to the people's homesteads so that the water users do not have to travel long distances to access the water. Digging a well at the homestead is a common practice of securing water and reducing pressure on the communal boreholes in the district, especially when reliable community water supplies become defunct. The wells are common in the district because of their low construction cost and minimum maintenance.

Indigenous knowledge is used by the experts within the community to locate the right spot at which to dig a well. The presence of certain species of trees such as the *muonde* (fig tree) and the *muhute* (*syzygium cordatum* tree) is indicative of an underground water source. These are often subsurface dams/sand dams or riverbeds with high groundwater tables. Their lower depths allow for manual excavation within a brief period (Aroka, 2010:7).

The discussions with the respondents revealed that all the wells are excavated during the peak of the dry season to yield high volumes of water. The wells are often deepened as the water level falls so that the wells still tap some groundwater (Africa Groundwater Atlas, 2019). The sides of the well are lined with bricks to prevent collapse, and a wellhead cover is used to minimise the threat of pollution, contamination, and evaporation. The water from the well is raised by a rope and a bucket, which then rest on the concrete well slab when not in use.

The interviews conducted in the study area revealed that the communities make use of a rotational timetable to manage the water table and the fetching of water in the well or the borehole. For example, a well in the Chikwati village is used by the school learners, the teachers, and the parents. In the morning (6 am to 8am), the priority to fetch water is given to the teachers so that they can do their chores and get to work on time. The parents and learners are only allowed to fetch water from the well from 9am to 3pm. The teachers are then given another opportunity to fetch water from 4pm to 6pm after work. After 6pm the well is then locked to secure the water source from being exploited during the night and to allow the natural recharge of the water.

The informants also reported that during the dry season, the households are limited to a maximum of 40 litres of water per day (the amount reported is said to decrease as the water level decreases) and the community members are prohibited from watering their gardens using the water from the well (Interviewee # 18). However, it has been observed that some wells are more reliable than others during the periods of low rainfall and most of them tend to dry up during the peak of the dry season. When the wells dry up most of the community members are left with no other option but to shift to the limited communal boreholes.

Figure 6.7: A woman removing the cover of her dry well in Chikwati Village, Ward 6 (August, 2019)

6.8.4 Mufuku

A village head from Ward 6 explained that mufuku is a name derived from the act of digging on the riverbed (kufukura). Mufuku is a source of water that is dug once the water in a seasonal river drops below the surface of the sand. The community members usually excavate the sand up to the water-bearing layer and then a bucket with both sides open is inserted into the wet sand. The water source is usually covered with thorn tree branches or a lid to protect it from the animals and to reduce evaporation (Clanahan & Jonck, 2005:26). This water source is mainly used for domestic needs such as drinking, cooking, and laundry. The limited diameter (up to 30 mm) of the water source and the use of a gourd cup (*mukombe)* to fetch water in *mufuku* makes it difficult for one to draw lots of water thereby contributing to water conservation.

The water that is sourced from the *mifuku* (plural) is mainly used during the peak of the dry season when most of the rivers and other sources of water are dry. The water source is mainly used in conjunction with the communal boreholes. The water is used for drinking and domestic purposes. It was observed that the villages that are close to the river make use of *mifuku* as a primary water source and also the further away one's from the borehole, the more likely they are to use *mifuku* or deep wells as an alternative water source.

The findings of the study have shown that the rules and the regulations that are imposed on the use of wells are similar to those imposed on the *mifuku*. Water rationing is done in the community to conserve water. The water committee make decision to restrict villagers to 40 litres of water per person and then 20 litres of water depending on the level of the water table and the increase of water demand at the source. Also, the watering of the animals and the plants using *mufuku* is prohibited during the dry season.

6.8.5 Dams

All the wards in the study area have a dam (Shinga dam in Ward 4, Katoto in Ward 5, and Chisero dam in Ward 6). The respondents in Wards 4 and 6 have reported that the dams were built mainly for irrigation and which has contributed to the increase in food production. However, before the construction of the dams, the traditional leaders in the district are called for traditional rituals to be performed at each dam site to ensure the sustainability of the water resource. A key informant was recorded as saying,

"Takapira kuvadzimu, tikabvisa makuva aive ari panzvimbo yaida kuiswa dhamu. Tikaenda kumasvikiro, headman na chief vakapa bikiro nekuvasuma zvirimaringe nekugadzira dhamhu" (Key informant interviewee # 03).

The key informant explained that before the construction of the dam, all the graves that were at the site where the dam was to be constructed were removed as it is a local belief that an adult person's grave is not supposed to be in close contact with water, "*Mufi haafanire kupindwa nemvura" (Key informant interviewee # 03).* The belief is that if an adult is buried close to a water source or if the corpse gets wet it will result in the appearance of *dzimudzangara* (ghost). After the removal of the graves, the local women were tasked with brewing the traditional beer made from sorghum that is presented to the ancestors. The beer is used to appease the water spirits so that they protect the water source and make sure it does not dry up. This practice ensures that the dead bodies do not pollute the water source, thereby helping the local people to protect and conserve the water in their dams.

The study noted that although the government provided monetary and technical support in the construction of the dams in the district, it is the role of the local community to promote the sustainable utilisation of the water resources. For example, the women in Wards 5 and 6 have reported that various rules and regulations guide the community in the way they use the water. For instance, the local community members in all the three wards are not allowed to cultivate close to the dam as this will cause siltation problems, which lowers the water level, thereby resulting in the dam not delivering irrigation water requirements throughout the year (Moyo et al., 2017:745). In addition, the regulations and the restrictions have been put in place by the water resource management committee in their villages to prohibit community members from swimming and doing their laundry in the dam. The use of soap in the dam when doing laundry causes pollution and affects the aquatic life. It was noted that the elderly population has a strong belief that the water-living animals such as frogs are essential and are associated with protecting the water source from drying up. To minimise the risk of water pollution, stiff penalties are imposed as a deterrent to potential polluters. The restrictions ultimately contribute to the sustainable conservation of water resources.

Noticeably, most of the horticulture production in the district is located close to the water sources, mainly the dams and the communal boreholes. This makes it easy for the farmers to irrigate their crops using irrigation pipes or buckets. The use of irrigation pipes is short-lived as it is replaced by the use of bucket irrigation from September to mid-December when the dam water levels are at their lowest. Instead of using running irrigation pipes, the farmers use buckets for watering their plants, which reduces runoff thereby conserving water in the dam.

6.9 Agricultural water conservation strategies

6.9.1 The bucket irrigation system and weed control.

The bucket irrigation system is an agricultural water management technique that is used in the district to conserve water during the peak of the dry season. Evidence shows that 29% of the total surveyed population linked their roles to gardening. Most women in the district grow various vegetables such as kale and tomatoes which provide additional income. The income from the produce is used to buy domestic animals, and household furniture as well as to pay school fees.

As already stated, most of the gardens are located close to the surface water sources to ensure stable access to water during the rainy season. The gardens observed range from 70 to 150 square metres and most women make use of watering buckets or watering cans to irrigate their gardens early in the morning or in the evening to reduce water evaporation. A key informant supported this watering method by stating that it is an efficient water-saving approach if done appropriately on a levelled field, as the villagers only apply the exact amount of water that is needed for a basin. Also, optimal water efficiency means minimising losses due to evaporation, runoff, or subsurface drainage (Kumari & Singh, 2016:77). However, the bucket irrigation systems are mostly used by people with gardens close to water sources to avoid the loss of water during the transportation process.

In an interview the Agritex officer reported that the villagers conserve water in their gardens by constantly removing weeds that compete with the vegetables for water. The key informant added that weed control is important because the weeds use water that could later be used by the crops. What should be noted is that not only does remove weeds contribute to the conservation of water, but it also decreases yield losses (Abouziena et al. 2014). However, such knowledge is important for planning, proactive climate change adaptation measures in rural areas.

6.9.2 Mulching and pfumvudza ("new season") concept

During an in-depth interview with a key informant in Ward 4, mulching was noted as a water conservation method that is used by the community members. Mulching is the application of organic and inorganic covering material on the surface of the soil to minimise moisture losses, and weeds, as well as to enhance the crop yield (Kader et al., 2019). Mupungwa et al. (2012), Kader et al. (2019), and Kodzwa et al. (2020) have all shown that mulch conserves water. Mupungwa et al. (2012) as well as Kumari and Singh (2016:77) elaborate that mulch aids in retaining moisture by reducing evaporation and runoff thus increasing infiltration while reducing crop failure. This is supported by Kodzwa et al.'s (2020:7) findings, which have shown that mulch is important in conserving moisture during the dry spells on the grain yield. This implies that mulch is an important method in water conservation, and it is also an adaptation to the effects of climate change.

The study also found that the communities in the district adopted the *pfumvudza* concept. The concept, which means “new season”, has similar benefits to that of mulching in conserving water. The concept requires the digging of planting basins which will be covered by mulch before the start of the rainy season to allow the farmers to plant their crops with the first effective rains (Edwards et al., 2014:107). The key informant in Ward 4 also reported that should there be erratic rain, the small plot (16m x 39m) that is used for the concept can be irrigated by water buckets. The harvested maize is said to feed a family for the whole year. The precision application of manure in planting basins ensures that the moisture is maintained around the rooting zone as well as fertility. Another method that is used for water conservation in the district is the use of sandbags obstruction.

6.9.3 Sandbags obstruction

Sandbags obstruction is a system that is designed to abstract water from an alluvial aquifer such as river sand beds to conserve water for use when the river surfaces dry (Clanahan & Jonck 2005:1**)**. The respondents in the Ward 4 FGDs as well as the key informants in Ward 6 reported that sandbag obstruction is a water harvesting technique that supplies water to the villagers. To create sandbag obstructions, the communities in Ward 6 recycle their sacks (jute-bags) and fill them up to two-thirds of their capacity with sand. It should be noted that not everyone is capable of using this water conservation method. The sandbags are then bedded across the river channels and streams, blocking the water flow/runoff, and capturing a considerable volume of water to make a weir dam. Thus, instead of the water flowing down the stream, water is sustained for an extended period, thereby minimising the wastage of the rainwater.

The sandbag obstructions are only used temporarily to harvest water during the rainy season. The water that is harvested is mainly used for domestic (laundry, cleaning, bathing) and agricultural purposes (watering the garden and watering the domesticated animals). In addition, the water may be used for building houses, as well as latrines, and for the structures for the domesticated animals. However, only a few people in Ward 6 make use of this water harvesting technique. This is mainly because the method is laborious. For example, to fill in one sack with sand requires two people, one holding the sack whilst the other is filling the sack with sand. The sandbags also require to be lined up across the river channel. Despite these limitations, the study reveals that sand obstruction contributes to water conservation in the district. However, not only do sandbags conserve water, but they also reduce erosion and land degradation by stemming flow velocity and encouraging sediment settlement. This eventually slows down the aridity in the region (Prasad et al., 2014).

6.9.4 Crop substitution

The AGRITEX officer in Ward 4 reported that the district is no longer suitable for the growing of maize because of unpredictable rainfall during the past years. As a coping strategy, the community members in the studied wards have switched to low water-consuming crops. The farmers have shifted to the development of small grains (sorghum, finger millet, and pearl millet), to compensate for the growing of maize, which is used to prepare *sadza* (thick porridge) a staple food in Zimbabwe. This enhances the people's resilience to the effects of climate change. As previously noted, agriculture is the dominant source of livelihood in Mudzi, and it is also the biggest consumer of water resources. Hence, growing small grains is an effective adaptation and water conservation strategy, since such crops can withstand high temperatures and thrive in dry areas (Mathew, 2015:53).

6.10 Domestic water conservation strategies

6.10.1 Water harvesting

Rainwater harvesting is used to augment the water supply and to reduce the water demand in the district. Rainwater harvesting is a low-cost technique that involves receiving, collecting, storing, and using rainwater for domestic and irrigation purposes. The method is used alongside the traditional water sources. The technique is implemented as a means of combating the detrimental effects of climate change (Aroka, 2010:10). However, the erratic rainfall makes it difficult to meet the water demands in the district.

The respondents in Mudzi have reported that they make use of domestic rainwater harvesting in times of adverse rainfall to sustain their water demands. The water is collected from the corrugated rooftops and stored in 20-25 litre buckets, and in some tanks for livestock and domestic use. The informants with houses that do not have corrugated rooftops reported that they have to ask their neighbours for permission to use their rooftops to harvest rainwater or put their buckets at an open space. However, those who cannot be involved in joint rainwater harvesting with their neighbours have the option of collecting water in shallow wells or riverbeds. When the water is harvested, it is sometimes treated using diluted sodium hypochlorite solution, for safe drinking purposes (Kumwenda et al., 2014:2). Nonetheless, only a few respondents reported that they can afford to purchase the solution.

The discussions with the respondents revealed that many households make use of multiple buckets to store water since most of the villagers cannot afford to buy big water storage tanks. The respondents were of the view that storing harvested rainwater in many buckets helps to conserve water that could have been wasted through runoff. The buckets are then closed with lids to help reduce potential losses through evaporation. Harvesting rainwater and storing it in buckets does not only conserve water in Mudzi district but it also spares the water users from walking long distances in search of water. It also reduces congestion and the demand for water on communal water sources.

Harvesting rainwater also contributes to the replenishment of groundwater (Aroka, 2010:5). The discussions with the respondents also revealed that water harvesting increases agricultural yields, which enhances financial security in their households. The water that is harvested is used by some of the community members to grow vegetables which are then sold to the market for income. Water harvesting can result in improved rain-fed agriculture production during the mid-season dry spells thereby improving household food security and livelihoods.

6.10.2 Water recycling

Recycling and the reuse of freshwater have been turned into a common adaptive practice to water scarcity in the district. Formerly, water recycling was a response to the prolonged dry spells. Currently, water recycling and reuse is a viable water conservation method that is used to address the alarming demand for water in the district. The study found that the wastewater from bathing, from laundry, and from the washing of hands is often used for domestic and irrigation purposes. For example, most women reported that the wastewater from the washing of hands before eating is used to wash the dishes, which will then be rinsed with clean water. Additionally, the women make use of limited detergents when washing the dishes to limit the rinse water that is required. The wastewater from the washing of the dishes is used for household cleaning and eventually to irrigate the household garden. However, water recycling may have a negative effect on human health when consumed. Thereby, it will also contribute to the achievement of sustainable development Goal 6 which is related to clean water and sanitation (Firmansyah et al., 2021).

In an interview, a woman in Ward 5 expressed that after bathing her children, she immediately used the water to wash the children's clothes and then finally irrigate her home garden with the same water. The some of the interviewees explained that the time she would have gone to fetch water for washing the children's clothes is saved by using recycled water. Thus, not only does recycling and reusing water conserve water but it also saves the time, to be utilised for productive activities.

Whilst the women in the FGDs highlighted the recycling of water for domestic and irrigation purposes, their male counterparts had an interesting way of conserving water. The respondents in the male FGDs have highlighted that at times they have to repeatedly wear the same clothes for 2 to 3 days. In addition, some men also reported that they have to skip bathing some days to conserve water and not to strain women who have to walk long distances in search of water during the dry season. This behaviour is socially expected of men in society but not expected for women. According to the respondents, the local recycling and the reuse of water reduces the amount of water that is withdrawn from the communal water sources. This helps in securing the existing water sources and increasing the water supply.

It is fundamental to know the perception of the rural-based population's knowledge about recycling and reusing wastewater to conserve and manage the resource. This viewpoint is unlike the previous studies done by Mandevere (2015), Asano (2005), and Nhapi (2004) which mainly focused on recycling and the reuse of water in urban areas. However, to fulfil Goal 6 of the Sustainable Development Goals adopted by the United Nations in 2015, which involves achieving access to adequate and equitable sanitation and hygiene for all and supporting and strengthening the participation of local communities in improving water and sanitation management, there is an urgent need to design a range of cost-effective solutions that address the health and pollution threat from recycled wastewater.

6.10.3 Dry toilet system

Most households in the studied area make use of a dry toilet system. A waterless toilet system is a decentralised compost system that processes human waste within its confinement (Olanrewaju, 2015: 1). The respondents in all the wards make use of waterless latrines, which overcome the issue of water scarcity in the district. The use of dry latrine systems conserves between 25 to 30% of the total household water consumption (Zaied, 2018:1). Not only does this type of toilet conserve water but it uses bacteria to break down organic materials into a nutrient-rich fertilizer that can be applied to trees and other plants (Olanrewaju, 2015: 2).

Some of the households observed make use of waterless latrines in conjunction with a tippy tap (*chigubu* gear) to conserve water. A tippy tap is a simple device that dispenses a limited amount of water slowly and facilitates a thorough hand wash after using the latrine. Using a tippy tap, the villagers conserve water by having a good hand wash with only 60 to 80ml of water (Kumari & Singh, 2016:77).

The latrines were located more than 30 metres from the shallow wells for hygienic practices. However, there are health risks that are associated with the use of latrines if not properly managed. Hence, more is needed for the community to observe the WHO guidelines on sanitation and hygiene to make water conservation effective by using a dry toilet system (WHO, 2018). Nonetheless, with the current focus on increasing the access to sanitation, urgent research is required to ensure that this is done without compromising the quality of groundwater resources on which the community water supplies depend on.

6.10.4 Dry vegetables (mufushwa)

In the dry season, the community members are prohibited by the water committe from watering their gardens as a measure to conserve water. This then results in a widespread shortage of fresh vegetables throughout the district, causing the price for fresh vegetables to increase beyond the reach of the low-income community members. To solve this problem, the surplus fresh vegetables that are produced in the wet season are thoroughly rinsed with water, cut and sun-dried, or boiled before being dried by the women. The vegetables are then conserved for consumption during the dry season when the household incomes are generally low.

Most cited dried vegetables include kale (*brassica oleracea*), okra (*abelmoschus esculentus*), cowpea (*vigna unguiculata*) leaves, cabbages, and tomatoes. Not only do the women dry the vegetables but they also dry legumes such as kidney beans and fruits such as ziziphus mauritiana (*masau*), which are then sold door to door or on stalls along the Harare-Nyamapanda Road. These dried horticulture commodities contribute a lot to the diet and the nutrition of the people living in the district. One respondent in an interview was cited saying that the sun-dried fruits, legumes, and vegetables, if stored properly, can last a household for 12 months.

The drying of horticultural crops implies that the small-scale farmers will be able to conserve the water that is meant for irrigation. The conserved water is then used for drinking and other domestic purposes. For instance, instead of using water from the well for watering horticulture crops, the local communities will conserve that water for household consumption thereby utilising the conserved water for an extended period.

Figure 6.8: Vegetables being sun-dried. Ward 6, August, 2019

6.10.5 Harvested livestock fodder (maize residue)

Mudzi is traditionally a livestock-producing area and livestock is regarded as a key asset. However, the severe water scarcity affects the livestock, thereby leading to death in some cases. To ameliorate the death of livestock due to hunger, the small-scale farmers in the district harvest maize residues and lay them on top of the kraal to dry as shown in Figure 6.9. The fodder will then be used to supplement the livestock feed when the communities are confronted with the loss of grazing during the dry season.

Harvesting fodder reduces the unnecessary loss of water to irrigation. Without fodder, some farmers irrigate grazing land using the already limited water resource or do nothing, which has proven to be costly for the farmers. Hence, the use of fodder also contributes to water conservation, and it spares the farmers from walking long distances in search of pastures.

Figure 6.9: Dried maize stalks. Ward 5, August 2019.

6.11 Traditional beliefs on water conservation

The elderly people living in the Mudzi Rural District have a strong belief that the spirit mediums *(masvikiro*) and the ancestral spirits (*vadzimu*) are key towards the provision of rains by God (*Mwari/ Dzivaguru) (*Aschwanden, 1988). The spirit mediums, traditional leaders, and the elders in the past performed rain-making rituals in the district. The mediums often suggested that the erratic and inadequate rains are indicative of a failure to appease the ancestors (Fontein, 2015:4). Nonetheless, Fontein (2015) argued that the role of *masvikiro* has been embraced at the very highest levels, but this has never amounted to sustain the incorporation into the local government structures in the way the chiefs have been. This then results in the marginalisation of the role of *masvikiro* in the communities.

The elderly respondents reported that the practice of rain-making rituals in the district for water security has diminished over the years. The elderly respondents have blamed the discontinuation of the practice on the emergence of churches and the influence of western practices during the colonial period. This view contradicts Muhlanga and Garusta (2014:157) who have blamed the elderly (the custodians of indigenous knowledge) for failing to disseminate the information to the younger generation. Traditionally, the elderly were the ones that prescribed the role of facilitating water rituals. Although the elderly respondents blamed the Western cultural influence and the emergence of Christian churches, it is worth noting that the middle-aged respondents partly blamed the elderly for not imparting the tradition and knowledge of securing water through rain-making rituals to the young generation.

The elderly women and men were asked about the practices that they used to do to conserve water. All the participants seemed to agree that the mountains were a sacred place for *mhondoro* (the local territorial lion spirit that is responsible for rain making). According to the village headman interviewed in Ward 6, the *mhondoro* are close to *Mwari* who is responsible for the welfare of the people. These *mhondoro* spirits under the leadership of Chaminuka knew whether the rain was going to fall or why it was being withheld (Murimbika, 2006:17).

The respondents added that the people would go on top of the mountains to do *kuombera* (hand clapping) as a sign of showing respect to the ancestors while venerating and requesting the ancestors to intervene by 'giving the ground some moisture lest the children (community) die from hunger' [*own emphasis*]. The veneration is then followed by the pouring of traditional, home-brewed beer on the ground to formally address the ancestors reminding them of their rightful duties of looking after their people (Ndlovu, 2010: 27). The elderly respondents expressed that the ritual worked when conducted properly.

"... by the time we reached the foot of the mountain, rains would have already started falling" (an elderly woman in an FGD in Chikwati village, Ward 6).

The respondents in a female FGD in Ward 6 argued that the local community members no longer respected the sacred mountains, which belonged to the *mhondoro*. The violation of the sacred mountains has been partly regarded as the cause of low rainfall in the district. The blame for the violation of the sacred mountains has been partly blamed on the apostolic churches that go and pray on the mountains, and the churches that frown upon the ancestral venerations. Blame was also put on modernisation which has negatively impacted the belief to the extent that the ritual ceremony is no longer practiced in the district.

The discussions with the respondents during the FGDs have shown that taboos also played an important role in conserving and preserving water sources. The findings have shown that the community members were prohibited from constructing wells using cement as it was said to make the water source dry. Also, the community were only allowed to use gourds cups (*mikombe*) when fetching water at the well or in spring. In addition, the metal and the plastic cups were not allowed at the water source as they were said to make the water source dry up. Moreover, fetching water was done during the day, and the villagers were not allowed to bring metal tins to the water source, especially the ones that would have been on the fire. These taboos were observed to avoid the contamination of the water sources which would result in the water sources drying up.

The respondents also highlighted that it was taboo for the women who are breastfeeding or for women having their menstrual period to fetch water at the water source. This was done to limit the contamination of water with breast milk and menstrual blood. An elderly interviewee reported that these taboos were there because the acts were disapproved by the ancestral spirits and if they were to be done, the water source would dry up. In addition, the water resources such as springs were reported to be sacred. The elderly respondents reported that before fetching water, a ritual was done to thank the ancestral spirits for the water. However, the respondents in FGDs and in-depth interviews reported that some of the springs have dried up because of the villagers violating the regulations for abstracting water from the springs.

It is important to note that the various water conservation strategies that are being used by the communities in Mudzi to conserve water are crucial and should be included in the national climate change response strategy. Nevertheless, there appears to be a missing gap in climate change information dissemination in the district. The climate change information is more accessible to men than women. The community members as the key stakeholders in the activities surrounding their environment deserve access to climate change information to improve their environment positively. The limited access to climate change information reduces the women's ability to adapt to the effects of climate change.

6.12 Climate change information dissemination

The level of climate change information diffusion was evaluated, and the study found that the level of climate change information awareness is higher in men compared to women. A total of 87.5% of the male respondents indicated that they got the information on climate change through periodic meetings with their AGRITEX officers, the radio, the newspapers, the school, and speaking with their colleagues at the bottle stores. Only 27.7% of the female respondents indicated that they are aware of climate change information. However, the sources of women's climate change information are different from those of the men. Most women indicated that they got information on climate change from other villages or through hearsay. Although some of the respondents indicated that they have never had access to climate change information, all the respondents agree that the climate is changing, and they have relied mostly on their personal experiences as a source of information.

The findings indicate that other than gender, the demographic factors such as educational qualifications and age did not influence the climate change information access. It appears that the people who indicated that they have had access to climate change information were a mixture of people from all age groups, which included the educated and the less educated people. The role of the AGRITEX officers in disseminating information on climate change is exceedingly important. However, it is of concern that the meetings are made up of mostly men. This is mainly because the women are usually left behind taking care of the children, working in the fields, or engaging in other domestic roles. Having limited access to climate change information and being excluded from climate change discussions deepens the women's existing inequality. Inclusivity in the dissemination of climate change information to people with diverse characteristics such as age, education, disabilities, and socioeconomic backgrounds is a feasible option in reducing the vulnerability that is associated with climate change (Jones, 2016; Nwammuo & Nwafor, 2019).

One of the key informants that was interviewed was of the view that the lack of climate change awareness affects the women's ability to respond and cope with the effects of climate change, especially among the old and the disabled women. Hence, investing in mainstreaming gender will enable the attainment of gender equality. It will also increase the access to climate change information, thereby resulting in a rapid rise in economic growth in the arid and the semi-arid regions.

6.13 Gender equality and climate policy

To find out if the people in Mudzi were consulted before the crafting of the 2016 climate change national policy, and the climate change response strategy, the respondents were asked if they had been involved in any climate change discussions. The survey results indicate that none of the respondents have been involved in climate change policy discussions. This indicates that the involvement of rural-based people (women being the majority) in policy formulation and decision-making in climate change and adaptation is limited. This implies that their skills and experiences are often marginalised. A study by Perlaviciute and Squintani (2020) on public participation in climate policy making has shown that excluding the public from participation in climate change policy decisions fuels resistance, thereby leading to socially unacceptable policies. In addition, it also undermines public support, which is required to implement climate change mitigation policies.

A key informant in ward 6 reported that the development of sustainable climate policy and mitigation strategies requires the involvement of the public, the government, and all the stakeholders to integrate a gender perspective in their address of climate change. Thus, the 1995 Beijing Platform for Action recognised gender mainstreaming as one of the most effective ways to involve all the people in achieving gender equality (Ampaire et al., 2020:44).

From the findings of this study, it was gathered that to ensure equal representation for all in the making of the climate change policy, the policymakers need to make sure that the specific needs of the men and women are equally addressed. Excluding one group in discussions that is linked to climate change hinders the progress in attaining sustainable strategies that are used by that group to cope with the effects of climate change. However, extensive consultations among the stakeholders are necessary to produce an inclusive evidence-based climate policy and response.

Integrating gender equality into the climate change policy and programs requires effective coordination between the experts and the stakeholders in gender issues (NGOs, human rights/ women rights, etc.) and the Ministry of Lands, Agriculture, Water, Climate and Rural Resettlement. The coordination can help to address the negative effects of climate change on different groups of people thereby leading to gender-responsive mitigation action. For example, addressing the negative impacts of climate change on the women will result in awareness and advocacy efforts that lead to the amendments of the climate policy that fully considers the needs of both the men and women (UNFPA:1). An interviewee was recorded stating that it is certain that ignoring the women's perspective would mean missing their ideas and the skills that might lead to potential climate change solutions and a strong conscientious climate policy.

Another way of mainstreaming gender equality in climate change and the policies indicated by the key informants was through the use of a "bottom-up" approach and capacity building. Learning about the effects of climate change on gender from the grassroots level may result in improved comprehensive climate change policies. The policy may also give rise to an improvement in the climate change adaptation strategies which involves improved water management strategies. Also, incorporating the practical ideas from the women's point of view (the most vulnerable) in the climate change policy and programs generates benefits such as women empowerment and gender equity which facilitates growth in social development. Exploiting the practical strategies that the women are using to cope with water scarcity as a result of climate change enhances the women's full participation in climate change programs.

The discussions with the key informants revealed that adequate financial funding for capacity building, education, workshops, media campaigns, and outreaches on gender and climate change helps to explicitly address the effects of climate change on women. It also sensitises both men and women about the importance of mainstreaming gender equality in climate change policy. The funding for gender mainstreaming at the local level can be sought from the Ministry of Women Affairs, Community, Small and Medium Enterprises budget or the Green Climate Fund which is a fund for a global response to climate change. However, the mechanisms for gender mainstreaming require experts in the field of climate, water, and gender to ensure the dissemination of accurate information. In addition, the financial funds for the proposed strategies need to have adequate structures for distribution that considers a gender perspective in all phases of funding.

The regular monitoring and evaluation of the progress in mainstreaming gender equality into the climate change policy and programs have to be an ongoing process to ensure good service delivery. The monitoring and evaluation can be in the form of reviews, feedback, and the progress reports that are done by the independent gender specialists (with local knowledge) to ensure a gender balance and that the initiatives are adjusted and improved to increase their effectiveness.

Given the existing societies where the power of decision-making is predominantly done by the males and the gender gaps in the access to crucial productive resources such as land, and gender mainstreaming must be complemented with the actions that promote women's empowerment. This is mainly because gender-neutral runs the risk of reinforcing existing discrimination (United Nations Industrial Development Organisation (UNIDO), 2014: 5). Moreover, the failure of the climate policies to address gender equality hinders the success of climate change mitigation (Tafur et al., 2015).

6.14 Conclusion

This chapter has shown that the impacts of climate change on women are real. These impacts exacerbate the existing inequality in a society that has socially constructed gender roles. The socially constructed gender roles make women more susceptible to the effects of climate change. Climate change affects the women's health, increases the prevalence of poverty, reduces productivity, and reduces financial freedom. As a result of water scarcity, the women bear the responsibility of searching, drawing, and carrying water for domestic use. The sources of water, such as boreholes, shallow wells, dams, and the *mufuku* represent the most vital water sources in the district as a means of livelihood. These sources are being used to conserve water in the face of climate change. Integrating the indigenous water conservation strategies stated in this study remains a major challenge for policymakers and development practitioners. However, there is a need for all the stakeholders to join hands to put measures to improve water availability. The availability of adequate water will enable the community members to have access to reliable sources of water which will improve their well-being and adaptive strategies. While this study provided knowledge on how the women are being impacted by climate change and the water conservation methods that are being used to combat climate change, the knowledge has to be translated into action to increase adaptive capacity. The next chapter will discuss the research findings that were explored in this chapter.

CHAPTER 7: DISCUSSION

7.1 Introduction

This chapter provides a discussion of the major findings of the study, which are informed by fieldwork data on the vulnerability of women to climate change and the sustainable water management strategies that are being used to combat the effects of climate change. The chapter begins by giving an analysis of the communities' perception of climate change to understand how it is linked to the differential vulnerability of the people to the effects of climate change. This evaluation creates the basis for understanding why women are more susceptible to the effects of climate change. The chapter also offers a comprehensive understanding of how different women are impacted differently by the effects of climate change. However, despite the women being seen as victims of the climate change effects, the results of the study that are given in the previous chapter have shown that women are agents of innovations in water management. Thus, an analysis of the water management strategies that are being employed in the study areas was made. As the chapter unfolds, the ways in which gender equality can be mainstreamed into climate policy are assessed to help find ways to reduce the women's vulnerability and to attain sustainable water management.

7.2 A local perspective on climate change

The local community members in the Mudzi District all agree that the climate is changing although they differ in their perspectives on what is causing the climate to change. The community members have observed a decrease in rainfall and increasing temperatures as the key indicators of climate change. The residents of the Mudzi District perceive that the temperatures have increased, and the rainy season has become unreliable in terms of its amount, duration, and distribution. The district has been receiving rainfall for a shorter duration, coupled with poor distribution when compared to the past decades. For example, the onset of the rainfall has been reported to have shifted from mid-September to mid-December. However, the shift in rainfall and temperatures has spiked the water shortages, thus posing the challenges to women and this ultimately induced the community members to adopt water conservation strategies.

There is a general agreement in literature that the temperatures have increased, and the rainfall has decreased in Zimbabwe (Brazier, 2017; Ungani, 1996;). This study reveals that the community's perception of climate change is in accordance with the real trends analysis by Ungani (1996), IPCC (2007), Brazier (2017), and the World Bank Group (2021). Although their view is in line with the community's perception of climate change, the former has based their climate change analysis from a scientific perspective, which differs from the community's indigenous knowledge. However, the importance of the communities' narratives and the perceptions of climate change is not adequately appreciated in Zimbabwe. This has prompted this study to document the community's perception of climate change and the water management strategies to complement the existing scientific knowledge. Thus, the quest for climate change knowledge should not only be limited to scientific data but should also include local knowledge. Combining scientific data and local knowledge would improve the adaptation strategies and the livelihood sustainability (Basdew et al. 2017:58). In addition, the combined information is particularly useful in the Mudzi District where the climate change information is sparse. This has been evidenced by the participants' different worldviews on the perception of the causes of climate change.

García-del-Amo et al. (2020) have shown that the information on the local perception of climate change and the use of local knowledge to detect climate change is rarely collected. Most researchers and institutions (World bank, 2021; Brazier, 2017; IPCC, 2007; Ungani, 1996) have relied on the information that has been reported and documented by the meteorological departments to understand the national and the regional climatic trends. To discredit the use of local knowledge, Basdew et al. (2017) and Zuma-Netshiukhwi et al. (2013) point out that the indigenous weather forecasts are difficult to predict, especially with regards to the quantities of the rainfall. This, among other factors, might be the reason the other researchers have only relied on data from the meteorological departments for environmental change. However, because of the sparse data on environmental conditions, the local climate information is mostly used by the communities in Mudzi to understand the climate trends. The sharing and documentation of cost-effective indigenous climate change information are likely to enhance effective and lasting climate change adaptation programs (Jørstad & Webersik, 2016: 986). When carried out using local knowledge through participatory means, the climate change adaptation programs may indeed lead to sustainable rural livelihoods, and it may also enhance local empowerment.

Regardless of all the participants agreeing with most of the scientific researchers that the climate is changing, they differ in their opinions on what is causing the climate to change. The elderly population of the respondents (61+ years) mostly viewed the change in climate as a punishment for not upholding the tradition and culture in the district. This view undoubtedly affects how people respond to the effects of climate change. Misinformation on climate change knowledge and awareness, can lead to misunderstanding between the community and the Ministry of Lands, Agriculture, Water, Climate, and Rural Resettlement. As a result, it limits the community's adaptive capacity. It is vital, therefore, that climate change awareness through capacity building and the training of local people on the causes of climate change by the climate experts needs to be strengthened.

Contrary to the elderly men and women's belief that the climate change is a punishment from God, most men (55.56%) knew about climate change and linked the cause of climate change to water pollution and deforestation. This view differs from that of most women who mostly rely on hearsay for climate change information. The men's perception of the causes of climate change can be linked to their higher education attainment, mobility, and the access to media compared to women. Contrary to this finding, the results of the study by Sraku-Lartey et al. (2020) show that the level of education and gender did not influence the perception of climate change of the communities in the Offinso Municipality, in Ghana. Apart from that, their study concurs with this study on age contributing to a person's perception of climate change. For instance, most elderly people in this study believed that the lack of adequate rainfall was a punishment for the wrong doings such as relatives marrying each other and people committing murder in the community whereas the young population believed it was a result of deforestation due to the increase in population.

The inadequate access to climate change information by women in Mudzi increases their risk of climate change misinformation. The men's mobility as a result of climate change makes them more exposed to climate change information when compared to the women. This is evidenced by the 31% of married women who indicated that they have their husbands working in urban areas as an adaptive response to the local environmental pressures. Whilst the men's mobility enabled them to have access to a wealth of information on climate change (daily newspapers, electricity, radio, social media, and television), it tends to compound the women's poverty and vulnerability (Denton, 2002:17). The women who are left behind struggle with the increased workload and they have to reshape their gender roles to fill in the gap that is left by their spouses. The discussions with the respondents showed that this tends to leave women impoverished and stressed, thereby negatively affecting their overall well-being. As a result, the progress of rural sustainable development is hindered.

For the women who are left behind, the lack of climate change information increases their vulnerability. Critical information in the media, such as cropping patterns, and weather reports influence the communities' adaptation capacity. However, the lack of this information results in crop failure and hunger. This implies that the source of income for these women will vanish, thereby pushing them into further poverty and vulnerability. The male migrants in the urban areas have better chances of accessing climate change information, which improves their capacity to respond to climate change compared to the women who are left behind in the rural areas. This is because the media plays a vital role in creating the awareness of climate change (Duku et al., 2018:16). It is also a valuable tool to access information on the weather updates, climate change, adaptation, and the mitigation activities, which are critical for sustainable livelihoods. It is therefore crucial that the women get access to climate change information. Although Section 4 of the Zimbabwe Climate Change Response Strategy of 2012 emphasises strategy enablers such as the use of the radio, television, drama, posters, and the pamphlets to raise public awareness of climate information, the government has not translated this into action. Through observation, the posters in the district are commonly placed at the growth points and around the rural grocery stores as well as the bars where the males usually socialise. This then leaves the women as still having limited access to climate change information. A more inclusive climate change communication strategy is therefore needed to increase climate change information. This may ultimately improve the rural-based women's adaptation to climate change.

7.3 Women and climate change

The critical effects of climate change in the Mudzi District are the increase in temperatures and unpredictable rainfall, which have caused the drying up of water sources. The respondents have reported that there has been a change in the rainfall intensity and distribution. Particularly vulnerable in the Mudzi District to these intensified weather events are the women who rely on climate sensitive agriculture. The vulnerability of women is further enhanced because the women make up a larger percentage of people living in the district. In addition, the findings have shown that the vulnerability of women to climate change effects has many interrelated causes, and it is determined by one's ability to adapt. Some of these causes include but are not limited to skewed power relations, cultural norms, and the inequitable distribution of roles, resources, and power (Onwutuebe, 2019; Yavinsky, 2012; Masika 2002). The respondents in the Mudzi District reported that the socially constructed gender roles such as fetching water and taking care of the family have shaped their vulnerability. Also, the women's limited mobility and resources due to socio -cultural constraints have been pointed out to be the factors that limit their adaptive capacity. However, it is vital for women to be actively involved in climate change policy and decision-making processes to strengthen their adaptive capacity and contribute meaningful solutions to their problems.

The scarcity of water as a result of extreme weather events is currently forcing most women in the Mudzi District to wake up before dawn in search of water. The respondents reported that when they arrive at the water source, they have to spend at least an hour queuing for their turn to draw water. When the water table gets low, they have to wait extra hours for the borehole to recharge. After fetching water, most of the women return to their homes carrying 20-litre buckets on their heads and a 5-litre container in their hands. Having gone through the struggle of fetching water, most of these women still have to do their domestic daily chores. Taking into consideration that some of these women already have added responsibilities left to them by their migrant spouses, the increased time spent fetching water affects their overall wellbeing. However, given that the time spent fetching water reduces the income-generating productive time whilst increasing the women's workload, some women resort to fetching water at nearby contaminated sources. This exposes their families to water-borne diseases such as dysentery, diarrhoea, and cholera. A key informant from the Ministry of Health and Child Welfare reported that water borne diseases are prominent in the district during the period of August to February. The correlations between the use of contaminated water sources and increased mortality have been identif ied in Zimbabwe and South Africa (Chirenda et al., 2015; Gundry et al., 2006), with the elderly and infants being particularly susceptible. Although some of these climate change risks have been explored in the literature (Jerneck 2018; Babugura 2009; Glazebrook 2011; Masika 2002), it is important to explain the phenomena of the vulnerability of women to climate change in the arid and in the semi-arid rural local context.

The study further revealed that the women's responsibilities as food producers and household food security agents often place an extra burden upon them. For instance, the elevated temperatures and the poor rainfall distribution during the growing season have caused high yield losses of maize, which is one of the major subsistence crops in the district. As a result, several subsistence farmers, mostly women, shifted to the growth of small grains such as sorghum and millet, which, though they are more labour-intensive compared to maize, are more suitable under such conditions. This, compounded by a lack of land ownership amongst women, has made it difficult for the women to adapt to the changing climate.

Despite Zimbabwe being a signatory to the Convention on the Elimination of All Forms of Discrimination against Women (1979), the Beijing Platform for Action of 1995, and the SADC Gender and Development Declaration of 1997, the women still have unequal access to land. The women's limited access to land in Mudzi is linked to patriarchy, tradition, and the cultural belief. Most women (83.33%) in the district indicated that they do not own land. Land ownership in Zimbabwe and in other African countries is based on the logic of inheritance and the male children are the legatees to family lands (Onwutuebe, 2019:4). The Zimbabwean Constitution Section 289 (c) states that the allocation and distribution of agricultural land must be fair and equitable, with regard to gender balance and diverse community interests. In addition, according to the constitution of Zimbabwe, Section 80 (3), all laws, customs, traditions, and cultural practices that infringe the rights of women conferred by this constitution are void to the extent of the infringement (GoZ, 2013). However, the current lack of monitoring and the evaluation on equal access to land inhibits the adaptation of women to climate change and weakens the efforts geared toward the women's empowerment. This also explains why most women in the Mudzi District have limited access to land ownership. Furthermore, Tekwa and Adesina (2018) argue that the social policies in Zimbabwe should aim to enhance the productive capacities of communities by attending to the unequal distribution of the means through which the people seek to meet their needs and goals. As a result, this will promote gender equality and reduce poverty.

Research has shown that land ownership is linked to adaptive capacity (Fon 2011; Jost et al., 2016). To support this, the findings of this work showed that the lack of land ownership limits women from attending climate change meetings for landowners, which are usually called by the Department of AGRITEX and other non-governmental organisations such as Bio-Innovation Zimbabwe. As a result, this prevents the women from becoming resilient to the changing environmental conditions and it limits farm investments. However, the responsible authorities on land administration in rural areas need to acknowledge the existence of land inequality and should try to find ways to empower women to access land under their names without the interference from their husbands (Ingwani, 2021). Also, an advanced study needs to be done on how the distribution of land in rural areas is being made by traditional leaders to find solutions to the current land inequality problem.

One of the major findings of the study is that the struggle that the women encounter because of the effects of climate change is not uniform, as is previously portrayed in literature. Most studies that have investigated the women's vulnerability to climate change overlooked that the effects are not uniform. For example, Alam et al. (2015); Phiri et al. 2014; Onwutuebe (2019), and Masika et al. (2002) have all looked into the vulnerability of women to climate change. However, in their studies, they overlooked the socio-dynamics such as age, marital status, abilities, and wealth, which differentiate the vulnerability of women. The participants in the FGDs were asked who is more likely to be vulnerable to the effects of climate change. The findings from the discussions indicated that among the women living in Mudzi, certain groups are more vulnerable, in particular those who have disabilities, the elderly, widows, and those who are resource deficient. The women living with their spouses, those who have social support systems and assets, were the least vulnerable as they were better able to adapt to climate change. The data on the differential impact of various groups of women on the effects of climate change is important for designing the adaptation strategies that are centred on addressing the specific needs of each group of women in society. However, the generalisation of the vulnerability of women is likely to deflect attention on those who are in most need of help to intensify their vulnerability to the risks and stresses (Tadesse, 2010).

From the findings of this study, the vulnerability of women is inextricably linked to water scarcity. The observations in the Mudzi District showed that the women travelled long distances to fetch water owing to increasing water scarcity. The burden of walking several kilometres in search of water is detrimental to their well-being. Despite this, women in the Mudzi District have reported that they have never been involved in any climate change adaptation decision processes or programs. However, to redress the vulnerability of women to the effects of climate change, the numerous societal constraints faced by women must be addressed (Onwutuebe, 2019:5). Redressing this problem requires the involvement of the different strata of the society such as the Ministry of Lands, Agriculture, Water, Climate and Rural Resettlement, NGOs, and the civil society organisations. The government policies need to put into consideration the women's concerns and their complaints regarding how climate-related vulnerabilities could be addressed. Additionally, the Ministry of Lands, Agriculture, Water, Climate, and Rural Resettlement needs to join hands with all the development stakeholders in constructing more water infrastructures in rural areas. This will allow the people to save the time spent fetching water. The time can then be used for income-generating activities, which would improve the household income and the women's overall well-being.

7.4 Adaptation

The women's responsibility of collecting, storing, and distributing water has enabled them to devise water management strategies to circumvent water scarcity. Despite the women being seen as victims of climate change effects, they have proved to be agents of change by contributing to climate change adaptation (UN, 2021; Alam et al., 2015; Annecke, 2010). As mentioned in the previous chapter, the women make use of domestic, agricultural, and indigenous water conservation strategies to combat the effects of water scarcity in increasing climate challenges. These strategies are used together with localised rules and regulations to ensure sound water management.

The traditional water management strategies and the knowledge that is possessed by the communities in the Mudzi District need to be mainstreamed in climate policies. For instance, the national water policy in Zimbabwe overlooks the role of spirit mediums and local water management (Zimbabwe National Water Policy, 2013). In addition, the National Water Policy's lack of a bottom-up approach in addressing the water conservation strategies detaches itself from the local rural water conservation realities. This weakens the adaptive capacity of the rural communities, thereby resulting in the increased vulnerability of women. The IKS have always been a way in which the Africans deal with the changes in climate over the years. The literature mentions the acceptance of the indigenous knowledge discourse in development (Mahlangu & Garutsa, 2014; Shepherd, 2001; Hubbard, 2001; World Bank, 2000; Warren 1991). Of paramount importance is that the IKS in water management. Documenting the IKS in water management reduces knowledge erosion and enhances community-centred socio-economic development.

This study found that when the communities in Mudzi want to embark on any development, they consult the spirit mediums first. This was reported to have been done before the construction of the Chisero and the Shinga dams. The respondents in the FGDs believed that the failure to consult the spirit mediums before constructing the dams in the district would anger the ancestors thereby resulting in the failure of the dam construction project or in the collapse of the dam. Mugambiwa (2021:5) concurs with this finding by stating that the elders and the spirit mediums are important in climate governance as they have control over the natural world and their role is vital in climate change governance. This implies that the indigenous knowledge and the wisdom that is exhibited by the elderly and the spirit mediums are vital in improving the well-being and the livelihoods of the local communities in the face of climate change. Furthermore, it provides a sound platform for water management in rural areas, which facilitates the enrichment of the current water systems (Mahlangu & Garutsa, 2014:151). However, this form of indigenous community-organised adaptation strategy has not been given as much attention as it deserves, and it lacks being mainstreamed into the water and climate policies.

Although this study has recorded the importance of IKS in water management, Briggs (2013:233) is of the view that it might be difficult to use the ideas, concepts, and the results derived from one specific context to the other, which poses the problem of universality. However, what is important to note is that some of the indigenous water management strategies mentioned in Sections 5.9, and 5.10 of this study can inform the research beyond the context and the geographical location undertaken. Also, the copying and the adopting skills from the others is an important strategy of adaptation (Lemma, 2016.) Although there appears to be a challenge on how this knowledge can be widely used beyond the Mudzi Rural District, the IKS can be integrated with scientific methods to contribute meaningfully to sustainable water management.

Similar research that has focused on rural water management (Ndlovu et al., 2020; Phiri et al., 2019; Nyamadzawo et al., 2013) mostly based their studies on water management in the agricultural sector. This is mainly because agriculture is the major consumer of water in rural areas and plays a crucial role in the country's economy (Kjeldsen et al., 1999:532). However, these studies give little information on the water management strategies that are used for domestic purposes in the arid and the semi-arid regions of Zimbabwe. Thus, the study fills this gap by providing an acute awareness of the local domestic water management strategies that are being used to combat water scarcity.

Contrary to this study, several studies in the water management discourse, Pahwaringira, et al. (2015), Gambe and Dube (2015), and Maodzwa (2015) have carried their research in urban areas. Despite their studies being carried out in the urban areas, Pahwaringira et al. (2015) and Maodzwa (2015) found that water harvesting, and water rationing are also common water management strategies. This shows that the two methods are common coping strategies that are used in both the urban and the rural areas to combat water scarcity. Although the above studies were conducted in the urban areas where the water infrastructures are better off, the researchers agree that the women as primary water users experience the impact of water scarcity first-hand.

Despite the existence of the Zimbabwe water legislation and the Sustainable Development Goal 6 of ensuring the availability and sustainable management of water for all, the communities in rural Mudzi still face an inadequate water supply. The government's implementation of water infrastructures in some rural areas has been less effective than hoped for. Thus, mainstreaming local and traditional water management into the national water policy is required to enhance the local approaches to water scarcity (FAO, 2018). This is not just a matter of promoting local approaches to water scarcity, it also makes good economic sense. It also creates an opportunity to strengthen the empowerment of local people. By promoting indigenous channels, the external researchers and the non-governmental organisations can, in turn, promote development in the community.

7.5 Mainstreaming gender equality into climate policy

The findings of this study have shown that gender inequality exists because of the existing socio-cultural norms of people living in arid and semi-arid rural regions. While some strides have been made to ensure gender equality in all the sectors, the significant gaps remain in the climate change policy. For example, the Government of Zimbabwe has alluded to various national and international gender declarations and conventions to end gender inequality. Among these are the 1965 Convention on the Elimination of all Forms of Racial Discrimination (CERD); and the 1979 United Nations Convention on the Elimination of all Forms of Discrimination Against Women

(CEDAW) (UN Women, 2004:1). Also, the Constitution of Zimbabwe, Section 56, provides a solid framework for the equality for all (GoZ, 2013).

As aforementioned, most women in the Mudzi Rural District have reported that they do not own land. This comes after gender equality was emphasised in the redistribution of land in Zimbabwe. Despite the emphasis on gender equality in land redistribution, there still exists a gap in equal access to land in arid and semi-arid rural regions (Tekwa & Adesina, 2018:50). This has implications for the success of sustainable climate change adaptation for rural-based women. Hence, to ensure a more viable mainstreaming of gender equality in climate change policy, there is a need for a bottom-up approach, in which the most vulnerable population provides solutions to their problems. In supporting this line of thinking, Babuguru (2019) states that the women as the victims of climate change effects are also part of the solution, with specialised knowledge and capacities to influence and shape effective gender-responsive climate change actions. For this to be successful, Pratiwi et al. (2016:13) suggest the adoption of the principles of gender equity at all stages, from scientific research to monitoring and evaluation. Thus, without these principles, the process of climate change adaptation and mitigation will not be successful.

From the gathered data, there is a strong perspective among the key informants that capacity building and inclusivity are powerful drivers for effective climate change adaptation leading to sustainable livelihoods. It is therefore important for the stakeholders and the non-governmental organisations to design inclusive climate change project interventions that provide equal representation in decision-making. The interventions will not only give women an opportunity to share their lived experiences, but they will also provide a platform for them to share adaptation information and ideas. The given information and ideas will then shape climate change and the water adaptation strategies that might rectify the current climate injustice.

Although the discussions on gender equality are complex and are often contested in African society, it is an essential element to reduce the vulnerability of women to the effects of environmental change. Mainstreaming gender equality in all the spheres allows the society and the stakeholders to be aware of the most vulnerable population and their needs. This will enable the tailoring of adaptive interventions to suit the vulnerable groups in society. When gender equality is mainstreamed, the problems causing women to be vulnerable will be addressed and the solutions to their problems will be implemented. For example, mainstreaming gender equality in climate policy enables the stakeholders to construct water infrastructures. The availability of more water sources reduces the distance covered in fetching water and it improves the health and livelihoods of women.

7.6 Conclusion

The chapter discussed the major findings of the study. Here, the community's various perceptions of climate change were addressed. However, the perception of climate change seems to vary according to one's age, gender, ability to access climate change information, and the level of education. From the results of the study, what seems to be uniform is the perception the communities have with regard to the effects of climate change in terms of rainfall and temperature in the district. The climate change effects have resulted in a scarcity of water, which has disproportionately affected the women whose livelihood and income rely on this precious resource. Because of the vagaries of climate change, the communities in the Mudzi District have employed a plethora of local mechanisms to conserve water. Hence, the study has documented these mechanisms, which are a combination of the IKS and the adopted water conservation strategies. These mechanisms are being used to combat the effects of water scarcity to enhance sustainable rural livelihoods. However, despite the community members playing a key role in conserving water, the Minister of Lands, Agriculture, Water, Climate, and Rural Settlements' support in drilling more boreholes to extract groundwater will enable sustainable livelihoods in the district. This will also enable the communities to access safe and clean water.

The response to the vulnerability of women to the effects of climate change require mainstreaming gender equality in climate change programs and policies to ensure sustainable climate change adaptation. Although this tool has been used in other sectors in the past, with slow-paced progress, it has been proven to be a powerful drive for growth and social justice if it is built on a local foundation. Hence, the next chapter includes a local perspective of the critical recommendations that are necessary to be implemented to sustain the indigenous and adopted water conservation strategies that are being used by the communities in Mudzi. This is envisaged to eventually lower the vulnerability of women by increasing the water sources and enhancing sustainable water management.

CHAPTER 8: CONCLUSION AND RECOMMENDATIONS

8.1 Introduction

This chapter concludes the study by providing the thesis statement, the key findings of the study in relation to the research questions, the study aims, and the objectives. It should be noted that the results found in this study have implications for the achievement of the agenda 2030 Sustainable Development Goals (SDG 2 of gender equality, Goal 10 of reduced inequality, Goal 13 of urgent action to combat climate change and its impacts, Goal 3 of good health and wellbeing, Goal 1 of no poverty, and Goal 2 of no hunger). The SDGs are interlinked, hence the failure to reduce the effects of climate change on women will have implications for achieving climate justice and ultimately the rural livelihood's sustainability. In addition, with the aim of better addressing the challenges faced by women in the Mudzi District, this chapter made recommendations. The recommendations focus on the possible ways in which the information gathered from the study can be used to ameliorate the current vulnerability of women to climate change and improve the current water adaptation strategies.

8.2 Study summary

The aim of the study was to investigate how the women are being impacted by the effects of climate change and to highlight the sustainable water management strategies that are being adopted to adapt to the effects of climate change. To achieve the study's aim, a mixed research design which is largely qualitative was used. There is substantial evidence and data that was collected using a questionnaire survey, the in-depth interviews, the FGDs, and the observations in the Mudzi District. The study concludes that the women living in the Mudzi District are indeed vulnerable to climate change. Climate change has disproportionately affected the women's livelihoods as they predominantly rely on climate-sensitive agriculture. However, not all the women are impacted the same by the effects of climate change. This contradicts the common narrative in the literature that homogenised the experiences of women to climate change impacts, without reflecting on the possible differences based on their age, social class, marital status, educational level, and ability.

The reports from the questionnaire surveys, the interviews, and the FGDs indicate that the effects of climate change have induced the local community to conserve water as an adaptation strategy. The communities in the Mudzi District are conserving water through water harvesting, water rationing, the application of rules on water points, water recycling, and the drying of vegetables. These local water conservation strategies have managed to enable the communities to have sustainable livelihoods. However, all the stakeholders and the government institutes that focus on climate change need to ensure they find means to reduce the vulnerability of women to climate change and improve the water supply in the rural areas. Thus, this study has managed to produce recommendations. The recommendations focus on the possible ways in which the information gathered from the study can be used to ameliorate the current vulnerability of women to climate change and improve the current water adaptation strategies. However, the recommendations are going to be discussed later in this chapter.

8.3 Thesis statement

This thesis examines the effects of climate change on women and the water management strategies that are being used by the marginalised communities in the Mudzi Rural District, in north-eastern Zimbabwe, to combat the effects of climate change. The study found that the effects of climate change in the district are dire and have exacerbated the existing levels of equality, poverty, and well-being. The effects of climate change are heavily pronounced in women as a result of their less adaptive capacity and dependency on the biophysical environment, which is vulnerable to the effects of climate change. The biophysical environment is an important asset to the livelihood and the wellbeing of the communities in Mudzi, and the effects of climate change on it have led to disproportionate impacts on women. However, the vulnerability of women is differentiated by age, social class, marital status, and the levels of education. The elderly, widowed, disabled, and poor women are heavily impacted compared to the young and married women who live with their husbands. The study observed that the vulnerability of women emanates from the scarcity of water, food insecurity, disease, and the socio-cultural systems.

The scarcity of water because of climate change has increased the vulnerability of women, thereby forcing them to adopt alternative water management strategies. The strategies that are being used to adapt to the effects of climate change are mostly based on local, indigenous knowledge in the district, and serve to challenge the perception that the women are mere victims of such changes, but rather they are agents of knowledge in situations requiring adaptation. The study has found that the water adaptation strategies in this district have led to the sustainable utilisation of water resources. For instance, the respondence in the Mudzi District have reported that as a result of water scarcity they have adopted water rationing as a water conservation strategy. This allows everyone to have equitable access to water. Nonetheless, the women lack climate change information, which is widening the inequality between them and the men. Due to a lack of access to media such as radio, social media, and the newspapers, the women lack information such as weather updates, cropping patterns, and the climate change mitigation measures. This lack of knowledge has also increased their vulnerability to climate change. However, to ensure sustainable water management strategies, gender equality should be mainstreamed in the climate change policies and programs. This will empower the women and give them a voice to contribute to the climate change adaptation strategies. As a result, the country will have an inclusive climate response action plan. Subsequently, it will also ensure greater success of the mitigation and the adaptation measures.

Although the communities in Mudzi adopted a number of water management strategies, the prevailing situation needs urgent intervention. It was observed that some of the boreholes are not functional. Thus, there is a need for instituting borehole drilling and rehabilitation. A plan for maintaining the water infrastructure has to be put in place to ensure the effective and smooth running of the water sources.

8.4 Assessment of key study findings

Climate change vulnerability is not a future problem, it is already here. This study depicts that the change effects are not equally distributed within and across communities. It is evident that the most vulnerable population bears the brunt of climate change. For instance, most women in the Mudzi District lack access to assets (financial, human, physical, natural, and social) which limits their adaptive capacity. Hence, this study has specifically contributed towards an improved understanding of how diverse groups of women living in the Mudzi district are impacted by the effects of climate change. The research findings on how women are currently being impacted by climate change attest that immediate interventions are required to ameliorate and minimise risk.

Although the communities in the Mudzi District have produced adaptation measures to combat the effects of climate change, there is a need for the government to finance and improve the strategies. However, inadequate assistance and recognition may limit the local rural communities from achieving the SDGs, alleviating poverty, and reducing inequalities (Hallegatte & Rozenberg 2017).

Moreover, the study confirms of the existence of opportunities for water management and climate change adaptation to jointly contribute towards improving the local rural communities in managing water resources in the face of adverse climate trends. Locally, the derived insights in water management coming out of this study hold value not only in the contested nature of water management but also in the institutional adaptation towards effective and sustainable water management within a specific context. In addition, the results of this study provide an impetus for development practitioners to consider proactive adaptation strategies that enable continued rural livelihood sustainability. The obtained information can be used to improve or formulate appropriate adaptation practices to manage the climate change problems in farming. Using these key study findings, the next section focuses on the recommendations that are being made.

8.5 Recommendations

The study has identified several key priories when considering women and climate change. These include but are not limited to mainstreaming gender in climate change, inclusivity in climate change project interventions, and providing women with climate change education and information. Also, there is a need to construct more water infrastructures in the arid and the semi-arid rural areas to reduce the vulnerability of women. This need to be weighed against factors such sustainability of the water table and geology of the areas. However, the following research priorities are recommended for immediate attention:

8.5.1 Women's vulnerability to climate change

1. To reduce the vulnerability of women to climate change, the study recommends that the Government of Zimbabwe under the Ministry of Primary and Secondary Education should facilitate the empowerment of women through climate change education, training, outreach, awareness creation programs, and capacity building. These are essential preparatory steps that are needed to facilitate the dissemination of climate change information which enhances adaptive strategy in climate change. The communities' capacity building to understand climate change and variability is an essential prerequisite for effective adaptation. Moreover, education is also a powerful instrument in enhancing

the adaptive capacity of women living in the arid and the semi-arid rural areas. To effectively implement the dissemination of climate change information through education, the government can partner with the private sector in disseminating and mainstreaming climate change information in all sectors.

In addition, there is also a need for the government to embrace local knowledge in climate change mitigation and adaptation strategies. This is because the local people understand their environment better than the outside people. Hence, their knowledge can be used to inform the government on the sustainable ways that can be used to mitigate the vulnerability of women to climate change exposure. This will strengthen the education of the local people, which is a necessary starting point for sustainable development.

2. There is a need for the revision of the existing policy frameworks that are related to the climate, land rights, water, and agriculture to integrate the perspectives of women and persons with disabilities. This can be done by engaging persons with disabilities in policy formulation and amendments. This can be done not only by Zimbabwe's policies on climate change, but by other countries in Africa (South Africa, Zambia, Botswana, and Namibia) which find themselves in this predicament. As a result, it will strengthen the adaptive capacity of women and of the persons with a disability. Also, further studies can be conducted to assess the experiences of rural women's livelihoods that are affected by climate change and how the government and stakeholders can intervene to help them.

   Despite the need for the revision of the climate change policies that are currently in use, measures need to be put in place to ensure that the policies are based on research. Gusta (2014) reports that the main challenge affecting the policymakers is access to research evidence to come up with evidence-based policies. As a result, the policymakers are often accused of engaging in uninformed policy making. Madzwamuse (2010) argues that the research-based climate change policies are important to remove the barriers that may affect the protection of the vulnerable groups. Therefore, in the context of climate change, it is important that the decisions are made on the evidence for the policies to be effective. This can be done by providing communication channels between the researchers and the policymakers which allows swift information sharing on the climate change issues in Zimbabwe.

3. Efforts in all spheres are required to reduce the vulnerability of women to climate change. This research finds that most of the women's limited education and the lack of access to important assets such as land among other factors contribute to their vulnerability to climate change. However, there is a need for Zimbabwe's Ministry of Lands, Agriculture, Fisheries, Water, and Rural Resettlement to secure the women's right to land and other crucial resources to reduce their vulnerability. To support this view, Yadav, and Lal (2018) have argued that the formal ownership of land improves the women's productivity and increases their coping capacity to the climate change effects.

   There is an agreement in the literature that gender equality is a key factor to face climate change (Nyahunda & Tirivangasi, 2021; Yadav & Lal, 2018; Alston, 2013). Hence, gender equality needs to be mainstreamed in climate policy and climate change programs to reduce unsustainable gender inequalities. In the case of the Mudzi District, the women's mobility is limited due to traditional and cultural constraints. This is detrimental to the women's ability to adapt to the effects of climate change. Considering that women are at the centre fold in achieving the SDGs and a solution to all the SDGs objectives (Huyer, 2016) it is important that their problems and constraints are addressed. This can be done by mainstreaming gender in all the sectors. Mainstreaming gender into climate change mitigation and adaptation enables the stakeholders and the policymakers to understand the different concerns of women and men. As a result, the vulnerable population will be empowered to safeguard the environment. In addition, there will be a reduction in the vulnerability of the marginalised population, which is key to a successful adaptation measure.

8.5.2 Adaptation

4. The study recommends that the meteorological department in Zimbabwe improve its early warning systems and make use of artificial intelligence to warn people of future weather conditions. This involves providing people with an early warning of agriculture-related impacts such as droughts and the onset of rains. For instance, El-hadary (2022) reported

that in Hegaza, Kom Ombo town, Aswan (Southern Egypt) the farmers are using the early climate warning application. The application feeds the farmers with the expected temperature throughout the week. The application also informs the users to use sprinkle irrigation in cases of hot temperatures to preserve the buds from falling. The use of early warning systems directs how the communities should cope in times of extreme weather conditions. In addition, the early warnings and the prior information are critical to minimise fatalities during disasters. As a result, it protects the livelihoods and the environment. Moreover, the relevant weather information that is given well in advance increases the women's preparedness and significantly reduces their vulnerability. Also, the access to tools that assess future weather conditions (e.g., weather forecasting or early warning systems) enables the people who rely on climate-sensitive livelihoods to take pre-emptive actions to minimise the negative effects of climate change.

Early warning systems have their own limitations. For instance, the Palu earthquake and the Tsunami in 2018 resulted in the death of many people because there was a power cut after the earthquake and the Uninterrupted Power Supply (UPS) backup generators were not working (UNDRR & UNESCO-IOC, 2019). This case shows that there are a lot of planning and financial resources that are required to have an effective early warning system. Also, the UNDRR and the UNESCO-IOC, (2019) have argued that the over-reliance on technology creates a false sense of security. Moreover, the early warning systems should be people-centred to enhance the capabilities and resilience of the communities to protect themselves in case of technology failure.

5. The study further suggests the improvement of the access to climate change information by the Ministry of Information, Publicity, and Broadcasting in Zimbabwe to enhance the adaptation capacity of rural-based people. This requires the setting up of rural climate information centres. Such centres must provide an inclusive information repository, thereby reducing the climate change information gap between the rural areas and the urban areas. The centres will also act as the basis for lifelong learning and empowering information services (Makwanya, 2018). Moreover, the communities will be able to store and keep records of vital climate information. Additionally, the holders of the IKS will

have an opportunity to store and share their knowledge at the climate change information centre.

It should be noted that most of the climate change information centres are online, especially on social media platforms. An example of such an information centre is “The Climate Science Information Center” on Facebook (Meta, 2021). The information is only helpful to the people who have access to the internet and have mobile phones. However, this information centre is beyond the reach of the rural based people in Zimbabwe who struggle to have cellphones due to financial constraints and the lack of access to electricity, cellular network, and the internet. For these reasons, there is a need for information centres that are within the reach of people who stay in remote rural areas such as the Mudzi Distinct.

6. In the Bukhar-Zhyrau District, in the central Kazakhstan areas. Omarova et al. (2019) found that the rural water supplies have been overshadowed by the urban ones. Although the study was done in central Kazakhstan, it mirrors what has been traditionally happening in Zimbabwe. However, the call to achieve the SDG for full coverage of safely managed drinking water by 2030 seems to be difficult for many developing countries (Dhoba, 2020). Considering that water crises have plagued Zimbabwe for a long time (Gambe & Dube, 2015; Maodzwa, 2015) and seem to be getting worse each year, achieving this goal requires good governance. Moreso, there is an urgent need for investment in infrastructure projects, especially in arid and semi-arid rural regions to promote the efficient use of water resources. In addition, the rehabilitation of the current water infrastructure especially in the Mudzi District is also required as it helps with the sustainability of the water sources. To achieve this, the local authorities and the governments must collaborate with the private sector for financial assistance.

   To add on Egbe (2014:27) argue that for sustained rural development to take place, a bottom-up approach should be considered at the implementation stages. This will enable the communities to have a sense of ownership of the projects. However, the bottom-up approach alone might not be effective. There is a need for a novel plan that combines the strength of the bottom-up approach and the top-down approach for rural water projects.

Additionally, the achievement of the SDG 6 can also lead to the achievement of the SDG 3, which pertains to good health and well-being.

7. To achieve sustainable adaptation, the study recommends that the development of climate change adaptation strategies and policies should be supported by sound knowledge and the understanding of the vulnerable people. The research on the effects of climate change on the humans' alerts policymakers to the potential effects of climate change which might lead to capacity building and amendments in climate change policy and programs. Moreover, building adaptive capacity to climate change requires the conscientisation of men on how social norms add to the vulnerability of women to the effects of climate change. Although changing the mindset of men on social norms is a challenge, it can be achieved gradually by increasing the number of community outreach programs that require equal contributions from both the men and the women.

   Nyahunda and Tirivangasi (2021) opine that the success of mitigation and the adaptation strategies depends on the availability of institutions that support these processes. Although the above view is a valid point, it should be noted that most of these institutions make use of a top-down approach that excludes the local people's inputs (Gusta, 2014). Chanza and Gundu-Jakarasi, (2020) further opine that the integration of the needs of the marginalised and the vulnerable population in the adaptation programs is still a challenge in Zimbabwe. Thus, this study recommends that the development of climate change adaptation strategies and policies should be supported by sound knowledge and the understanding of the vulnerable people. This can be done by conducting research on vulnerable groups. The research on the effects of climate change on humans alerts the policymakers to the potential effects of climate change which might lead to capacity building and amendments in climate change policy and programs.

   In addition, the UNFCCC (2019: 6) for climate change adaptation to be successful it is vital to know how societal gender norms and power relations influence the women's and the men's exposure, as well as the ability to respond to environmental change in local situations. For instance, the results of this study indicate that the women's roles such as fetching water expose them to climate change. Thus, there is a need for conscientious men on how the social norms add to the vulnerability of women to the effects of climate change. Although changing the mindset of men on social norms is a challenge, it can be achieved gradually by increasing the number of community outreach programs that require equal contributions from both men and women.

8.6 Possible future developments

Given the fact that climate change is affecting everyone, but differently, the need for further research on this dynamic is unquestionable. Given the significant gaps in the literature on how men and children are being impacted by climate change, research needs to be conducted to investigate how other various social groups are being impacted by climate change. This is essential to improve the understanding of the key vulnerabilities to climate change. Moreover, the sustainable water management strategies that are being used by the communities in the Mudzi district assist in conserving water, however, nothing much is known about the safety of the water sources and the consumed water. For that reason, water high-quality evaluation studies need to be conducted. This will enable the communities to achieve sustainable development Goal 6 on the access to clean water and sanitation.

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APPENDIXES

Appendix A: Survey questionnaire

My name is Ashiella Musindo. I am a Ph.D. student in the Department of Anthropology and Archaeology at the University of Pretoria. I am conducting field research on how women are being impacted by the effects of climate change and the sustainable water management strategies that are being adopted in-order to adapt to the effects of climate change. Will you please participate in my research project by answering the below questionnaire?

Questionnaire number……

SECTION A: SOCIO-DEMOGRAPHIC INFORMATION

1 Village ……………………

2 Ward………………………

3 Age

☐ 18-30 ☐ 31- 40 ☐ 41- 50 ☐ 51-60 ☐ above 60

4 Gender

☐ Male ☐ Female

5 Marital status

☐ Married living with spouse ☐ Married spouse away ☐ Divorced

☐Widow/Widower ☐Never married

☐ other (specify)...........................

6 The number of children ………………………………….

7 Level of education

☐Never ☐Primary ☐ Secondary ☐ college ☐ University

☐ Other (specify)…………………………………………..

8 Main occupation

☐ Farmer ☐Agro pastoralist ☐ employed ☐Self-employed

☐ Other (specify) ………………….

SECTION B: CLIMATE CHANGE

9 How long have you been staying in the Mudzi rural district? (In a number of years)

………………………………………………………………………………………………

………………………………………………………………………………………

10. Have there been any long-term shifts in the amount and duration of rainfall over the years in the district?

....

11. Have there been any long-term shifts in temperature in the district over the years?

…………………………………………………………………………………….

12. Are the changes affecting you? If yes, in what way?

………………………………………………………………………………………………

………………………………………………………………………………………

13. What strategies do you use to adapt to the changes in weather from year to year?

………………………………………………………………………………………………

………………………………………………………………………………………

14. Have you ever been involved in climate change policy discussions or programs?

…………………………………………………………………………………………

15. Do you have access to information on climate change? If yes, how do you access the information?

....

SECTION C: GENDER RELATIONS

16. What are your roles as a male /female in the household and community?

…………………………………………………………………………………………………
…………………………………………………………………………………

17. Do you own any land? / Are you entitled to land ownership? Please explain.

18. Do men and women have equal opportunities to own or inherit the land?

…………………………………………………………………………………………………
…..……………………………………………………………………………………

SECTION D: HOUSEHOLD WATER INFORMATION

19 Do you receive adequate water for all household needs?

………………………………………………………………………………………………

20 How often do you experience shortages of water in your household? ☐ Everyday

☐ Once in a week ☐once in two weeks ☐ once in one month

☐ other (specify) ……………………………………………………………………….

21 What do you think is the primary cause of water shortages?

……………………………………………………………………………………

22 What type of water sources do you use?

☐ Borehole ☐rainwater tank

☐ Dam/ pool/ stagnant water/ river ☐ well

☐ other (specify) ……………………………………………………………………….

23 What type of water sources do you use in times of water shortages?

☐ Borehole ☐Well

☐ Rainwater tank ☐ Dam/ pool/ stagnant water/ river

☐ other (specify) ……………………………………………………………………….

24 How long does it take a member of your household to fetch water from the nearest water source?

……………..……………………………………………………………………...

25 Who in the household is involved in fetching water from the water source to the household?

……………………………………………………………………………………….

26 What are some of the coping/adaptive strategies you have used as a result of an inadequate supply of water?

……………………. ... …………………………………………………………………

27 Do the water sources that you use dry up /if so which period and what do you do when the water sources are dry?

………………………………………………………………………………………………

……………………………………………………………………………………….

28 What are some of the challenges that you encounter when dealing with water shortages?

………………………………………………………………………………………………

……………………………………………………………………………………

29 How did you get information on water management?

……………………………………………………………………………………

Thank you very much for your time

APPENDIX B: INTERVIEW SCHEDULE

Appendix B: Interview Guide for community members

The main aim of this research is to examine the vulnerability of women to the effects of climate change and the water management currently being used to combat the effects of climate change. This interview meeting will be guided by the following questions:

Women and climate change

1. What do you do on a regular weekday?
    - What keeps you busiest at home?
    - Do you enjoy that work?
2. What is your experience of climatic changes in the past 10-15 years? (climate change to be explained)
3. What information is available to you on climate change?
4. How is the scarcity of water affecting you?
5. Are you using any indigenous knowledge systems in water management? If yes, state and explain.
6. What is the role of women and men in their families?
7. What is the role of men and women in the community?
8. What are the key livelihood strategies employed by women in Mudzi? (**Listing**)
9. Do women own, have access to, or control the natural livelihood resources?
10. Is there a difference among women (single, married, divorced, etc) in ownership, access, and control of livelihood resources?
11. How do culture impact ownership, access, and control of livelihood resources?

Appendix B2: In-depth interview guide for key informants

The main aim of this research is to examine the vulnerability of women to the effects of climate change and the water management currently being used to combat the effects of climate change. This interview meeting will be guided by the following questions:

DEMOGRAPHICS

Name	
Gender	
Location	
Occupation	

- Is the information on climate change accessible to community members? If so, how?
- Do women have decision-making roles in local institutions?
- Do the institutions consult both men and women when crafting climate change policies and projects?
- Are there programs specifically for women in natural resources management? If yes, what organizations are involved?
- Are leadership positions dominated by a particular social group?
- Do women occupy leadership positions? If so, which women?
- How are women empowered and how do they participate in the decision-making regarding climate change mitigation projects?
- Are there any projects that have been done in the district to help alleviate the effects of climate change?

APPENDIX C: FOCUS GROUP GUIDE

Appendix C: Guide for focus group discussions

The focus group meeting is being conducted to facilitate engagement on issues that came up from the questionnaires and the in-depth individual interviews. The discussions of this meeting will be limited to a maximum duration of 90 minutes. More so, the discussion will be guided by the following questions:

1. In your own opinion, what has been the trend in temperature over the past years?
2. In your own opinion, what has been the trend in rainfall patterns over the past years?
3. How are you affected by climate change? (climate change term to be explained) What kinds of adjustments do you make in your daily activities in order to adapt to the impact of climate change?
4. How are women's and men's time divided? How much time is devoted to productive activities? Domestic activities? Community activities? Leisure? Sleep? How do they vary by season?
5. Which resources are controlled by a) women and b) men?
6. Who in the household is the most vulnerable when there is inadequate water as a result of the effect of climate change and how? How is this vulnerability differentiated according to gender, age, and other social?
7. How do you ensure that you have water when water sources are dry?
8. Are there any Indigenous knowledge water management strategies that you been using in the last 5-10 years?
9. What future actions do you plan to take to ensure sustainable water management?
10. Who decides what water management adaptation strategy to implement? Who takes action and implements the strategy and is he/she involved in the decision making?
11. Is there anyone – a person or an organization – that helps you when you are affected by water shortages?
12. Have you been involved in any climate change discussions, programs, or projects?

APPENDIX D: RESEARCH PERMISSION LETTER MUDZI DISTRICT

MINISTRY OF LOCAL GOVERNMENT, PUBLIC WORKS AND NATIONAL HOUSING

All correspondences should be directed to the District Administrator
Telephone: (065)2230/2818/2687

Email: damudzikotwa@gmail.com

ZIMBABWE

MINISTRY OF LOCAL GOVERNMENT, PUBLIC WORKS AND NATIONAL HOUSING
Office of the District Administrator
Office 215, 2nd Floor
MUDZI GOVERNMENT COMPLEX
Kotwa Growth Point
P.O.Box 100
MUDZI

XC/116/13/A

January 28, 2019

Prof. Innocent Pikirayi, PhD
Faculty of Humanities
Department of Anthropology and Archaeology
University of Pretoria
Private Bag X 20
Pretoria
Hatfield 0028
SOUTH AFRICA

PERMISSION TO CARRY OUT EDUCATIONAL RESEARCH IN MUDZI DISTRICT, ZIMBABWE: ASHIELLA MUSINDO (STUDENT NO. 18347178)

The office of the District Administrator has cleared ASHIELLA MUSINDO STUDENT NO. 18347178; who is your PhD Student to carry out research on *"Women and climate change induced sustainable water management strategies in Zimbabwe"* in Mudzi District, Mashonaland East Province, Zimbabwe.

This office will assist with the necessary information towards the research. The student is expected to follow the confines of the topic as prescribed. We also entreat Ashiella to share her findings with the Ministry after completion of her study.

Thank you.

DISTRICT ADMINISTRATOR
MUDZI
28 JAN 2019
P. O. BOX 100, MUDZI
ZIMBABWE, TEL: 2230

R. MZEZEWA
DISTRICT ADMINISTRATOR
MUDZI

Cc Ashiella Musindo – University of Pretoria, P Bag X20, Hatfield 0028, South Africa

APPENDIX F: ETHICAL CLEARANCE LETTER

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Humanities 100.
1919 - 2019
Research Ethics Committee

12 September 2019

Dear Miss A Musindo

Project Title:	WOMEN AND CLIMATE CHANGE INDUCED SUSTAINABLE WATER MANAGEMENT STRATEGIES IN ZIMBABWE.
Researcher:	Miss A Musindo
Supervisor:	Prof I Pikirayi
Department:	Anthropology and Archaeology
Reference number:	18347178 (HUM022/0419)
Degree:	Doctoral

I have pleasure in informing you that the above application was **approved** by the Research Ethics Committee on 29 August 2019. Data collection may therefore commence.

Please note that this approval is based on the assumption that the research will be carried out along the lines laid out in the proposal. Should the actual research depart significantly from the proposed research, it will be necessary to apply for a new research approval and ethical clearance.

We wish you success with the project.

Sincerely

Prof Maxi Schoeman
Deputy Dean: Postgraduate and Research Ethics
Faculty of Humanities
UNIVERSITY OF PRETORIA
e-mail: PGHumanities@up.ac.za

Fakulteit Geesteswetenskappe
Lefapha la Bomotho

APPENDIX G: LETTER OF INFORMED CONSENT (ENGLISH VERSION)

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Humanities 100.
1919 - 2019
Department of Anthropology & Archaeology

LETTER OF INFORMED CONSENT (Form for research participant's permission)

RESEARCH PROJECT: Women and Climate Change Induced Sustainable Water management Strategies in Zimbabwe

My name is Ashiella Musindo, Identity number 63-1344903 J13. I am a PhD student (u18347178) in the Department of Anthropology and Archaeology at the University of Pretoria, and I am conducting field research on how women are being impacted by the effects of climate change and the sustainable water management strategies that are being adopted in-order to adapt to the effects of climate change.

Will you please participate in my research project by joining in the discussions and interviews?

Confidentiality

All information will be treated as confidential, and you may withdraw from discussions or interviews at any time without any consequences. With your permission, I will voice record and take notes during the interview. The recording is to accurately record the information you provide and will be used for transcription purposes only. If you choose not to be audiotaped, I will take notes instead. The voice recordings will not be broadcasted on radio, television, and internet or on social media but will be utilised to make findings for the study. After I have completed the study, I will submit all information to the University of Pretoria where it will be stored in password protected format at the Department of Anthropology and Archaeology. Data collected will be used for further research.

Participants' rights

Participation in the study is voluntary and you will not be paid for participating in this study. If you agree to take part in the study, you will be free to withdraw from the study at any time if you so wish, without any negative consequences for yourself. There will be no danger to you in participating in this study.

My aim, objectives and research methods are summarised on the last page of this document. I will provide you, upon request, with any additional information on my research project and answer any questions about my studies, my research methods, and myself. You may also contact me at the following telephone number: 0773197546 or email musindoashiella@yahoo.com. My supervisor is Professor I Pikirayi. He or the secretary of the Department of Anthropology and Archaeology may be contacted via telephone (+27 12 420 4661) or e-mail innocent.pikirayi@up.ac.za

I, the undersigned, have read the above and I understand the nature and objectives of the research Project of Ashiella Musindo as well as my potential role in it and I understand that the research findings will be published. I understand that the interview/discussions may be voice recorded. I voluntarily consent to participate in all discussions, to give my expert opinion and to provide details about my experience and opinions keeping in mind that I have the right to withdraw from the project at any stage.

I also grant the researcher the right to use my contribution to the research project in completing this project as well as other projects that may emerge from it in future.

Full name of participant	**Signature of participant**	**Date**
Full name of the investigator	**Signature of the investigator**	**Date**

AIM AND OBJECTIVES OF THE RESEARCH

The main aim of this research is to investigate how women are being impacted by the effects of climate change and sustainable water management strategies that are being adopted in-order to adapt to the effects of climate change**.** The specific research objectives ensuing from this broad aim are:

1. To examine the current state of vulnerability of women to the effects of climate change and inadequate water supply.

2. To assess the impact of climate change on various groups of women and the impact of climate change on water sources in selected parts of rural Zimbabwe.

3. To strengthen the documentation of Indigenous Knowledge Systems (IKS) in sustainable water management strategies in Zimbabwe in order to complement the scientific strategies.

4. To identify ways in which gender equality can be mainstreamed into climate change policies and programs in order to improve water governance in arid and semi-arid areas.

APPENDIX H: INTRODUCTION LETTER

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Humanities
Department of Anthropology and Archaeology

15 January 2019

To Whom It May Concern

Re: Ashiella Musindo (Student No. 18347178)

This is to confirm that the abovementioned student is enrolled at the University of Pretoria in my department, which is located in the Faculty of Humanities. She is reading for a PhD in the field of Development Studies.

I am requesting your assistance of her in terms of gathering of data for this purpose. I confirm that she will conduct her research in accordance with the University of Pretoria's ethical clearance policies.

Please direct an queries telephonically or through my e-mail address, both of which are given in the footer below.

Yours sincerely,

Innocent Pikirayi, PhD
(*Professor in Archaeology and Head of Department*)

Room 8-15, Level 8, Humanities Building
University of Pretoria, Private Bag X20
Hatfield 0028, South Africa
Tel +27 (0)12 420 4661
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Fakulteit Geesteswetenskappe
Lefapha la Bomotho