BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE EDUCATION

DEPARTMENT OF CURRICULUM AND EDUCATIONAL MANAGEMENT STUDIES

IMPACT OF CLIMATE CHANGE ADAPTATION STRATEGIES ON SMALL HOLDER FARMER REVITALISATION PROGRAMME AT HAMA-MAVHAIRE IRRIGATION SCHEME, CHIRUMANZU DISTRICT

BY

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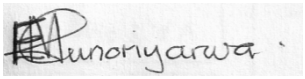
APPROVAL FORM

The undersigned certify that they have read and recommend to Bindura University of Science Education for acceptance, a research project entitled: *Impact of climate change adaptation strategies on small holder farmers revitalisation programme at Hama-Mavhaire Irrigation Scheme, Chirumanzu*. Submitted by Munoriyarwa Ellen (B225820B) in partial fulfilment of the requirements for the Master of Science Education degree in Geography.

Student:  **Date: 09.10.24**

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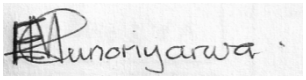
DECLARATION

I Ellen Munoriyarwa, declare that *Impact of climate change adaptation strategies on small holder farmers revitalisation programme at Hama-Mavhaire Irrigation Scheme, Chirumanzu* is my own work and that all the sources that I have used or quoted in the study have been indicated and acknowledged by means of complete references.

Signed:  Date: 12/02/2024

This research work was undertaken under the supervision of Dr. P. Chikuvadze

Signed:  Date: 13.02.24

DEDICATION

This research project is dedicated to my late mother, Tracy Shamai Munoriyarwa, who would have been pleased to see me succeed, and my daughter, Ruvimbo Alicia Nyevhe, for the support throughout the study.

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ABSTRACT

This study sought to gain insight into the impact of climate change adaptation strategies on smallholder farmer revitalisation programme at Hama-Mavhaire Irrigation Scheme in Chirumanzu Ward 7. The study was grounded on the paradigm of pragmatism and mixed approach. This design enabled the study to inherently exploit the use of both qualitative and quantitative analysis procedure. The sample comprised 284 participants who were selected using both probability and non-probability sampling approaches. The data were collected through semi-structured questionnaire and personal interviews. Numerical data were analysed through the use of frequencies and percentages, with non-numerical data analysed according to emerging themes. The analysed data revealed that climate change adaptation strategies are utilized and play a vital role in the development and sustainability of agricultural systems by small holder farmers in Hama-Mavhaire Irrigation Scheme in Chirumanzu Ward 7. Farmers highlighted some of the adaptation strategies they implemented and also challenges they encountered when trying to practice or apply the strategies. They also highlighted how they benefited both socially and economically as a result of the implementation of climate change adaptation strategies.

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CHAPTER ONE: PROBLEM AND ITS SETTING

1.1 Introduction

This introductory chapter outlined the background of the study and statement of the problem,research objectives, research questions, and assumptions of the study. The chapter also described the significance of the study, delimitation of the study, limitations of the study and provided definitions of key terms used. Finally, it included an outline of the chapters in the dissertation.

1.2 Background to the study

Climate change is widely viewed as a development issue because its impacts are multidimensional affecting various socioeconomic sectors and in turn have consequences on lives and livelihoods (Ndhlovu, 2022). A study by Sithole and Mawere (2023) shows that in recent years, climate change has fast become a reality that warrants concerted action from stakeholders across, as smallholder farmers report high incidences of socioeconomic disruptions. In response to this developmental problem, Diallo et al. (2020) coined that the social change agents have been implementing the resilience projects for smallholder farmers to cope positively and adapt to climate change adverse effects since 2000. There is scarcity of studies around the evaluation of the impact of these interventions in terms of the effectiveness, relevance, impact, and sustainability. Agricultural activities are vital livelihood support systems for farmers in Africa (Njieassam, 2019). According to del Pozo et al.(2019), these smallholder farmers rely on agricultural activities for employment opportunities, generating income and creating resilience other socioeconomic needs.

Zimbabwe is highly dependent on agriculture and there is widespread poverty and under-nutrition in the country (Stoeffler et al., 2016). More than 70% of Zimbabweans are smallholder farmers engaging in smallholder subsistence farming, which is the most important sector of the economy (Kahinda et al., 2007). Maize is the main staple food for 90% of the population of Zimbabwe, and almost all agricultural production is rain-fed (Nciizah, 2021). This situation is worsened by erratic rainfall and frequent dry spells, as well as limitations to the expansion of irrigation (Kahinda et al., 2007). In addition, Zimbabwe experiences recurring droughts, macroeconomic instability, high unemployment, declining soil fertility and poor agricultural policies, which reduce agricultural productivity and subsequently reduce food and nutrition security (Kahinda et al., 2007; Stoeffler et al., 2016; Witter et al., 2017). Hence, the need for this study to contribute towards the closure of this gap by exploring smallholder farmers' experiences pertaining to how the climate change adaptation strategies are impacting on their agricultural activities at the Hama-Mavhaire Irrigation Scheme.

1.3 Statement of the problem

Social change agents in collaboration with the Department for International Development are implementing a smallholder farmer revitalisation programme at Hama-Mavhaire Irrigation Scheme, as a climate change adaptation strategy (Manyanga etal., 2022). The programme's goal is to improve the food security and reduce smallholder farmers' burden towards economic and social shocks that emanates from climate change (Diallo et al., 2020). This is accomplished by improving access to climate smart agriculture, agricultural markets and financial services, reforming and/or enlarging specific irrigation facilities, and aiding these and neighbouring rain fed areas in boosting output and incomes (Sithole & Mawere, 2021). Since the implementation of small holder farmer revitalisation programme at Hama-Mavhaire Irrigation Scheme, there is scarcity of research done to determine if the scheme is beneficial or not as far as climate change adaptation is concerned. There is not much information available about the efficiency, importance, and sustainability of the Hama-Mavhaire Irrigation Scheme, since the invention of the irrigation system. It is in this regard that this study sought to contribute towards the closure of this gap, guided by the following main research objective: To establish the impact of climate change adaptation strategies in smallholder farmer revitalisation programme at the Hama-Mavhaire Irrigation Scheme.

1.4 Research objectives

From the above main research objective, the following research objectives were derived:

1. To establish smallholder farmers' conceptualization of climate in Chirumanzu district.
2. To identify climate change adaptation strategies which are used by smallholder farmers at Hama-Mavhaire Irrigation Scheme.
3. To establish how such climate change adaptation strategies can be used to build a socio-economically resilient community.

1.5 Research questions

This sought to answer the following research questions:

1. What is the smallholder farmers' conceptualization of climate change?
2. What are the climate change adaptation strategies that are used by smallholder farmers at Hama-Mavhaire Irrigation Scheme?
3. How can these climate change adaptation strategies be used to build a socioeconomic resilient community?

1.6 Assumptions of the study

Assumptions are things that are accepted as true, or at least plausible, by researchers and they include paradigmatic, prescriptive, and causal (Samuels, 2020). It is assumed that the study respondents and participants were truthful and honest in their reporting during data collection. Despite the fact that the researcher was conversant with the local language, there was always a risk of loss of information in the process of translation and analysis of data. It was being assumed that the translations were accurate and faced no risk during the study. It was also assumed that the research methodology used was representative of the small holder farmer revitalization programme at Hama-Mavhaire Irrigation Scheme.

1.7 Significance of the Study

This section interrogates the significance of the results to the following:

1.7.1 Policy makers

Climate change is a serious threat to global welfare (Sithole & Mawere, 2022). The findings on the sustainability of the climate change adaptations strategies would be useful to policy influence on poverty alleviation. Climate change experts always argue that smallholder farmers in developing countries are vulnerable to climate change due to lack of sustainable adaptive capacity (Boko et al., 2011; Roudier et al., 2011) but there is scanty empirical evidence on how adaptation strategies can contribute to a reduction in climate change vulnerability. This study would assist the policy makers on climate change budgeting and allocation of various technical expertise needed by the smallholder farmers to be able to adapt to climate change. This would make policy makers and the government contribute to the Sustainable Development Goals.

1.7.2 Smallholder farmers

Understanding and managing the shocks brought by climate change is necessary. Such knowledge encourages many households to analyze with conscience the multi-dimensional nature of global climate change and its local-level repercussions, which helps to improve overall vulnerability. The study would help establish smallholders conceptualization of climate change adaptation strategies and identify various climate change adaptation strategies they are using to be resilient to climate change and related shocks. This would help the social change agents to recommend measures that would be used to reduce the impact of climate change that smallholder farmers face. The findings on the impact of climate change adaptation strategies would be useful to smallholder farmers in the allocation of social, physical, human capital and economic assets to the area.

1.7.3 Bindura University of Science of Education

This study would help the university to explore in new areas of research and able to get funding for post-doctoral researchers looking at the significance of this current research. The findings of the study are anticipated to contribute to a body of knowledge to furnish academia and future students and researchers at the university with a comprehensive understanding of the local livelihoods' dynamics to climate change impacts and maximize on the recommendations the research would give.

1.7.4 Researcher

The research would help the researcher to inform action, gather evidence for theories development, and contribute to developing knowledge in a field of study of climate change adaptation.

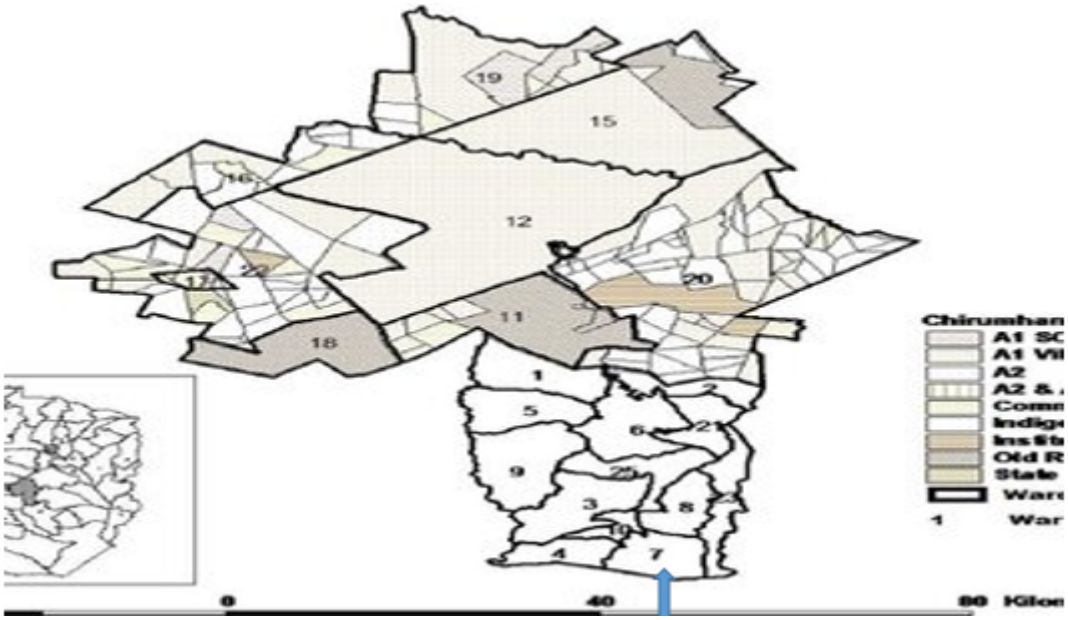
1.8 Delimitation of the study

The delimitation of this study focused on:

1.8.1 Geographical delimitation

The study is limited to Smallholder Farmer Revitalisation Programme of Hama-Mavhaire Irrigation Scheme in Chirumanzu ward 7. The irrigation scheme comprises about 980 hectares of land which accommodates 412 smallholder farmers. Hama-Mavhaire is located at the centre of ward 7 in the Midlands Province. Figure 1.1 shows the location of ward 7 in relation to other wards in Chirumanzu District.

Figure 1.1: Map of Chirumanzu Ward 7



Source: Chirumanzu Rural District Council

1.8.2 Conceptual delimitation

This study is only limited to the impact of climate change adaptation strategies on Smallholder Farmer Revitalisation Programme at Hama-Mavhaire Irrigation Scheme in Chirumanzu. The study established the smallholder farmers' conceptualization of climate change adaptation strategies and identified the climate change adaptation strategies that are used by smallholder farmers at Hama-Mavhaire Irrigation Scheme. It established how such climate change adaptation strategies are used to build a socio-economically resilient community.

1.9 Limitations of the study

The main stakeholders of Smallholder Irrigation Revitalisation Programme (SIRP) and smallholder farmers in Hama-Mavhaire irrigation scheme were not prepared for the study as this speaks to their real-life experiences. As a result, there was initially a lack of buy-in from these stakeholders, which led to scarce resources, uncooperative staff, and a lack of understanding regarding the necessity study. This made the data gathering procedure take longer. To stop this, the researcher met with the relevant authorities, traditional leaders and smallholders and discussed the value of researching on the adaptation strategies to climate change in order to ensure buy-in and preparedness. Later, after realizing the significance of the study and how it would aid development there was stakeholders buy-in.

The researcher's original plan was to compare the smallholder farmers before and after treatment using a One Group Pre-Post method to ascertain the impact of these adaptation strategies being implemented at the Hama-Mavhaire Irrigation Scheme. To fully utilize this quasi-experimental design, the baseline study was needed. The researcher discovered that there was no baseline data for most of the variables. The researcher utilized an experimental design using the control and intervention group. The methodological triangulation was thus used to curb this limitation.

1.10 Definition of terms

In this section the following terms are defined contextually:

1.10.1 Adaptation strategy

Adaptation strategy refers to a programme, project, or approach that has been developed to respond to the adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts (Intergovernmental Panel on Climate Change, 2017). It refers to changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change (Intergovernmental Panel on Climate Change, 2017).

1.10.2 Climate change

Climate change is defined as a long term change over decades or centuries in the earth's climate caused by the release of greenhouse gases, notably carbon dioxide and methane, which trap heat in the atmosphere (Food and Agriculture Organisation, 2017). Climate change is the long-term changes in the weather patterns in the region (Rosenberg, 2017). Climate change also refers to long–term shifts in temperatures and weather patterns. These shifts may be natural, but since the 1800s, human activities have been the main drivers of climate change, primarily due to burning of fossil fuels (like coal, oil and gas), which produces heat-trapping gases (United States Environmental Protection Agency, 2021). Therefore, climate change is the significant changes in global temperature, precipitation, wind patterns and other measures of weather and climate that occur over a long period of time.

1.10.3 Farmer revitalization programme

It is a programme meant to reduce vulnerability among smallholder farmers to food and nutrition insecurity, climate change effects and economic shocks, through planning, conservation, rehabilitation, clearance, development and redevelopment and preservation of available resources (Donatti et al., 2019).

1.10.4 Irrigation scheme

An irrigation scheme is an area where crops are grown under irrigation through any method, including flood recession, gravity or pump-fed canal systems, supplying either surface or underground water, water harvesting and pressurized systems, such as drip and sprinkler (Food and Agriculture Organisation, 2019).

1.10.5 Smallholder farmer

According to the RBI (2022), a 'Smallholder Farmer' is a farmer who cultivates up to 2 hectares of agricultural land (as owner, renter or sharecropper). Mortimore and Adams (2016) defines smallholder farmer as small scale farmers, pastoralists, forest keepers, fishers who manage areas varying from less than one hectare to 10 hectares.

1.11 Chapters layout

Introduction, study backdrop, problem statement, research aims, research questions, study significance, theoretical framework, study constraints, study delimitations, and definition of words were all covered in Chapter 1. The second chapter is a survey of the literature that includes all relevant books and periodicals. Google scholar was utilized to obtain the most recent and relevant literature. Chapter 3 is the methodology while chapter 4 looks at data analysis and presentation. Chapter Five provides summary of the study, conclusions and recommendations.

1.12 Chapter summary

The chapter is more significant since as it established the foundation for the study and gave a rundown of it by outlining the goals and open-ended questions that would direct the researcher's work. The chapter presented the study's background material and details on how the topic under investigation came to be. In addition, it defined the study region by providing pertinent information about the study location. Finally, the chapter discussed the constraints or difficulties that affect the research. Once the research introduction was complete, the researcher went on to the second chapter, the review of related literature.

CHAPTER TWO: REVIEW OF RELATED LITERATURE

2.1 Introduction

In the previous chapter the problem at the centre of this study was contextualized. In this chapter relevant sources were interrogated with the view to identify the gaps to be filled by this study. In this context relevant theories were identified leading to the formulation of a lens through which the study is observed. Themes derived from the research objectives and research questions in chapter 1 were used as a guide in the review of the relevant literature sources.

2.2 Theoretical framework

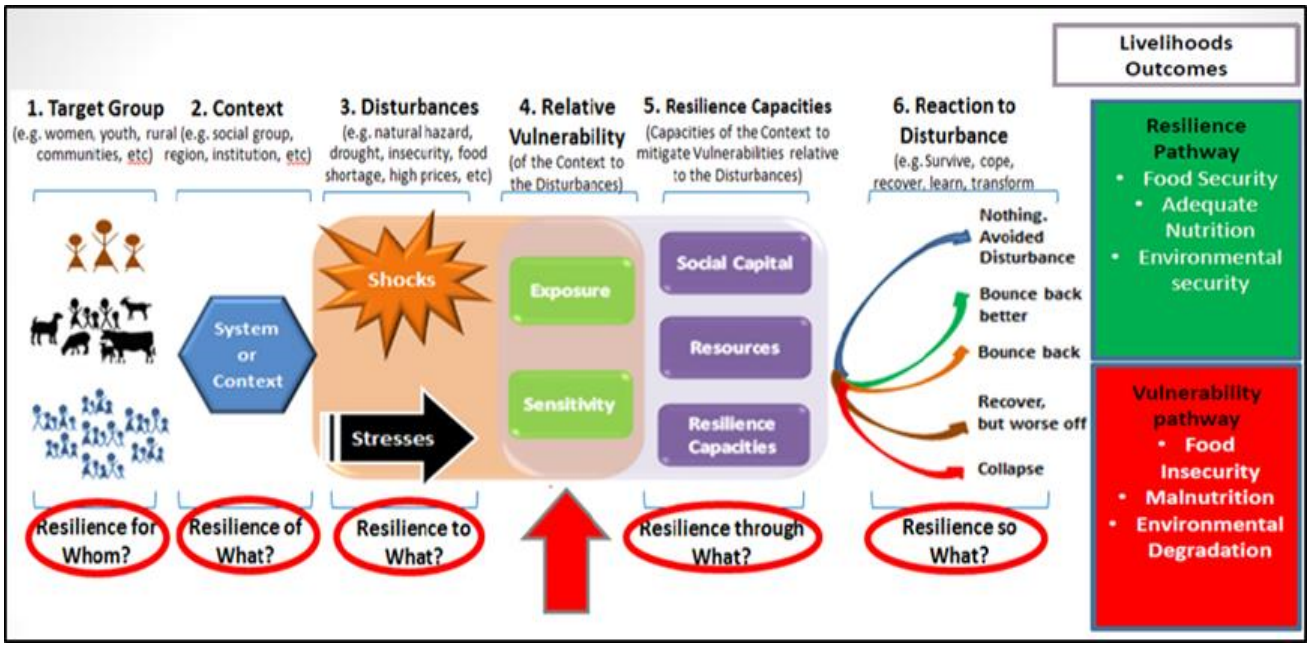
The study was substantiated by the Resilience Theory (RT) propounded by Garmezy (1973; 1997), who argued that specifically, individuals can develop adaptation skills and perspectives, including manifesting adaptive behaviours, engaging in problem-solving skills, maintaining optimistic perspectives, sustaining positive social functioning, utilizing positive emotion eliciting coping strategies, and finding meaning. The resilience theory is particularly relevant in this study because it helps to explain how smallholder farmers adapt to climate change and become more resilient to shocks(Southwick et al., 2014). Reflecting this present focus, Garmezy (1974) developed a resiliency framework that illustrates an adaptive response to chronic stress, caused by everyday stressors and major life events. Resiliency is thus, specifically, the ability to maintain adaptive functioning in response to the ongoing stress of daily living (del Pozo et al., 2019).

The theory fits in the study area of Chirumanzu Hama-Mavhaire, where communities are affected by climate change as a shock. Smallholder farmers are expected to mitigate the shock either through resisting or absorption. This is where smallholder farmers in Hama-Mavhaire are expected to undertake the activities to reduce the severity. Smallholders and social change agents are expected to respond and adapt to climate change through activities and programmes to manage the adverse effects of climate change. This would help to improve the livelihoods and food security and recover from stress.

2.3 Conceptual framework

The study is substantiated by the Sustainable Livelihoods Framework (SLF), propounded by the United Nations Development Programme (2015 and revised in 2021) and later adopted by the government of Zimbabwe.Figure 2.1 shows the conceptual framework that guided the research.

Figure 2.1: The conceptual framework that guided the research



Source: United Nations Development Programme (2021)

The framework looks at the different assets and strategies that smallholder farmers use to adapt to climate change, and how these assets and strategies are influenced by external factors like government policies and social norms (Kupika et al., 2019). Asfaw et al. (2021) concurs that the sustainable livelihoods framework is based on the idea that smallholder use different strategies to adapt to climate change and shocks, depending on the assets they possess at the household. These assets include physical assets, human capital, social, economic and financial assets. The more assets the household have the better the adaptation strategy (Karki et al., 2020). These strategies include things like changing the crops they grow, diversifying their income sources, and buying productive assets.

The Sustainable livelihoods framework also considers how external factors influence people's ability to adapt to climate change (Bedeke et al., 2019). For example, government policies can make it easier or harder for smallholder farmers to access resources like physical assets and human capital. The bundle of assets smallholder farmers in Chirumanzu District have determines their degree of adapting to climate change. The framework is important in this study because it provides a conceptual and analytical foundation for the study, guiding the research design, data collection, and

analysis (Mugi-Ngenga et al., 2021). Karki et al. (2020) added that the sustainable livelihoods framework helps to identify the key variables, concepts, and relationships that are relevant to the research topic, and to develop hypotheses and research questions.

Smallholder farmers use different climate change adaptation strategies to increase resilience (Donatti et al., 2019). According to Aryal et al. (2020), the interaction between climatic factors, the biophysical environment that include soil types, resource availability, socio-cultural backgrounds, farmer perceptions regarding climate change, and benefits of implementing strategies contribute to choice of strategies. According to Phiri et al (2019), smallholder farmers can adapt to climate change including the marginalised households, but what differs is the level of vulnerability. In the Makoni and Hwedza Districts of Zimbabwe, for example, households that were perceived marginalized were able to cope and adapt to changing climates and variability (Rurinda, et al., 2022). They adapted through diversifying crops and staggering planting dates. Adaptation forms that reduce the impact of climate-induced risks for different environments include autonomous or planned, and reactive or anticipatory adaptation (Dyke et al., 2020). Forms of adaptation in smallholder systems include use of different technologies, financial management, and diversification of livelihoods and networks (Chehade et al., 2020). Adapters include stakeholders in the value chain and these stakeholders are the social change agents from both the public and private sector departments (Asia et al., 2021).

2.4 Smallholder farmers' conceptualization of climate change

Small holder farmers across the globe conceptualize climate change in terms of changes in the amount and distribution of rainfall, as well as environmental temperature variations. As Carr (2016) observes, climate change has also affected farming systems in temperate regions. In the UK such cold spells have limited market gardening and fruit growing to lowland regions predominantly in the southern half of the country. This location is intended to avoid the frost pockets which occur in valley bottoms in late spring. Thus, despite increasing artificial ways of protecting crops from adverse weather conditions and extending the growing seasons, climatic influences remain very important (Carr, 2016). Physical conditions remain important because every effort to create artificial conditions is costly. In 2019 climate change has led to intense hailstorms in Australia, in which a single hail stone was as large as a tennis ball, which devastated horticultural infrastructure including greenhouses as well as the crops.

In tropical regions, the smallholder farmers in the ACP and the Central American Republics of Colombia and Ecuador are the ones who suffer most from natural disasters that have increased in magnitude and frequency as a result of climate change. In 1998 Hurricane Mitch destroyed much of the plantation area of Nicaragua and Honduras, and in 2005 Grenada's crop was devastated (Waugh,

2009). Moreover, climate change leads to aridity in southern Africa, and droughts have become longer and more intense (Brazier, 2015). Zimbabwe has been affected by frequent and severe droughts in the following periods: 1991-1992/1996-1997/2001-2002 and 2006-2008 (Brazier, 2015). These droughts deplete water reservoirs and leads to severe water shortages in rural areas of Zimbabwe, thus affecting the smallholder irrigation schemes, as well as the dambo vegetable plots through wetland loss.

Furthermore, Nciizah et al (2021) and Mugandani (2012) have observed that in Zimbabwe there is a general increase in mean annual temperatures and a decrease of mean annual rainfall. According to Zinyemba and Archer (2021), the analysis of the trends in weather elements over the years revealed that mean annual temperature in Zimbabwe increased by 0.41^{o}c from 2010 to 2022. Mugandani (2012) has also revealed that mean annual temperature has been rising over the past decade in Zimbabwe from 2010 to 2022. Hence, from 2010 to 2012 the mean annual temperature was slightly above average, with the highest temperature recorded in 2011. Also, from 2013 to 2016 temperatures were consistently above average, with the highest temperatures recorded in 2014 and 2015. In 2017 and 2018, temperatures were slightly below average, before rising again in 2019 and 2020 (Mugandani, 2012). In 2021 and 2022, temperatures were once again above average. This pattern suggests that mean annual temperatures in Zimbabwe are increasing, regardless of year-to-year variability (Meteorological department, 2022). These trends are shown in Figure 4.1

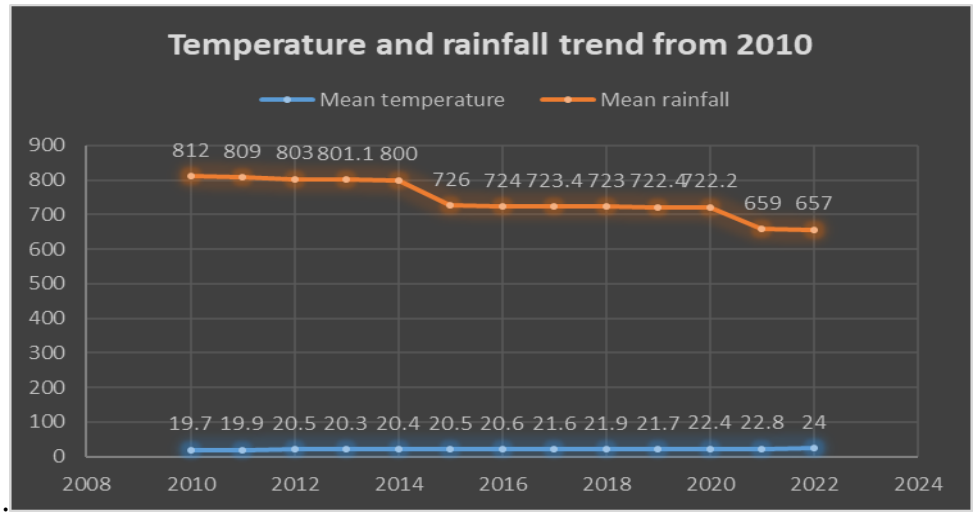


Figure 4.1: Trends in mean annual temperatures in Zimbabwe from 2010 to 2022 (Source: Meteorological Department, 2022)

Smallholder farmers conceptualize climate change in terms of its impact on their daily lives. According to Nciizah et al (2021), rural communities in Zimbabwe rely on rain-fed agriculture and are vulnerable to climate change, leading to food shortage, and hunger and famine. Mavhura,

Manyangadze and Aryal (2022) observed that Zimbabwe's livelihood zones show that most livelihood activities in the country are primarily centred on rain-fed agriculture (crop production, livestock and fisheries). Hence, such activities are highly susceptible to climate-related hazards and shocks, thereby, making rural households vulnerable to shifts and changes in the climate. Thus, poor people without reserves to face climate related shocks and stresses may adopt forms of adverse coping strategies, which may support short term survival but undermine overall well-being in the medium to long-term (Mavhura et al., 2022).

Small holder farmers also conceptualize climate change in terms of land degradation. The frequent and more severe droughts are a critical causative factor of land degradation in the communal lands of Zimbabwe. They deplete vegetative cover and lead to human actions such as livestock overgrazing and the expansion of farmlands, as well as the growth of invasive species like the cacti and lantana camara, that propel drylands more rapidly towards a desert-like condition (Akhtar-Schuster et al., 2017). During drought periods, the roots of perennial grasses are unable to survive, while annual grasses are fail to seed. Therefore, climate change exposes the land to many agents of erosion and act as major catalysts in land degradation, which makes communal areas unsuitable for the production of crops.

Small holder farmers also conceptualize climate change in terms of the increased frequency of natural disasters and the outbreak of pests and diseases. Drought also triggers such secondary disasters as the outbreak of pests and diseases, including the army worm, red locusts, red ants and quelea birds that destroy vegetation and crops. Zimbabwe has experienced one of the severest invasions by the army worm, which devastated crops and pastures in all the farming sectors during the 1994-1995 agricultural season. As Brazier (2015) observe, during this period larval densities were variable in the affected areas with the highest densities of 300-400 larvae/square metre (sqm) being reported from the Mashonaland provinces. The country has also faced several tropical cyclones in the recent past which include Cyclone Japhet (2005), Cyclone Gloria (2014), Cyclone Idai (2018) and Cyclone Ana (2022). These cyclones left hundreds of people homeless, destroyed infrastructure including roads, power lines and communication networks, as well as crop failure and devastation. Therefore, climate change is characterized by changes in the amount and distribution of rainfall, environmental temperature variations, land degradation, the increased frequency of natural disasters, and the outbreak of pests and diseases.

2.5 Climate adaptation strategies used in agriculture

This sub-section analyses climate change adaptation strategies used by smallholder farmers across the globe. More emphasis is given to the Africa and Zimbabwe, because of the context of the study. Adaptation is not a new concept and there is no consensus definition of climate change adaptation. Climate change adaptation refers to actions that reduce the negative impact of climate change, while taking advantage of potential new opportunities (Asfaw et al., 2021). According to Donattiet al. (2019) climate adaptation is about dealing with the market systems and involves adjusting policies and actions because of observed or expected changes in climate. Kalele et al. (2021) is of the view that adaptation can be reactive, occurring in response to climate impacts, or anticipatory, occurring before impacts of climate change are observed. In most circumstances, anticipatory adaptations would result in lower long-term costs for smallholder farmers and are more effective than reactive adaptations (De Sherbinin, 2018).

Adaptation (responding to climate impacts) and mitigation (reducing GHG emissions) are necessary complements in addressing climate change (Haq& Ahmed, 2021). The fourth assessment report of the intergovernmental panel on climate change states that while neither adaptation nor mitigation actions alone can prevent significant climate change impacts, taken together they can significantly reduce risks for smallholder farmers (Notta & Zetterli, 2023). Mitigation is necessary to reduce the rate and magnitude of climate change, while adaptation is essential to reduce the damages from climate change that cannot be avoided (Haq &Ahmed, 2021). Single policies and measures can be designed to help tackle both mitigation and adaptation (Chersich & Wright, 2019). For example, as the climate changes, a projected higher frequency and intensity of rain storms may increase storm water runoff and the potential for localised flooding which destroys crops. Planting crops across contour ridges is an initiative that smallholder farmers can use to both reduce storm water runoff (adaptation) and increase carbon storage (mitigation) (Aryalet al. 2020).

Farmers are known to implement both coping and adaptation options in response to climate change and variability, since adaptation strategies can reduce impacts of climate change on the well-being of farmers. The interaction between climatic factors, the biophysical environment that include soil types, resource availability, socio-cultural backgrounds, farmer perceptions regarding climate change, and benefits of implementing strategies contribute to choice of strategies. Even marginalized households can adapt to changing climates(Black et al.,2017).In the Makoni and Hwedza Districts of Zimbabwe, for example, households that were perceived marginalized were able to cope and adapt to changing climates and variability (Rurinda, et al., 2019). They adapted through strategies that included diversifying crops and cultivars and

staggering planting dates. Adaptation forms that reduce the impact of climate-induced risks for different environments include autonomous or planned, and reactive or anticipatory adaptation (Fankhauser, et al., 2019). Autonomous or planned forms of adaptation in smallholder systems include use of different technologies, financial management, and diversification of livelihoods.

2.5.1 Use of technologies

Adaptation strategies are diverse across the African continent. Management strategies include use of water conservation techniques (Nhemachena & Hassan, 2017) and in-situ rain-water harvesting strategies (Biazin et al., 2021). In-situ rainwater harvesting technologies include infiltration pits, cross-tied graded contours, and deepened contours (Hagmann, 2018). Water conservation techniques include mulching and different forms of conservation agriculture. Some farmers from 11 African countries, such as Ethiopia, Senegal, Sudan, Chad, Niger, among others, use adaptation strategies that include crop diversification, using different crop varieties, and varying the planting and harvesting dates. The farmers also increase the use of irrigation, increasing the use of water and soil conservation techniques, shading and shelter, shortening the length of the growing season, and diversifying from farming to non–farming activities (Hassan & Nhemachena, 2020).

Mavhura et al (2022) observed that introducing irrigation schemes as a way of climate change adaptation can improve climate change adaptation, by mitigating the effects of drought and water scarcity, which are expected to increase as a result of climate change. A study by Mushore et al. (2021) concludes that providing a steady supply of water, irrigation schemes can help to increase crop yields and improve food security thereby causing a sustainable adaptation to climate change. Chersich and Wright (2019) also argued that using irrigation schemes approach in the face of climate change as an adaptation strategy helps reducing poverty by providing jobs and income for local communities. Therefore technical support from the government, such as the Smallholder Irrigation Revitalisation Programme (SIRP), is the panacea to the negative effects of climate change among smallholder farmers in Chirumanzu District.

According to Mushore et al (2021), smallholder farmers in Nyanga district employ a wide range of climate change adaptation strategies which include ethno-science adaptive measures such as growing of drought tolerant crops, multiple planting, early planting, barter trade. Growing of drought tolerant small grain crops such as millet, sorghum, and rapoko is usually done to curb issues of low and unreliable rainfall, which are caused by climate change (Mushore et al., 2021). Current weather conditions are making it impossible to grow maize which is the staple cereal for Zimbabwe. As a result, small grain crops are suitable because they can survive in dry conditions. This is helpful because it ensures the availability of food even during drought seasons. However, lack of access to seeds such as millet and rapoko has contributed to the ineffectiveness of this climate change adaptation strategy.

Multiple cropping also increases smallholders' chances of getting yield in harsh climatic conditions. This involves planting a variety of crops such that if other crop types fail due to the given weather conditions the surviving crops would act as safety nets(Mushore et al., 2021). Thus, they mix crops like pumpkins, maize and beans together. This helps in promoting soil fertility as the legumes are nitrogen fixing crops. Again they create soil cover which helps in soil moisture retention and preservation. Multiple cropping also ensures that families would get some yields to harvest even when other crops fail.

Furthermore, early planting takes advantage of early rains and the full length of season. Based on the deep knowledge of their agro-ecological conditions and expectation of a good rainfall season (based on Indigenous Knowledge Systems), smallholder farmers plant crops as soon as the first rains fall. However, as Care (2009) noted, some smallholder farmers avoid this method since the rains could go away after they had planted and that would be wastage of seeds. Some would want to practice this method but might face hindrances like lack of inputs, such as seeds during the time of the first rains. Dry planting also counters uncertainty in the start of season. As Mushore et al. (2021) observe, the Nyanga farmers prepare the land and saw their crops in September and October before the rainfall come. This is done so that when the rains come, the already sowed seeds would sprout with the first rains. The types of crops which are normally dry planted include maize, groundnuts, round nuts and rapoko. This method gives smallholder farmers a chance to focus on other off-farm activities if it is properly done. The method also helps in moisture preservation, thus making crops thrive even in dry conditions.

2.5.2 Practising mixed farming

Precipitation often influences smallholder farmers' practicesas too much or too little of rainfall affects yields negatively, and normal or adequate rains promote good harvests. Under dry-land, the most common practices by farmers include multiple cropping mixed with livestock rearing conditions (Mukwanya, 2017). Strategies used by farmers in dry climates include differing varieties, shading and sheltering/planting trees, shortening growing season, increased use of soil and water conservation, soil conservation techniques, changing from farming to non-farming activities, differing planting dates and those in wet climates mainly used differing varieties followed by differing crops (Maddison, 2021). Meanwhile, adaptation strategies to decrease in precipitation mentioned by farmers include different varieties, shortening the growing season, increased use of soil and water conservation techniques, soil conservation techniques, shading and sheltering/tree planting and differing in planting dates in descending order (Chan, 2015).

Temperature also influences farmers' choices of adaptation strategies. According to Bedekeet al (2019), adaptation strategies of some farmers in Africa include growing different varieties, shading and sheltering trees, shortening growing season, increased use of soil and water conservation techniques and soil conservation techniques. Meanwhile maize-beans and sorghum were the main crops in cooler regions of Africa and in hot regions farmers preferred cowpea and millet (Kurukulasuriya & Mendelsohn, 2020). According to Maddison (2020), adaptation strategies of farmers in cooler regions included changing from farming to non-farming activities, use of insurance or weather derivatives, use of irrigation/ groundwater/watering, differing varieties, and differing planting dates. Some farmers mentioned adaptation strategies to increases in temperature that include shortening the growing season, shading and planting trees, changing from farming to non-farming activities, as well as increased use of water conservation techniques, and growing different crop varieties(Ayamga et al., 2020).

The commonly used crop management strategies in sub-Saharan Africa include crop and variety choices, and crop diversification (Phillips et al., 2022). Based on cross sectional household survey data collected from 1000 households during the 2004/2005 production season, adaptation strategies of farmers in the Nile basin of Ethiopia included planting trees, soil conservation, use of different crop varieties (most common), changing planting dates and irrigation (Deressa et al., 2017). Smallholders also integrate livestock into crop farming systems (Mortimore & Adams, 2016). Adaptation in field-based livestock systems include use of

supplementary feeds and concentrates, and mixed livestock/crop systems including using adapted forage crops among others.

Adaptation and coping strategies commonly used by farmers in Zimbabwe include dry and early planting, growing drought resistant crops, changing planting dates, and using irrigation (Mano & Nhemachena, 2016). Saunyama (2017) showed dry and early planting to be the most commonly used strategy (about 21%). Others diversify income sources, for example, some farmers in Zvishavane District of Zimbabwe who participate in non-farming activities like artisanal gold mining (Mutekwa et al., 2017). There are five agro-ecological regions with different agricultural potential due to differences in rainfall patterns, and other biophysical differences such as temperature and soil types in wetter agro-ecological regions, for example in Munyawiri (Goromonzi District II) that lies in a wetter region (AER II) of the country (Mushore et al., 2021).

Zvigadza et al (2018) noted that in addition to crop production, horticulture was important for economic livelihoods particularly for the better-off households. The farmers also had a number of other livelihood strategies. Some adaptation options to increased rainfall variability in some Zimbabwean smallholder areas include diversifying crops and cultivars and staggering planting dates (Rurindaet al., 2019). In drier agro-ecological regions of Zimbabwe, small grain production and extensive livestock production are important strategies for farmers(Mushore et al., 2021). The most common adaptation strategy mentioned by farmers in Gweru and Lupane Districts of the country, for example, was the use of drought tolerant crops (Mutsvangwa, 2016). In Zvishavane District (AER IV), farmers reported changes in climate that included increased frequencies of drought, excessive precipitation, and changes in timing and pattern of seasons (Gariwe et al., 2017). Farmer-suggested adaptation options to these changes included strengthening and improving indigenous land and water management practices, use of decision support tools, such as seasonal weather forecast data, growing drought resistant crops, improving indigenous animal breeds, and development of irrigation infrastructure (Kori, 2023).

Strategies to manage stress from warmer climates and climate variability by the middle of the 21st century and beyond can include use of short season crop varieties and changing crop choices, as well as shifts in livelihoods strategies (Bedekeet al., 2019). Agronomic modelling by Matarira et al (2014) using GCM adjusted climates and the Ceres-maize model, projected reduction in maize yields in future climates primarily due to temperature increases that shorten the crop growth period, particularly the grain-filling period. Adaptation options suggested from the study included switching to stress tolerant small grains and short season maize varieties.

Nyabako and Manzungu (2021) also suggested most of the country may become more suitable for short-season maize varieties (e.g., current AER II and III) and the current drier agro-ecological regions may become unsuitable for maize production and become more suitable for stress tolerant small grains such as sorghum and millets. The area of AER I and II may decrease in size by 14%, AER III by 26%, while AER IV and V may increase by 40% (Nyabako & Manzungu, 2023). According to their models, most agro-ecological regions would become unsuitable for long season varieties of maize crop. However, there is need for more studies on adaptation to future climates. Current information is mostly for country-level adaptation strategies, generalising for different communities.

2.6 The use of climate change adaptation strategies to build a socioeconomic resilient community

According to Calmon and Feltran-Barbieri (2019), in order to build a socioeconomic resilient community, four agricultural interventions which include integrated systems agriculture, rehabilitation of degraded pastures, agro-forestry and sustainable forestry, can power climate change adaptation strategies. Hence, instead of focusing the farm on one kind of production (crops or livestock or forestry), integrated systems combine them into one of four combinations, which are crops and livestock, crops and forestry, livestock and forestry, or crops, livestock and forestry. In Latin America, such integrated systems can produce food, energy, fiber, timber and non-timber forest products in the same area, at the same time or in rotation (Calmon & Feltran-Barbieri, 2019). This makes farms more resilient since integrated systems can improve the local micro-climate by reducing local temperature and increasing precipitation and water availability; reduce the impact of extreme weather events on crops, livestock and other products; reduce soil erosion; improve productivity; and provide additional socioeconomic benefits by increasing the number of products farmers can produce for subsistence or to sell.

Pasture degradation is a major problem on Brazilian farms as elsewhere in the world. Degraded lands are prone to erosion and so retain less water, have less nutritious grass for feeding animals and contribute to low-productivity livestock production. Degraded pasture can be more sustainably recovered by planting native forage or grass, or by introducing trees in the pasture to avoid soil erosion (Calmon & Feltran-Barbieri, 2019). Rehabilitation of pasture can contribute to new and more sustainable ways of raising animals, as this combines grazing with trees to improve the health of the soil and the well-being of the animals while mitigating carbon emissions. Rehabilitation of degraded pastures also provides climate adaptation benefits, including reduced local temperatures,

increased air humidity, better resistance against heat-waves and drought and more resilience against natural disasters. It also has a positive effect on soil erosion and water availability.

Agro-forestry integrates trees and crops in an intentionally designed system. In an agro-forestry system, every plant is selected for a particular purpose and species are selected so that plants will not compete but collaborate. This diversity of crops and trees allows the area to be productive all year long, so that small farmers can earn income in all seasons. As Calmon and Feltran-Barbieri (2019) explains, cocoa is one commodity that benefits from agro-forestry, since the plants grow better under the shade of other plants. In Peru, a public-private partnership seeks to support 20,000 farmers who produce organic and high-quality cocoa in agro-forestry systems on 58,000 hectares (about 143,000 acres). Thus, agro-forestry systems are an important tool for climate change adaptation in agriculture and produces adaptation benefits for local climate, including reducing the impact of drought, heat-waves, cold waves, heavy rain and floods, as well as improving soil and water availability, attracting pollinators and improving biodiversity.

According to Brazier (2015), smallholder farmers in Zimbabwe are resilient and adaptable people due to variable climate and a long turbulent history that made them familiar with adversity. Such turbulent history involves the colonial relocation of the majority into agro-ecologically sensitive marginal reserves with low rainfall and high temperatures, the negative impacts of economic structural adjustment programmes, the HIV/AIDS pandemic in the 1990s, and economic and political instability of the 2000s onwards. As Brazier observes (2015), regardless of these setbacks, Zimbabwe has the most highly educated population in Africa, with overall literacy rate of 96% (with 94% for women) and a wealth of local traditional knowledge, that has enabled communities to adapt to fluctuating climate for centuries. This has enabled the smallholder famers to harness new technologies, utilize mixed farming, to embrace financial services, and to market their agricultural produce to nearby towns and cities.

The use of technologies is another effective climate change adaptation strategy that can be used to build a socioeconomic resilient community. Apart from dam construction and rainwater harvesting water supply management techniques, there are diverse demand management technologies which include water and soil conservation, shading and sheltering, and shortening the length of the growing season through hybridization and genetic engineering of crops (Hagmann, 2018). According to Nhemachena and Hassan (2017), management strategies include use of water conservation techniques and in-situ rain-water harvesting strategies. Hagmann (2018) observed that in-situ rainwater harvesting technologies include infiltration pits, cross-tied graded contours, and deepened

contours Water conservation techniques include mulching and different forms of conservation agriculture. Accordinn to Biazin et al (2021), some farmers from 11 African countries, such as Ethiopia, Senegal, Sudan, Chad, Niger, among others, use adaptation strategies that include crop diversification, using different crop varieties, and varying the planting and harvesting dates. The farmers also increase the use of irrigation, increasing the use of water and soil conservation techniques, shading and shelter, shortening the length of the growing season, and diversifying from farming to non–farming activities (Hassan & Nhemachena, 2020).

According to Daley-Harris (2003), microfinance is the most powerful intervention strategy towards cutting absolute poverty considerably. Therefore, financial services are an important part of climate change adaptation because they can help smallholder farmers to access the resources they need to cope with the effects of climate change. Such financial services include insurance, microfinance, and savings and credit schemes (Daley-Harris, 2003). Microfinance loans can help smallholder farmers to invest in climate-resilient crops or irrigation, systems while insurance can help farmers to recover from the impacts of extreme weather events (Daley-Harris, 2003). At village level the savings and credit schemes can provide farmers with the capital they need to make necessary investments.

2.7 Chapter summary

The chapter reviewed the literature related to climate change adaptation. The chapter introduced the resilience theory as a theoretical framework and how it informs the study. The sustainable livelihoods framework was used as a conceptual framework. It included also the climate change strategies and its influence on agriculture activities. The study methodology that includes the research philosophy, approach, design and how data was collected and analysed, is contained in the next chapter.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

The techniques the researcher employed to respond to the research questions are described in this chapter. The chapter outlined the process used to conduct the research, which entails the research design, paradigm, approach, target population, sample and sampling procedure, research instruments, pilot study, data analysis, and research integrity. Lastly, the chapter summary was presented.

3.2 Research paradigm

Pragmatism is an approach which suggests that there are in fact many different ways of interpreting the world and conducting research to investigate reality and that combination of different approaches may provide a broader understanding of the phenomena being investigated (Grossoehme, 2014). It involves research designs that incorporate operational decisions based on 'what will work best' in finding answers for the questions under investigation, and this enables pragmatic researchers to conduct research in innovative and dynamic ways to find solutions to the research problems. There are many adaptation strategies that can be implemented by smallholder farmers to adapt to climate change. Pragmatism uses the approach that works best for the research problem (Irarrázaval, 2020). It does not adhere to the positivist principle of absolute truth or reality, nor to the constructivist view of multiple realities (Park et al., 2020). Pragmatism is based on the proposition that researchers should use the ideas, methods, approaches, or principles that explain a solution to the research problem (Morgan, 2007). This philosophical position was utilized to support the use of mixed methods in research from a methodological standpoint (Tashakkori & Teddlie 2003), in order to conduct a more thorough investigation and improve validity.

3.3 Research approach

According to Cresswell (2012), mixed method approaches are procedures for collecting, analysing and mixing both quantitative and qualitative data in a single study or in a multi-phase series of studies. In this data collection process, the researcher needs to decide on the emphasis which would be given to each form of data, which form of data to be collected first, how the data is going to be mixed, and whether the researcher should use theories to guide the study. The study's main goal was addressed using an embedded mixed methods strategy.The convergence model represents the traditional model of a mixed methods triangulation design (Creswell, 2006). In this model, the researcher collects and analyses quantitative and qualitative data separately on the same phenomenon and then the different results are converged by comparing and contrasting the different

results during the interpretation. Thus, the model is used to compare and validate, confirm or corroborate quantitative results with qualitative findings. The method was efficient, since both types of data were collected during one phase of the research at roughly the same time.

Moreover, each data could be collected and analysed separately and independently, using the techniques traditionally associated with each data type. This lent itself to team research, in which the team included individuals with both quantitative and qualitative expertise. However, much effort and expertise was required, particularly because of the concurrent data collection and the fact that equal weight had to be given to each data type.The mixed method approach was chosen by the researcher because it improved the validity of the findings and recommendations, the reliability of the data, and the understanding of the how smallholder farmers in Chirumanzu District are adapting to climate change. Mixed methods approach combines quantitative and qualitative research methods in different ways, with each approach adding something to the understanding of the phenomenon (Cresswell, 2019). If mixed methods offer a better understanding of the research problem than a single method design, then it is worth considering (Bamberger, 2012). In this scenario which involved climate change it was wise to use both research approaches in order to achieve the goal of finding climate change adaptation strategies in Ward 7.

3.4 Sample and sampling procedure

A sample is a selection from or any part of a defined population (Canhao & Keogh, 2004). In other words, it is a portion of the population that has been collected for statistical analyses. According to Firomumwe (2018), it is a subset of the target population. A total of 1080 smallholder farmers who benefited from the Smallholder Irrigation Revitalisation Program (SIRP) made up the target population. The main stakeholders who include the District Development Fund, Ministry of Agriculture and Mechanisation, Environmental Management Agency, Agritex, SIRP team, local authorities were also included in the target population, because they are the building pillars of the sustainability of climate change adaptation strategies, and other target populations were also included. The statistics for the target demographic is displayed in the Table 3.1.

Table 3.1: Distribution of the target population (N=1 102)

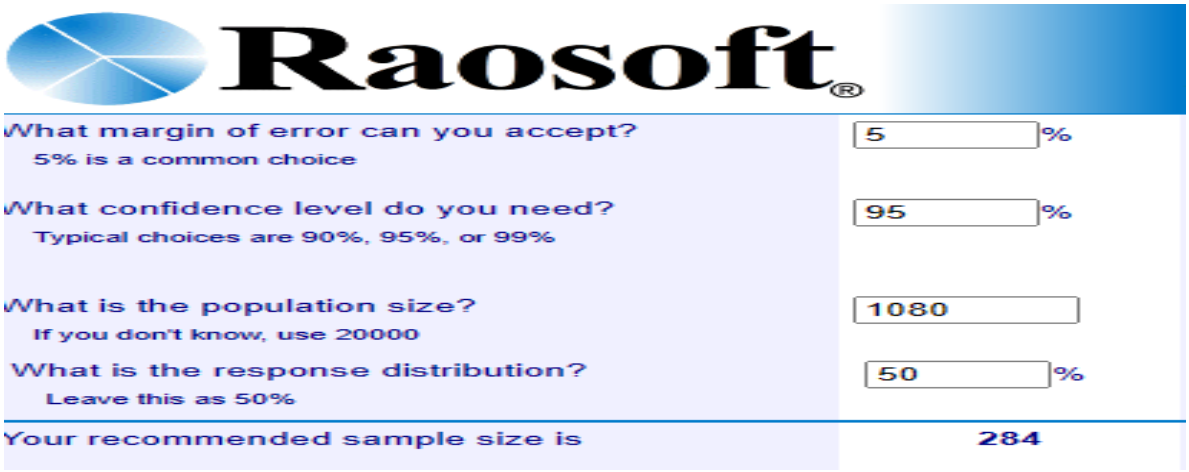
Unit of population	(N)

Smallholder farmers	1080
Farmer Group committee	8
District Development Committee	2
Ministry of Agriculture and Mechanisation	3
Ministry of Women Affairs	3
SIRP project implementation team	6
Target population	1102

According to Kumar (2004), sampling is the process of choosing a portion of the target population and a smaller population is used for data collecting because it is impractical to have the full population of interest participate. Instead of attempting to reach every member of the population, sampling from the target group is frequently more realistic and enables data to be obtained within the research timetable and at a lower cost. Sampling was used as it allowed researcher to carry out the study considering the limited time and resources the researcher had. Sampling was also used so as to improve the accuracy of the research findings and to reduce the total costs. Considering the limited period and the resources for the study, this use of the whole population in the study is not achievable.

A sample of the key informants, indicated in Table 3.1, was chosen from a selection of people known to have substantial experience and expertise in the topic (David, 2014). This is the group of professionals from which the researcher gathered opinions about their involvement as social change agents to help smallholder farmers' adaptation strategies in the face of climate change (Stevens et al.,2021). The key informants assisted with diagnostic analysis of why the change occurred or did not occur in addition to gathering expertise information.Sample size for one group Pre-test-Post test design was calculated using the Raosoft sample size calculator. Table 3.2 shows the sample size.

Table 3.2 Distribution of the respondents (n= 284)



The sample size was 284 smallholder farmers, which is 26%, using the target population of 1080 smallholder farmers at a level of confidence of 95% and a margin of error of 5% (Memon et al., 2020). Since 10% sample size is the general rule of thumb, the sample percentage of 25% was adequate.Therefore, the targeted sampling frame was three hundred and six individuals, which comprised 284 smallholder farmers. For data triangulation the following respondents were included in the study: 8 Farmer Group Committee participants, 2 District Development Committee participants, 3 Ministry of Agriculture and Mechanisation participants, 3 participants from the Ministry of Women Affairs, and 6 participants of the SIRP project implementation team.

These were selected through the purposive sampling which involved the picking of subjects on the basis of their judgement of their typicality or possession of the particular characteristic (Cresswell, 2012).The respondents were willingly selected to participate in the study. This method was appropriate since the researcher selected participants who were at work during data collection. The researcher moved around from one department to another, getting information from available participants, since the sampling frame was partially reliable.

3.5 Data collection techniques

According to Nyumba(2018), research instruments are tools used to obtain, measure, and analyse data from subjects around the research topic. Kaushik and Walsh (2019) explained that instruments are selected based on the type of study one is conducting: quantitative, qualitative, or mixed method. This study employed questionnaire surveys, Focus Group Discussions (FDGs), and personal interviews as data collection techniques. Therefore, the research instruments included semi-structured questionnaires, and observation and interview guides as research instruments.

3.5.1 Interviews

According to Leedy (1990) interviews are face to face interactions in which one party seeks to extract views held by the other on a given issue. A semi-structured interview is a meeting between two parties, the interviewer and the interviewee, with an objective to gather information in tandem with a set of questions (Creswell, 2014). The researcher used semi-structured interviews to obtain data from the smallholder farmers and key informants in the Farmer Group Committee, District Development Committee, Ministry of Agriculture and Mechanisation, Ministry of Women Affairs, and SIRP project implementation team, but was however not restricted to the questions on the paper only, since the interviews were done in person face to face at their workplaces. Personal interviews assisted in determining the "why" portion of the research questions, allowing participants' motivations for their actions to be documented, as well as their comprehension or misinterpretation of the concerns highlighted in the questionnaire. They provided information on local attitudes toward smallholder adaptation strategies. Selltiz (1995) has identified advantages of using the interview as compared to the questionnaire. These include the fact that questionnaires are inappropriate to a highly illiterate population, whereas an interview is appropriate. An interview can be flexible during the interview and can repeat or rephrase questions so that respondents understand what is really meant by a question. Thus, the interviewer is given access not only to hear what people say but how they say it. The non-verbal behaviour in an interview is an important aspect to be noted.

3.5.2 Semi-structured questionnaire

A questionnaire is defined as a set of written or printed questions with a choice of answers devised for the purposes of a survey or statistical study (William, 1979). It is a data gathering instrument through which respondents answer questions or respond to questions in writing (Best & Khan, 1993). According to Cleave (2023), semi-structured questionnaire is a form of guided interviewing where only some or few of the questions are predetermined. It includes a mix of both closed and open ended questions.The semi-structured questionnaire was employed because it has a number of advantages. Semi-structured questionnaire is considered ‘the best of both worlds’ since it collects comparable and reliable data, and its flexibility to ask follow-up questions. A questionnaire guarantees confidentiality or anonymity. It can be directly administered to a group assemble in a place thus at a mining area or at household level. It has a high response rate and the ease of reaching the participants. It also enables the researcher to collect data from people who are distant at the same time. The respondents were not influenced by the presence of the researcher, since they could answer questions during the researcher's absence. Moreover, data collected through a questionnaire

is easy to analyse, since the majority of the questionnaires items are yes/no and closed type. In this study, semi-structured questionnaire with a blend of structured and unstructured questions in a specific order were self-administered to the smallholder farmers. It had sections designed to gather information on prevalence of climate change in Chirumanzu, SIRP interventions, training received, crop production, livestock, nutritional gardens, and other related variables, including demographics (sex, age bracket, and level of education).

3.5.3Focus Group Discussions

A focus group is a small group of carefully selected participants who contribute to open discussions for research (Nyumba, 2018). A focus group discussion is a method of gathering data that takes the form of a carefully planned group discussion with ten or fewer participants, a moderator, and an observer. Its purpose is to gather a variety of opinions on a particular subject in a relaxed, permissive setting without any pressure to reach a consensus (Nyumba, 2018). Four (4) Focus Group Discussions (FGDs) were held in total to help the researcher uncover the true thoughts and concerns around the smallholder climate change adaptation strategies. These discussions are deeper than individual interviews or surveys, since group dynamics provide more in-depth responses. Of the four FGDs, two had all female smallholder farmers, one had all male smallholder farmers, and the fourth had a mix of males and female smallholder farmers. Each group included ten participants to ensure complete participation.

A moderator and an observer served as the two facilitators for the FGDs. The smallholder farmers were all the same and shared similar interests (Huyler, 2022). Similarly, it offered the extra non-verbal data (excitement, uncertainty, stress) that surveys were unable to capture. The FGDs discussed on smallholder farmers' conceptualization of climate in Chirumanzu District, climate change adaptation strategies which are used by smallholder farmers at Hama-Mavhaire Irrigation Scheme, and how such climate change adaptation strategies can be used to build a socioeconomically resilient community. FGDs were also adopted where the emphasis was on discussion. This method complimented the questionnaires. Its purpose was to elicit in-depth information to assist the researcher to understand deeply about an issue or topic.

3.6 Pilot study

A week prior to the actual data collection, a pilot study of the questionnaires, interview guides, transact walk and community mapping was conducted to allow for error correction and ensure that the instruments covered both the variables and proxy indicators. The quality of the instruments affects the quality of the research findings (Huyler, 2022). A representative sample of research participants was chosen for the pilot testing. This approach was effective for

identifying issues with test instructions and situations in which items were unclear (Tseng & Sim, 2020). This made it easier for the researcher to format the instruments and got rid of the eras and inconsistencies they had found.

3.7 Data collection procedure

According to Islam (2020), data collection is the procedure of collecting, measuring, and analysing accurate insights for research using standard validated techniques. Shaheen et al. (2019) has of the view that data collection is the process of gathering information for a specific purpose. The researcher obtained a letter from Bindura University of Science Education in order to obtain a research permit from the Ministry of Local Governance. The introductory letter enabled the researcher to obtain permission from the Chirumanzu District Development Coordinator to carry out the study at Hama–Mavhaire Irrigation Scheme in Ward 7.

Upon being granted permission by the responsible authority (cf. Appendix 2), the researcher notified the farmers' executive council about the research. The researcher outlined the objectives of the study to the council. Before entering in the field, the researcher also sought permission from the District Development Coordinator (DDC) and, upon entering in the field, from village heads as well. The interview participants were selected purposively and the researcher personally interviewed them. The smallholder farmers were selected by convenience sampling and semi-structured questionnaires were distributed to them. The researcher orally explained to the participants how the processes were going to be conducted. The researcher collected data using the semi-structured questionnaires and personal interview guides. Thus, both quantitative and qualitative data was collected simultaneously with the assistance of the research assistants, some of whom were the Agritex officers working in the irrigation scheme.

3.8 Data analysis

Data analysis refers to the systematic process of examining, organizing, and interpreting raw data collected during a research study (Jung, 2019). It involves extracting relevant information from the gathered data to answer research questions or test hypotheses. In this study, thematic data analysis was used to analyse qualitative data while SPSS was used to analyse quantitative data (Adosi, 2020).

3.8.1 Quantitative data analysis

To respond to research questions and make decisions, the researcher statistical analysis (descriptive and inferential). According to Islam (2020), quantitative data analysis is a process of presenting numerical data. In this study, the researcher used descriptive statistics for quantitative data, which involved cleaning the data to make sure that the data were correctly identified in order to gain knowledge about the data. Numerical data were analysed in this study through frequencies and percentages.SPSS and Excel were used to analyse the data, which was then presented in tables and graphs.

3.8.2 Qualitative data analysis

Thematic data analysis was used to analyse qualitative data. According to Adams and McGuire (2022) thematic data analysis is a qualitative research method that involves systematically analysing and categorizing the data to identify patterns and themes within the data set (Adosi, 2020). This approach allowed researcher to gain a deeper understanding of the underlying meanings and interpretations embedded within the data. Data was transcribed into Microsoft Word processing programme. The researcher then repeatedly listened to the recordings to ensure he has transcribed the recording accurately not missed out any information. The researcher identified themes in the responses from participants to present a clear common opinion among participants. These themes were presented during the presentation of results, with the direct quotes from the participants to highlight their opinions.

3.9 Research integrity

According to Mohajan (2017), research integrity refers to the ethical and professional standards that researchers must adhere to while conducting research. Madan and Kensinger (2017) coined that it encompasses both the scientific integrity of the research and the professional integrity of the researchers. Key elements of research integrity include honesty, rigour, transparency, and open communication, as well as care and respect for all participants and accountability (Roshaidai& Arifin, 2018). This section describes the research integrity used by the researcher.

3.9.1 Validity and reliability

In an effort to get accurate results, the researcher relied on content validity. The degree to which the questions on the test and the results from the questions accurately reflect all conceivable inquiries about the subject matter or competence is known as content validity (Patton, 2012). This made it easier for the researcher to confirm that the research captured the intended data. The assessor made sure the questionnaire had a sufficient number of items to capture the idea. This was made possible since the researcher collaborated with skilled enumerators to enhance the

instruments' content validity and ensure that they were aligned with the research's goals (Orodha, 2023).

This study attempted to achieve reliability by making the research procedure logical, traceable and clearly documented in a manner that other individuals from outside the research would be able to follow. Triangulation was also used to improve reliability (Best & Khan, 1993). Triangulation is the use of two or more methods of data collection in the study of some aspect of human behaviour (Cohen & Manion, 1994). Methodical triangulation is used where two methods, such as questionnaires and interviews, are used to collect information. The researcher used semi-structured interviews to obtain data from the smallholder farmers and key informants, whilst questionnaires were used to obtain data from smallholder farmers who were affiliated to Hama-Madzivire Irrigation Scheme, as well as the observation method, to ensure reliability.

3.10 Ethical considerations

Research ethics are moral principles that guide researchers to conduct research without deception or intention to harm the participants of the study or members of the society as a whole, whether knowingly or unknowingly. Each and every research has its ethical concerns to be considered. This research mainly focused on the ethics which include informed consent, voluntary participation of respondents, confidentiality, anonymity and protection from harm (Collis & Hussey, 2011).

3.10.1 Informed consent

Informed consent refers to the promise given by an individual to take part in a research study or any programme based on inclusive information regarding the nature of determination of the study or programme and their part in it (Bugler, 2003). The researcher explained the purpose of the research, the nature of the study, the benefits of the study, and risks if there are any. Therefore, anyone who was willing to participate after all this explanation was considered to have been given informed consent in the research.

3.10.2 Voluntary participation

The participants were not forced to take part in the research but were given the platform to volunteer willingly. Thus, the researcher stressed out her specifics that the participants were free or not to participate. This was done so that they could decide whether to be part of the study or not. Moreover, the participants were notified that they could take part or drop out at any point during the research, if they wanted to without being reprimanded.

3.10.3 Confidentiality

Confidentiality refers to the handling of information that an individual has revealed in a relationship of trust and with the anticipation that it would not be made known to others in ways that are unreliable with the understanding of the original expose without consent (World Health Organisation, 2013). Participants' risk of social harm when private information become public were protected by making their responses unknown and confidential, that is by using no identifiable information such as the names of the participants. Therefore, participants were guaranteed confidentiality as the information gathered by the researcher was not revealed to any one without their consent.

3.10.4 Anonymity

According to Whelan (2017), providing anonymity of evidence collected from students or research participants means that the scheme does not collect identifying evidence of singular subjects, for instance their names, addresses, or emails, so that the research paper does not link individual responses with participants' identities. It was therefore explained to participants that there was no proof of identity of names on the research instruments and in the final write-up. This was done to guarantee anonymity of respondents.

3.10.5 Protection from harm

A study that includes human beings is based on the principle that it should not harm not only the participants but also those closer to them like their friends, families and the community. The researcher has the primary responsibility to protect the participants from durable and sustained harm. The research was therefore conducted at the workplace setting, where the smallholder farmers and relevant stakeholders as key informants spent most of their time at, which therefore made them feel relaxed as the environment was favourable. The information in the questionnaire was also not harmful to the participants but rather clear and understandable.

3.11 Chapter summary

The chapter looked at the research philosophy, research approach and research design that guided the study. The study and target population were articulated together with the sampling procedure, sample size and data collection techniques and instruments. Data analysis and presentation of the findings are presented in the next chapter.

CHAPTER FOUR: DATA ANALYSIS AND INTERPRETATION

4.1 Introduction

This chapter presented and discussed the data generated from in-depth interviews, FDGs, direct observation, and questionnaire survey in line with the study aim and objectives, the research questions, and the problem statement. The aim of the study was to explore the impact of climate change adaptation strategies on smallholder farmer revitalisation programme at Hama-Mavhaire Irrigation Scheme in Chirumanzu Ward 7. This chapter first presented the characteristics of research participants and the themes which include **s**mallholder farmers' conceptualization of climate change,climate change adaptation strategies used by smallholder farmers, and the use of climate change adaptation strategies to build socioeconomic resilient community. Lastly, the chapter summary is presented.

4.2 Characteristics of the respondents

This section focused and presents the characteristics of the selected research respondents who were interviewed using semi-structured questionnaires and personal interviews. Such characteristics include research participants' sex, age, and professional qualifications of the selected key informants and smallholder farmers.

Table 4.1: Demographic characteristics of the selected respondents (n=284)

Attribute(s)	(n)	(%)
Sex		
Male	195	68.7
Female	89	31.3
Age range (years)		
25-30	0	0
31-35	4	1.4
36-40	17	6
41-45	46	16.2
46-50	87	30.6
51-55	69	24.3
Above 55	61	21.5
Professional qualifications		
Certificate/Diploma in Agriculture	16	5.6
O-Level	254	89.4
Unskilled (Primary/ZJC)	14	5

Table 4.2 shows that most participants (Smallholder farmers and Key informants) were males who constituted 68.7%, whilst females constituted 31.3%. Table 4.2 also shows that 16.2% of the participants were aged 41-45 years, 30.6% were aged 46-50 years, 24.3% were aged 51-55 years, and 21.5% were aged above 55 years, whilst 6% and 1.4% were aged 36-40 years and 31-35 years respectively. The majority of the participants were therefore in the late maturity group above 45 years. In terms of professional qualifications, most smallholder farmers and key informants had reached O-Level (89.4%), and 5.6% had certificate/Diploma in Agriculture, whilst 5% were unskilled having reached only Primary/ZJC. This is an indication that most smallholder farmers and key informants were skilled enough to conceptualize climate change and implement climate change adaptation strategies.

4.3 Small holder farmers' conceptualization of climate change in Chirumanzu district

In this section, the results are presented under the theme **s**mallholder farmers' conceptualization of climate change.Table 4.2 below presents the opinions of smallholder farmers and key informants who participated in the questionnaire survey.

Table 4.2: Smallholder farmers and key informants' opinions on their conceptualization of climate change (n =284)

Attributes	**Strongly Agree**		**Agree**		**Disagree**		**Strongly Disagree**	
	(n)	**(%)**	**(n)**	**(%)**	**(n)**	**(%)**	**(n)**	**(%)**
Decrease in rainfall amount and distribution	251	88.4	19	6.7	10	3.5	4	1.4
Increase in environmental temperatures	78	27.5	191	67.3	10	3.5	5	1.8
Increased evaporation in surface water sources e.g. rivers	84	29.6	186	65.5	9	3.2	5	1.8
Decreased crop yields	29	10.2	241	84.9	12	4.2	2	0.7
Increased outbreak of pests and diseases	79	27.8	191	67.3	8	2.8	6	2.1
Decreased livestock herds	18	6.3	261	91.9	3	1.1	2	0.7
Decreased food security	78	27.5	149	52.5	40	14.1	17	6
Land degradation	192	67.6	77	27.1	11	3.9	4	1.4
Decreased households income	79	27.8	190	66.9	9	3.2	6	2.1

4.3.1 Decrease in rainfall amount and distribution

Table 4.2 shows that most participants (88.4%) strongly agreed that climate change has caused a decrease in rainfall amount and distribution in Chirumanzu district and 6.7% agreed, whilst only 3.5% disagreed and 1.4% strongly disagreed. Therefore, the presented statistics reveal that the majority of smallholder farmers and key informants (95.1%) conceptualize climate change in terms of the decrease in rainfall amount and distribution. This concurs with the following in-depth interview response from the smallholder farmer in Chirumanzu ward 7:

> *We no longer have normal rainfall distribution as in the past because of this climate change. We are now sowing our crops as the as first rains fall contrary to what our ancestors did in the past. We used to havethree main types of rainfall gukurahundi (the rain that washes away the chaff), mvumiramutondo (the rain that helps the trees bloom) and munhuruka (the rain that signals the beginning of the rainy season). Therefore, the amount and distribution of rainfall has decreased today* (Ordinary Smallholder Farmer)

Another participant revealed that:

> *When we grew up, if there are individuals who grew up during our days, there were significant norms and values that ought to be respected in our traditional culture of Chirumanzu district and Zimbabwe as a whole, so that we would have normal seasons with heavy rainfall. We actually need to go back to the basics and respect the Creator as our ancestors did in the past. We are the ones to blame for climate change which has caused lack of rainfall and long droughts because we lost our traditional norms and values. In the past there were heavy rains and overflowing wetlands even during the hottest seasons. Soap and charcoal were forbidden at water sources and one would not carry metal plates to the open wells. The traditional holy days called 'chisi' were respected and one would not go to the field on those days […]* (Kraal head, a smallholder farmer)

From the above analogue it can be deduced that smallholder farmers and key informants conceptualize climate change in terms of the decrease in the amount and distribution of rainfall. This concurs with Nciizah et al (2021) and Mugandani (2012) who observed that in Zimbabwe there is a general decrease of mean annual rainfall. However, the some traditional participants like kraal head believed that climate change is caused by anthropogenic activities, and proffered spiritual factors as the main cause of decreases in rainfall amount and distribution.

4.3.2 Increase in environmental temperatures

Table 4.2 shows that most participants (67.3%) agreed that climate change has caused an increase in environmental temperatures in Chirumanzu District and 27.5% strongly agreed, whilst only 3.5% disagreed and 1.8% strongly disagreed. Therefore, the presented statistics reveal that the majority of smallholder farmers and key informants (94.8%) conceptualize climate change in terms of an increase in environmental temperatures in Chirumanzu District. This concurs with the following response from the smallholder farmer in Chirumanzu District:

> *Also, the first fruits of the season were given as tribute to the medium spirits, Nevana and Goredema to prevent drought and receive normal rainfall.Today climate change has increased the occurrence of serious droughts with high temperatures which keep on rising year after year…* (Kraal head, a smallholder farmer)

Another participant revealed that:

> *….This dry spell used to occur in January but due to climate change it occurs even in December of in February. That is the reason why we always have the scotching sun; the days are getting more and more hot* (Ordinary Smallholder Farmer)

Therefore, these findings have revealed thatthe majority of smallholder farmers and key informants conceptualize climate change in terms of an increase in environmental temperatures in Chirumanzu District. This concurs with Zinyemba and Archer's (2021) analysis of the trends in weather elements

over the years, which revealed that mean annual temperature in Zimbabwe increased by 0.41^{o}c from 2010 to 2022. Also, Mugandani (2012) revealed that mean annual temperature has been rising over the past decade in Zimbabwe from 2010 to 2022. Thus, climate change is indeed associated with an increase in environmental temperatures in Chirumanzu District.

4.3.3 Increased evaporation in surface water sources

Table 4.2 shows that most participants (65.5%) agreed that climate change has increased evaporation rates in surface water sources in Chirumanzu District and 29.6% agreed, whilst only 3.2% disagreed and 1.8% strongly disagreed. Therefore, the presented statistics reveal that the majority of smallholder farmers and key informants (95.1%) conceptualize climate change in terms of increased evaporation rates in surface water sources, for example rivers. This concurs with the following in-depth interview response from the smallholder farmer in Chirumanzu ward 7:

> *Also, the wetlands are drying and we have serious water problems in the area* (Ordinary Smallholder Farmer)

Another participant added that:

> *There were overflowing wetlands even during the hottest seasons... The so called civilization and technology has seen us wash our cars at sacred wetlands which eventually dried up much to our dismay* (Kraal head, Smallholder farmer)

Therefore, these findings have revealed that the majority of smallholder farmers and key informants conceptualize climate change in terms of increased evaporation rates in open water sources, including rivers. This concurs with Brazier's (2015) observation that climate change leads to aridity in southern Africa, and droughts have become longer and more intense. Hence, Zimbabwe has been affected by frequent and severe droughts in the following periods: 1991-1992/1996-1997/2001-2002 and 2006-2008 (Brazier, 2015). These droughts deplete water reservoirs and leads to severe water shortages in rural areas of Zimbabwe, thus affecting the smallholder irrigation schemes, as well as the dambo vegetable plots through wetland loss.

4.3.4 Decreased crop yields

Table 4.2 shows that most participants (84.9) agreed that climate change has decreased crop yields in Chirumanzu district and 10.2% strongly agreed, whilst only 4.2% disagreed and 0.7% strongly disagreed. Therefore, the presented statistics reveal that the majority of smallholder farmers and key informants (89.1%) conceptualize climate change in terms of decreased crop yields. This concurs with the following in-depth interview response from the smallholder farmer in Chirumanzu District:

> *Nowadays it's difficult to know when to start farming because we no longer have three types of rainfall as in the past. We constantly suffer from crop failures and decreasing yields as the crops are caught by a serious dry spell in the rainy season. This dry spell used to occur in January but due to climate change it occurs even in December of in February* (Ordinary Smallholder Farmer)

Another participant added:

> *Climate change is a serious problem. These days there are swarms of locusts and birds that feed on crops so that we no longer cultivate millet and sorghum. In previous years such pests decreased our yields greatly and we suffered from hunger and famine....* (Ordinary Smallholder Farmer)

Therefore, these findings have revealed that the majority of smallholder farmers and key informants conceptualize climate change in terms of decreased crop yields in Chirumanzu District. This concurs with Nciizah et al (2021)'s observation that rural communities in Zimbabwe rely on rain-fed agriculture and are vulnerable to climate change, leading to food shortage, and hunger and famine. Also, Mavhura, Manyangadze and Aryal (2022) observed that Zimbabwe's livelihood zones show that most livelihood activities in the country are primarily centred on rain-fed agriculture (crop production, livestock and fisheries). Hence, such activities are highly susceptible to climate-related hazards and shocks, thereby, making rural households vulnerable to shifts and changes in the climate.

4.3.5 Increased outbreak of pests and diseases

Table 4.2 shows that most participants (67.3%) strongly agreed that climate change has caused an increased outbreak of pests and diseases in Chirumanzu District and 27.8% agreed, whilst only 2.8% disagreed and 2.1% strongly disagreed. Therefore, the presented statistics reveal that the majority of smallholder farmers and key informants (95.1%) conceptualize climate change in terms of increased outbreak of pests and diseases. This concurs with the following in-depth interview response from the smallholder farmer in Chirumanzu District:

> *Climate change is a serious problem. These days there are swarms of locusts and birds that feed on crops so that we no longer cultivate millet and sorghum. In previous years such pests decreased our yields greatly and we suffered from hunger and famine. Besides pests there are also cattle diseases in the area. Last year some of us closed their kraals completely, as the diseases killed all the cattle in some households* (Ordinary Smallholder Farmer).

Therefore, these findings have revealed that the majority of smallholder farmers and key informants conceptualize climate change in terms of increased outbreak of pests and diseases in Chirumanzu District. This concurs with Chenje et al (1998)'s observation that climate change also triggers such secondary disasters as the outbreak of pests and diseases, including the army worm, red locusts, red ants and quelea birds that destroy vegetation and crops. Zimbabwe has experienced one of the severest invasions by the army worm, which devastated crops and pastures in all the farming sectors during the 1994-1995 agricultural season. As Chenje et al (1998) observe, during this period larval densities were variable in the affected areas with the highest densities of 300-400 larvae/square metre (sqm) being reported from the Mashonaland Provinces.

4.3.6 Decreased livestock herds

Table 4.2 shows that most participants (91.9%) agreed that climate change has decreased livestock herds in Chirumanzu District and 6.3% strongly agreed, whilst only 1.1% disagreed and 0.7% strongly disagreed. Therefore, the presented statistics reveal that the majority of smallholder farmers and key informants (93%) conceptualize climate change in terms of decreased livestock herds. This concurs with the following in-depth interview response from the smallholder farmer in Chirumanzu District:

> *…Besides pests there are also cattle diseases in the area. Last year some of us closed their kraals completely, as the diseases killed all the cattle in some households* (Ordinary Smallholder Farmer).

Therefore, these findings have revealed that the majority of smallholder farmers and key informants conceptualize climate change in terms of decreased livestock herds in Chirumanzu District. This concurs with Akhtar-Schuster et al (2017) who observed that frequent and more severe droughts

deplete vegetative cover and lead to human actions such as livestock overgrazing and the growth of invasive species like the cacti and lantana camara that propel dry lands more rapidly towards a desert-like condition. During drought periods, the roots of perennial grasses are unable to survive, while annual grasses are fail to seed. Therefore, climate change exposes the land to many agents of erosion and act as major catalysts in land degradation, which makes communal areas unsuitable for livestock and crop production (Akhtar-Schuster et al., 2017).

4.3.7 Decreased food security

Table 4.2 shows that most participants (52.5%) agreed that climate change has decreased food security in Chirumanzu District and 27.5%strongly agreed, whilst only 14.1% disagreed and 6% strongly disagreed. Therefore, the presented statistics reveal that the majority of smallholder farmers and key informants (80%) conceptualize climate change in terms of decreased food security. This concurs with the following in-depth interview response from the smallholder farmer in Chirumanzu District:

> *I am old and I can't participate in Food for Work programmes but I have no food for myself and my cousins because of drought. I rely on aid from donors and borrowing from relatives and friends. I also send my cousins to do casual work in the community, maricho* (Ordinary Smallholder Farmer).

Therefore, these findings have revealed that the majority of smallholder farmers and key informants conceptualize climate change in terms of decreased food security in Chirumanzu District. This concurs with withNciizah et al.'s (2021) observation that rural communities in Zimbabwe rely on rain-fed agriculture and are vulnerable to climate change, leading to food shortage, and hunger and famine. Also, Mavhura, Manyangadze and Aryal (2022) observed that Zimbabwe's livelihood zones show that most livelihood activities in the country are primarily centred on rain-fed agriculture (crop production, livestock and fisheries). Hence, such activities are highly susceptible to climate-related hazards and shocks, thereby, making rural households vulnerable to shifts and changes in the climate.

4.3.8 Land degradation

Table 4.2 shows that most participants (67.6%) strongly agreed that climate change has caused land degradation in Chirumanzu District and 27.1%agreed, whilst only 3.9% disagreed and 1.4% strongly disagreed. Therefore, the presented statistics reveal that the majority of smallholder farmers and key informants (71.5%) conceptualize climate change in terms of land degradation. This concurs with the following in-depth interview response from the smallholder farmer in Chirumanzu District:

> *It is clear that climate is changing in this area. There are dangerous weeds in the area which make the land useless, such as lantana and the cactus. The areas which we used to graze our livestock are now colonized by these weeds. Also, the wetlands are drying and we have serious water problems in the area* (Ordinary Smallholder Farmer)

Another participant added:

> *The area under forest is dwindling and this shows that the climate is changing.When we first came here, there were so many different kinds of trees that it was difficult to navigate the shrubs or trees. These items demonstrate the existence of climate change"* (Ordinary Smallholder Farmer)

Therefore, these findings have revealed that the majority of smallholder farmers and key informants conceptualize climate change in terms of land degradation. This concurs with Akhtar-Schuster et al's (2017) observation that frequent and more severe droughts are a critical causative factor of land degradation in the communal lands of Zimbabwe. Hence, they deplete vegetative cover and lead to human actions such as livestock overgrazing and the expansion of farmlands, as well as the growth of invasive species like the cacti and lantana camara, that propel drylands more rapidly towards a desert-like condition (Akhtar-Schuster et al., 2017). During drought periods, the roots of perennial grasses are unable to survive, while annual grasses are fail to seed. Therefore, climate change exposes the land to many agents of erosion and act as major catalysts in land degradation.

4.3.9 Decreased households income

Table 4.2 shows that most participants (66.9%) agreed that climate change has caused decreased household income in Chirumanzu District and 27.8%strongly agreed, whilst only 3.2% disagreed and 2.1% strongly disagreed. Therefore, the presented statistics reveal that the majority of smallholder farmers and key informants (94.7%) conceptualize climate change in terms of decreased household income. This concurs with the following in-depth interview response from the smallholder farmer in Chirumanzu District:

> *In previous years such pests decreased our yields greatly and we suffered from hunger and famine. Besides pests there are also cattle diseases in the area. Last year some of us closed their kraals completely, as the diseases killed all the cattle in some households* (Ordinary Smallholder Farmer).

Another participant added:

> *We constantly suffer from crop failures and decreasing yields as the crops are caught by a serious dry spell in the rainy season. This dry spell used to occur in January but due to climate change it occurs even in December of in February* (Ordinary Smallholder Farmer)

Therefore, these findings have revealed that the majority of smallholder farmers and key informants conceptualize climate change in terms of decreased household income.

4.4 Climate change adaptation strategies used by smallholder farmers

In this section, the results are presented under the theme climate change adaptation strategies used by smallholder farmers.Table 4.2 below presents the opinions of smallholder farmers and key informants who participated in the questionnaire survey.

Table 4.3: Smallholder farmers and key informants' opinions on their climate change adaptation strategies (n =284)

Attribute(s)	Strongly Agree		Agree		Disagree		Strongly Disagree	
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
Mixed farming	17	6	253	89.1	8	2.9	6	2.1
Changes in crop varieties	74	26.1	193	68	12	4.2	5	1.8
Planting early maturing crop varieties	182	64.1	87	30.6	9	3.2	6	2.1
Soil and water management	23	8.1	247	87	10	3.5	4	1.4
Practising irrigation farming	191	67.3	79	27.8	8	2.8	6	2.1
Changing planting dates	18	6.3	251	88.3	8	2.8	7	2.5
Getting involved in non-farm activities	78	27.5	149	52.5	35	12.3	22	7.7

4.4.1 Mixed farming

Table 4.3 shows that most participants (89.1%) agreed that climate change has caused smallholder farmers to practice mixed farming in Chirumanzu District and 6% strongly agreed, whilst only 2.9% disagreed and 2.1% strongly disagreed. Therefore, the presented statistics reveal that the majority of smallholder farmers and key informants (95.1%) generally agree that climate change has caused smallholder farmers to practice mixed farming. This concurs with the following in-depth interview response from the smallholder farmer in Chirumanzu District:

> *Climate change has therefore caused me practice mixed farming here. In times of drought I sell some of these cattle in order to put food on the table* (Ordinary Smallholder Farmer)

Therefore, these findings have revealed that the majority of smallholder farmers and key informants agreed that climate change has caused smallholder farmers to practice mixed farming in Chirumanzu District. Further descriptive statistical analysis revealed that before the irrigation scheme, most of the farmer did not own any livestock which shows the great impact that the Hama-Mavhaire irrigation scheme have to the smallholder farmers. Cattle, goats, sheep, poultry and pigs are the most popular livestock owned by rural households and used for adaptation. This concurs with Mukwanya's (2017) observation that climate change influences smallholder farmers' practices as too much or too little of rainfall affects yields negatively. Hence, under dry-land, the most common practices by farmers include multiple cropping mixed with livestock rearing.

4.4.2 Changes in crop varieties

Table 4.3 shows that most participants (68%) agreed that smallholder farmers in Chirumanzu District utilize changes in crop varieties as a major adaptation strategy and 26.1%strongly agreed, whilst only 4.2% disagreed and 1.8% strongly disagreed. Therefore, the presented statistics reveal that the majority of smallholder farmers and key informants (94.1%) generally agree that changing crop varieties is a major adaptation strategy. This concurs with the following in-depth interview response from the smallholder farmer in Chirumanzu District:

> *In this time of climate change we prefer early maturing varieties of maize crops such as mbizi and shoko. Very few people in this area prefer late maturing crops that need high rainfall such as Zhou* (Ordinary Smallholder Farmer)

Another participant added:

> *We now prefer to grow rapoko which is drought resistant. Of course, rapoko sadza is not palatable but at least we are assured of food security in times of drought. Besides, we brew*

beer and make more money with rapoko which we in turn use to buy maize (Ordinary Smallholder Farmer)

Therefore, these findings have revealed that the majority of smallholder farmers and key informants agree that changing crop varieties is a major adaptation strategy used by smallholder farmers in Chirumanzu District. This concurs with Ayamga et al.'s (2020) observation that some farmers mentioned adaptation strategies to increases in temperature that include growing different crop varieties.

4.4.3 Planting early maturing crop varieties

Table 4.3 shows that most participants (64.1%) strongly agreed that smallholder farmers in Chirumanzu District utilize planting early maturing crop varieties as a major climate change adaptation strategy and 30.6% agreed, whilst only 3.2% disagreed and 2.1% strongly disagreed. Therefore, the presented statistics reveal that the majority of smallholder farmers and key informants (94.7%) generally agree that agreed that smallholder farmers utilize planting early maturing crop varieties as a major climate change adaptation strategy. This concurs with the following in-depth interview response from the smallholder farmer in Chirumanzu District:

In this time of climate change we prefer early maturing varieties of maize crops such as mbizi and shoko. Very few people in this area prefer late maturing crops that need high rainfall such as Zhou (Ordinary Smallholder Farmer)

Therefore, these findings have revealed that the majority of smallholder farmers and key informants agree that planting early maturing crop varieties is a major adaptation strategy used by smallholder farmers in Chirumanzu District. This concurs with Mukwanya (2017) who observed that strategies used by farmers in dry climates include differing varieties, shading and sheltering/planting trees, and shortening growing season.

4.4.4 Soil and water management

Table 4.3 shows that most participants (87%) agreed that smallholder farmers in Chirumanzu District utilize soil and water management as a major climate change adaptation strategy and 8.1% strongly agreed, whilst only 3.5% disagreed and 1.4% strongly disagreed. Therefore, the presented statistics reveal that the majority of smallholder farmers and key informants (90.5%) generally agree that agreed that smallholder farmers utilize soil and water management as a major climate change adaptation strategy. This concurs with the following in-depth interview response from the smallholder farmer in Chirumanzu District:

> *The best way to adapt to climate change is to use contour ploughing in the fields. It helps farmers conserve moisture. We also encourage smallholder farmers to participate in good farming practices such as zero tillage, dhiga udye. This helps farmers to apply organic and artificial fertilizers in plant basins* (Head of Department, Ministry of Agriculture and Mechanisation)

Another participant added that:

> *Smallholder farmers need extensive training in the use of technologies as an effective climate change adaptation strategy that makes communities resilient. Besides dam construction there are water harvesting techniques in which modern rooftops, dwalas and bornhardts are designed to become sources water during the storm. Such water is stored in huge tanks and the used for irrigation. There are also water demand management technologies involving water and soil conservation and shortening the growing season of crops"* (Agricultural extension worker, Ministry of Agriculture and Mechanisation)

Therefore, these findings have revealed that the majority of smallholder farmers and key informants agree that soil and water management is a major adaptation strategy used by smallholder farmers in Chirumanzu District. This concurs with Nhemachena and Hassan (2017) who observed that management strategies include use of water conservation techniques and in-situ rain-water harvesting strategies (Biazin et al., 2021). In-situ rainwater harvesting technologies include infiltration pits, cross-tied graded contours, and deepened contours (Hagmann, 2018).

4.4.5 Practising irrigation farming

Table 4.3 shows that most participants (67.3%) strongly agreed that smallholder farmers in Chirumanzu District utilize irrigation farming as a major climate change adaptation strategy and 27.8% agreed, whilst only 2.8% disagreed and 2.1% strongly disagreed. Therefore, the presented statistics reveal that the majority of smallholder farmers and key informants (90.1%) generally agree that agreed that smallholder farmers utilize irrigation, as a major climate change adaptation strategy. This concurs with the following in-depth interview response from the smallholder farmer in Chirumanzu District:

> *We live close to the dam so we cultivate grain crops, vegetables, tomatoes and water melons in the garden. We also sell them at the local shops during Thursdays and Sundays. Irrigation also enables us to grow late maturing maize crops such as Zhou* (FGD Participant, Ordinary Smallholder Farmer)

Therefore, these findings have revealed that the majority of smallholder farmers and key informants agree that practising irrigation farming is a major adaptation strategy used by smallholder farmers in Chirumanzu District. A study by Mushore et al (2021) concludes that providing a steady supply

of water, irrigation schemes can help to increase crop yields and improve food security thereby causing a sustainable adaptation to climate change. Chersich and Wright (2019) also argued that using irrigation schemes approach in the face of climate change as an adaptation strategy helps reducing poverty by providing jobs and income for local communities. Therefore technical support from the government, such as the Smallholder Irrigation Revitalisation Programme (SIRP), is the panacea to the negative effects of climate change among smallholder farmers in Chirumanzu District.

4.4.6 Changing planting dates

Table 4.3 shows that most participants (88.3%) agreed that smallholder farmers in Chirumanzu District utilize changing plating dates as a major climate change adaptation strategy and 6.3%strongly agreed, whilst only 2.8% disagreed and 2.5% strongly disagreed. Therefore, the presented statistics reveal that the majority of smallholder farmers and key informants (90.8%) generally agree that agreed that smallholder farmers utilize changing planting dates, as a major climate change adaptation strategy. This concurs with the following in-depth interview response from the smallholder farmer in Chirumanzu District:

> *In this time of climate change we prefer early maturing varieties of maize crops such as mbizi and shoko that we plant very early in the season. Very few people in this area prefer late maturing crops that need high rainfall such as Zhou* (Ordinary Smallholder Farmer).

Therefore, these findings have revealed that the majority of smallholder farmers and key informants agree that changing planting dates is a major adaptation strategy used by smallholder farmers in Chirumanzu District. This concurs with Mushore et al (2021) who observe that the Nyanga farmers prepare the land and saw their crops in September and October before the rainfall come. It is also known in the district as kupandira in the local Manyika dialect. This is done so that when the rains come, the already sowed seeds would sprout with the first rains.

4.4.7 Getting involved in non-farm activities

Table 4.3 shows that most participants (52.5%) agreed that smallholder farmers in Chirumanzu District utilize non-farm activities as a major climate change adaptation strategy and 27.5%strongly agreed, whilst only 12.3% disagreed and 7.7% strongly disagreed. Therefore, the presented statistics reveal that the majority of smallholder farmers and key informants (80%) generally agreed that smallholder farmers utilize non-farm activities, as a major climate change adaptation strategy. This concurs with the following in-depth interview response from the smallholder farmer in Chirumanzu District:

You can't sit down and do nothing in the face of climate change. To solve the problem of water shortage we dig deep wells so that we fetch groundwater. There are individuals in our community who find employment in digging such wells and in turn solve the problem of food shortage caused by drought and crop failure (Ordinary Smallholder Farmer)

Therefore, these findings have revealed that the majority of smallholder farmers and key informants agree that getting involved in non-farm activities is a major adaptation strategy used by smallholder farmers in Chirumanzu District. This concurs with Hassan and Nhemachena (2020) who observe that the farmers increase the use of irrigation, increasing the use of water and soil conservation techniques, shortening the length of the growing season, and diversifying from farming to non–farming activities.

4.5 The use of climate change adaptation strategies to build socioeconomic a resilient community

Table 4.4: Smallholder farmers and key informants' opinions on their use of climate change adaptation strategies to build a socioeconomic resilient community (n =284)

Attribute(s)	Strongly Agree		Agree		Disagree		Strongly Disagree	
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
Access financial services	200	70.4	70	24.6	13	4.6	1	0.4
To grow drought resistant traditional varieties	183	64.4	84	29.6	11	3.9	6	2.1
To keep indigenous breeds of livestock	85	29.9	184	64.8	8	2.8	7	2.5
To use modern techniques of farming	245	86.3	25	8.8	10	3.5	4	1.4
To seek help from the government	195	68.7	75	26.4	7	2.5	7	2.5

4.5.1 Access financial services

Table 4.4 shows that most participants (70.4%) strongly agreed that smallholder farmers in Chirumanzu District need access to financial services in order to make climate change adaptation strategies build socioeconomic resilient community and 24.6%agreed, whilst only 4.6% disagreed and 0.4% strongly disagreed. Therefore, the presented statistics reveal that the majority of smallholder farmers and key informants (95.5%) generally agreed that smallholder farmers need access to financial services in order to make climate change adaptation strategies build socioeconomic resilient community. This concurs with the following in-depth interview response from the smallholder farmer in Chirumanzu District:

> *It's unfortunate that communal areas have ambiguous land tenure which does not give smallholder famers title deeds for their farms. This makes them unable to access financial services from banks since they have no collateral. Therefore, financial services are a critical climate change adaptation strategy that enables smallholder farmers to access the resources they need to cope with the effects of climate change. Microfinance loans can help smallholder farmers to invest in climate-resilient crops or irrigation, systems while insurance can help farmers to recover from the impacts of extreme weather events. All this is important, in order to build a socioeconomic resilient community* (District Development Committee member).

Therefore, these findings have revealed that the majority of smallholder farmers and key informants agree that smallholder farmers need access to financial services in order to make climate change adaptation strategies build socioeconomic resilient community in Chirumanzu District. This concurs with Daley-Harris' (2003) view that microfinance is the most powerful intervention strategy towards cutting absolute poverty considerably. Hence, financial services are an important part of climate change adaptation because they can help smallholder farmers to access the resources they need to cope with the effects of climate change. Microfinance loans can help smallholder farmers to invest in climate-resilient crops or irrigation, systems while insurance can help farmers to recover from the impacts of extreme weather events (Daley-Harris, 2003).

4.5.2 Grow drought resistant traditional varieties

Table 4.4 shows that most participants (64.4%) strongly agreed that smallholder farmers in Chirumanzu District need to grow drought resistant traditional varieties in order to make climate change adaptation strategies build socioeconomic resilient community and 29.6%agreed, whilst only 3.9% disagreed and 2.1% strongly disagreed. Therefore, the presented statistics reveal that the majority of smallholder farmers and key informants (94.0%) generally agreed that smallholder farmers need to grow drought resistant traditional varieties in order to make climate change adaptation strategies build socioeconomic resilient community. This concurs with the following in-depth interview response from the smallholder farmer in Chirumanzu District:

> *We now prefer to grow rapoko which is drought resistant. Of course, rapoko sadza is not palatable but at least we are assured of food security in times of drought. Besides, we brew beer and make more money with rapoko which we in turn use to buy maize* (Ordinary Smallholder Farmer)

Therefore, these findings have revealed thatthe majority of smallholder farmers and key informants agree that smallholder farmers need to grow drought resistant traditional varieties in order to make

climate change adaptation strategies build socioeconomic resilient community in Chirumanzu District. This concurs with Mutsvangwa's (2016) observation that the most common adaptation strategy mentioned by farmers in Gweru and Lupane Districts of the country, for example, was the use of drought tolerant crops.

4.5.3 To keep indigenous breeds of livestock

Table 4.4 shows that most participants (64.8%) agreed that smallholder farmers in Chirumanzu District need to keep indigenous breeds of livestock in order to make climate change adaptation strategies build socioeconomic resilient community and 29.9% strongly agreed, whilst only 2.8% disagreed and 2.5% strongly disagreed. Therefore, the presented statistics reveal that the majority of smallholder farmers and key informants (93.7%) generally agreed that smallholder farmers need to keep indigenous breeds of livestock in order to make climate change adaptation strategies build socioeconomic resilient community. This concurs with the following in-depth interview response from the smallholder farmer in Chirumanzu District:

> *...They paid high salaries which enabled me to buy many assets including cattle. I therefore practice mixed farming here. In times of drought I sell some of these cattle and put food on the table* (Ordinary Smallholder Farmer)

Therefore, these findings have revealed that the majority of smallholder farmers and key informants agree that smallholder farmers need to keep indigenous breeds of livestock in order to make climate change adaptation strategies build socioeconomic resilient community in Chirumanzu District. This concurs with Mukwanya (2017) who observed that under dry-land, the most common practices by farmers include multiple cropping mixed with livestock rearing.

4.5.4 To use modern techniques of farming

Table 4.4 shows that most participants (86.3%) strongly agreed that smallholder farmers in Chirumanzu District need to use modern techniques of farming in order to make climate change adaptation strategies build socioeconomic resilient community and 8.8% agreed, whilst only 3.5% disagreed and 1.4% strongly disagreed. Therefore, the presented statistics reveal that the majority of smallholder farmers and key informants (95.1%) generally agreed that smallholder farmers need to use modern techniques of farming in order to make climate change adaptation strategies build socioeconomic resilient community. This concurs with the following in-depth interview response from the smallholder farmer in Chirumanzu District:

> *The best way to adapt to climate change is to use contour ploughing in the fields. It helps farmers conserve moisture. We also encourage smallholder farmers to participate in good farming practices such as zero tillage, dhiga udye. This helps farmers to apply organic and artificial fertilizers in plant basins* (Head of Department, Ministry of Agriculture and Mechanisation)

Therefore, these findings have revealed that the majority of smallholder farmers and key informants agree that smallholder farmers need to use modern techniques of farming in order to make climate change adaptation strategies build socioeconomic resilient community in Chirumanzu District. This concurs with Nhemachena and Hassan (2017) who observed that management strategies include use of water conservation techniques and in-situ rain-water harvesting strategies (Biazin et al., 2021). In-situ rainwater harvesting technologies include infiltration pits, cross-tied graded contours, and deepened contours (Hagmann, 2018).

4.5.5 Seek help from the government

Table 4.4 shows that most participants (68.7%) strongly agreed that smallholder farmers in Chirumanzu District need to seek help from the government in order to make climate change adaptation strategies build socioeconomic resilient community and 26.4% agreed, whilst only 2.5% disagreed and 2.5% strongly disagreed. Therefore, the presented statistics reveal that the majority of smallholder farmers and key informants (95.1%) generally agreed that smallholder farmers need to to seek help from the government in order to make climate change adaptation strategies build socioeconomic resilient community. This concurs with the following in-depth interview response from the smallholder farmer in Chirumanzu District:

> *There is deep-seated need for more smallholder farmers in the district to participate in SIRP. The SIRP was launched in 2016 and is implemented by the Ministry of Agriculture, Mechanization and Irrigation Development. The goal of the SIRP is to increase food production and food security, boost rural incomes, and create employment opportunities for rural communities thereby adapting to climate change. To achieve these goals, the SIRP provides support to smallholder farmers through capacity building, the provision of inputs, and the promotion of farmer organizations. One of the most notable achievements in Chirumanzu is the increase in the number of hectares of irrigated land under smallholder farmers in Hama-Mavhaire irrigation scheme. This has resulted in increased food production, with maize production increasing by over 30% from 2019 compared to the previous years. In addition, the SIRP has helped to create over 100 jobs, mainly in the agricultural sector.SIRP has also helped to improve the quality of life for rural communities by increasing incomes and access to clean water and sanitation* (Member of the SIRP project implementation team)

Therefore, these findings have revealed that the majority of smallholder farmers and key informants agree that smallholder farmers need to participate in governmental initiatives in order to make climate change adaptation strategies build socioeconomic resilient community in Chirumanzu District. This concurs with study with Mushore et al (2021) who observed that providing a steady supply of water, irrigation schemes can help to increase crop yields and improve food security thereby causing a sustainable adaptation to climate change. Also, Chersich and Wright (2019) argued that using irrigation schemes approach in the face of climate change as an adaptation strategy helps reducing poverty by providing jobs and income for local communities. Therefore, technical support from the government, such as the Smallholder Irrigation Revitalisation Programme (SIRP), is the panacea to the negative effects of climate change among smallholder farmers in Chirumanzu District.

4.6 Chapter summary

This chapter analysed and interpreted the qualitative and quantitative results in order to respond to the research objectives espoused in chapter 1. The chapter was grounded in quantitative and qualitative analysis in its interrogation of the following issues: smallholder farmers' conceptualization of climate change, the impact of climate change adaptation strategies, and the use of climate change adaptation strategies to build a socioeconomic resilient community.The views of others scholars were included in the analysis and interpretation of the results, in order to create the platform for comparative analysis. This was contributed towards the closure of the research gaps identified in chapter 2. The next chapter provides the summary of the project, conclusions and recommendations.

CHAPTER 5
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The previous chapter presented, analysed and interpreted the research data. This chapter focused on the summary, conclusion and recommendations. The conclusions highlight the results of data analysis and recommendations suggest the way forward. Areas for further research were also suggested. The chapter summary was presented at the end of the chapter.

5.2 Summary of the project

Chapter 1 of the research presented the definition of the problem, background of the study, statement of the problem, research questions, assumptions of the study, significance of the study, delimitation of the study, limitations, definition of key terms, and the chapters' layout. The research sought to explore the impact of climate change adaptation strategies on smallholder farmer revitalisation programme at Hama-Mavhaire Irrigation Scheme in Chirumanzu Ward 7. Chapter 2 looked at literature review which provided literature on smallholder farmers' conceptualization of climate change, the impact of climate change adaptation strategies on smallholder farmers, and the use of climate change adaptation strategies to build a socioeconomic resilient community. The chapter also presented the as the Resilience Theory as theoretical framework that underpinned the study and the Sustainable Livelihoods Approach as the conceptual framework. Chapter 3 presented the research design, methods/tools, population, sample and sampling procedure, data analysis, research integrity and ethical considerations. The research was grounded upon a positivist paradigm, which has the view that only factual knowledge gained through observation, including measurement, is valid and reliable. In chapter 4, the researcher looked at data presentation, analysis and discussion.The chapter analysed and interpreted results concerning the issue under investigation. The following were the major results:

- Smallholder farmers in Chirumanzu District realize conceptualized climate change in terms of increasing temperatures and a decrease in the amount and distribution of rainfall, as well as its impact on their daily lives, including crop failure, decreasing yields, land degradation and the outbreak of pests and diseases.
- Smallholder farmers in Chirumanzu District utilize various climate change adaptation strategies, which include changing crop variety, mixed farming, planting early maturing crops, soil and water management, irrigation and changing planting dates.

- Adaptation strategies in Chirumanzu District are less successful overall and most smallholder famers are hard hit by climate change effects, leading them to resort to such copying strategies as seeking aid from donors, participating in food for work programmes, borrowing from relatives and friends, buying on credit and carrying out casual work in their communities that give them short-term relief.
- Smallholder farmers need to have access to financial services, grow drought resistant traditional varieties, keep indigenous breeds of livestock, use modern technology, and seek government intervention in order to make climate change adaptation strategies build a socioeconomic resilient community.

5.3 Conclusion

The study has shown that smallholder farmers in Chirumanzu are skilled enough to realize that the district was showing signs of climate change.The study has also revealed that smallholder farmers in Chirumanzu district use various climate change adaptation strategies, but such strategies are less successful as most smallholder famers are hard hit by climate change effects. Therefore smallholder farmers need to have access to financial services, grow drought resistant traditional varieties, keep indigenous breeds of livestock, use modern technology, and seek government intervention in order to make climate change adaptation strategies build a socioeconomic resilient community.

5.4 Recommendations

In accordance with the key findings presented above, the study recommends that:

- All stakeholders in communal farming need to consider smallholder farmers as social change agents not as victims of climate change. This would make them active participants in climate change adaptation.
- The government should involve smallholder farmers in all issues that affect them rather than forming structures that solve smallholder farmers' challenges in their absentia. This can be done through smallholder farmers groups, do community dialogues through events, workshops, role plays, community mapping and information campaigns.
- The government should allow smallholder farmers to form smallholder farmers' groups that are locally led with structures from the village level to national, where they openly discuss issues, best practices, and lessons learned, including the use of Indigenous Knowledge Systems (IKS).

5.5 Areas for further study

The researcher suggested the following areas of further research:

- An in depth interrogation on the impacts of climate change adaptation strategies in Chirumanzu district as a whole.
- Reapplication of the study in the other districts and provinces within Zimbabwe to establish the transferability of the results to diverse circumstances.

5.8 Chapter summary

This chapter discussed the results of the study in connection with the findings from related literature, in order to respond to the objectives espoused in the current study.The chapter also included conclusions and recommendations of the study. The conclusions highlighted the results of data analysis and recommendations suggested the way forward. Areas for further study were also suggested.

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APPENDICES

Appendix 1: Introductory Letter from Bindura University of Science Education

P Bag 1020
BINDURA
ZIMBABWE
Tel: 0271-7531 ext 1038
Fax: 263-71-7616

CEMS DEPT

BINDURA UNIVERSITY OF SCIENCE EDUCATION

Date: ----------

TO WHOM IT MAY CONCERN

NAME: MUNORIYARWA ELLEN REGISTRATION: B225820B

PROGRAMME: MScEd Cg PART: 2.1

This memo serves to confirm that the above is a bona fide student at Bindura University of Science Education in the Faculty of Science Education.

The student has to undertake research and thereafter present a Research Project in partial fulfilment of the MASTERS OF EDUCATION IN GEOGRAPHY programme. The research topic is: The research topic is: THE IMPACTS OF CLIMATE CHANGE ADAPTATION STRATEGIES ON SMALL HOLDER FARMER REVITALISATION PROGRAMME AT HAMA-MAVHAIRE IRRIGATION SCHEME- CHIRUMANZU

In this regard, the department kindly requests your permission to allow the student to carry out his/her research in your institutions.

Your co-operation and assistance is greatly appreciated.

Thank you

BINDURA UNIVERSITY OF SCIENCE EDUCATION
DEAN
Faculty Of Science Education
P. Bag 1020
Bindura

Y Mudavanhu (Dr.)

CHAIRPERSON - CEMS

Appendix 2: Approval from the District Development Coordinator

Tel: +263 542 532 234
+263 542 532 352

www.mlg.gov.zw

The District Development Coordinator
Ministry of Local Government and Public Works
P.O. Box 63
Mvuma

ZIMBABWE

Chirumanzu District Development Coordinator
PO Box 63
Chirumanzu

05 OCTOBER 2023

TO WHOM IT MAY CONCERN

REF: PERMISSION TO CONDUCT RESEARCH IN CHIRUMANZU DISTRICT

This letter serves to confirm that MUNORIYARWA ELLEN: REGISTRATION B2258208, PROGRAMME: MScEdGg at Bindura University Of Science Education has been granted permission to carry out her research in Ward 7 Chirumanzu District on the topic: THE IMPACTS OF CLIMATE CHANGE ADAPTATION STRATEGIES ON SMALL HOLDER FARMER REVITALISATION PROGRAMME AT HAMA –MAVHAIRE IRRIGATION SCHEME, CHIRUMANZU.

Yours sincerely

CHIMBOZA

//DDC Chirumanzu

DISTRICT DEVELOPMENT
COORDINATOR
MVUMA DISTRICT
24 JAN 2024
P.O. BOX 63, MVUMA
TEL: 054-2532352

Appendix 3: Semi-structured questionnaire for smallholder farmers and key informants

I am a final year Master of Science Education (Geography) degree student with the Bindura University of Science Education carrying out a study on the impact of climate change adaptation strategies on small holder farmer revitalisation programme at Hama-Mavhaire irrigation scheme, Chirumanzu

Instructions

Kindly answer all the questions. Do not discuss with anyone. Your answers to this questionnaire will remain strictly confidential. Read each question carefully and respond as carefully and truthfully as possible. You may ask for assistance if you do not understand something, or are not sure how to respond. Please fill in or tick all items that agree or are closest to your own opinion. If you decide to change your response to a question, put an 'X' over your first choice and put a tick on your own new choice. In order to maintain anonymity and confidentiality please do not write or sign your name.

Section A: Personal profile

1. Sex [ ] Female [ ] Male
2. What is your age range (in years)? [ ] 25-29 [ ] 30-34 [ ] 35-40 [ ] 41-45 [ ] 46-50 [ ] 51-55 [ ] Above 55
3. Professional qualifications: Certificate/Diploma in Agriculture [ ] O-Level [ ] Unskilled (Primary/ZJC) [ ]

Section B

5. Do you agree that climate change has influenced the following weather elements and farming activities in your area?

	Strongly Agree	**Agree**	**Strongly Disagree**	**Disagree**
Decrease in rainfall amount and distribution				
Increase in environmental temperatures				
Increased evaporation in surface water sources e.g. rivers				
Decreased crop yields				
Increased outbreak of pests and diseases				
Decreased livestock herds				
Decreased food security				
Land degradation				
Decreased households income				

Any other comments (if necessary)

……....

Section C

6. Do you agree that climate change has influenced the following smallholder farmers' adaptation strategies in your area?

	Strongly Agree	**Agree**	**Strongly Disagree**	**Disagree**
Mixed farming				
Changes in crop varieties				
Planting early maturing crop varieties				
Soil and water management				
Practising irrigation farming				
Changing planting dates				
Getting involved in non-farm activities				

Any other comments (if necessary) ……..

Section D

7. Do you agree that climate change has influenced smallholder farmers practise the following resilient strategies?

	Strongly Agree	**Agree**	**Strongly Disagree**	**Disagree**
Access financial services				
To grow drought resistant traditional varieties				
To keep indigenous breeds of livestock				
To use modern techniques of farming				
To seek help from the government				

Any other comments (if necessary) ……..

Section E

8. Do you agree that the following challenges that are encountered when implementing climate change adaptation strategies in your area??

	Strongly Agree	**Agree**	**Strongly Disagree**	**Disagree**
Limited commitment from stakeholders				
Ineffective communication channels				
Poor leadership				
Lack of funding and resources				
Poor human resource induction				

Any other comments (if necessary)

……...

Section D

1. In response to climate change, have you taken any adaptation measures to reduce the impacts of climate change? (1) Yes (2) No

2. If no, why?

Factors limiting smallholder farmers' capacity to adapt to climate change.	**Yes**	**No**
Lack of information		
Lack of physical assets		
Lack of financial assets		
Lack of social assets		
Lack of knowledge		
Shortage of farming land		
Not observing the climate related problems		
Less emphasis to climate change problems		
Others		

3. If Yes have you employed any of the following climate change impact adaptation strategies in your farm?

No//.	**Climate change adaptation**	**Responses**		**If no, please specify the reason why not?**
		(1) Yes	**(2) No**	
1	Buying insurance			
2	Change crop variety			
3	Mixed farming			
4	Temporary migration			
5	Planting early maturing crop			
6	Soil and water management			
7	Planting trees			

8	Irrigation			
9	Changing planting dates			
10	Seek off-farm employment			
11	Reduce number of livestock			
12	Others (specify if any			

4. In the past two years do you received any agricultural technical support from the Government in implementing adaptation? (1) Yes (2) No

   If yes what programmes are being implemented

5. What kind of technical support do you receive in your effort to reduce the impacts climate change and improve your farming system?

……
……

6. Do you have access to climate information?
   (1) Yes (1) No
7. How many of the following types of livestock do you have? Please fill in the head count column.

Number	Types of livestock	Head count
1	Cattle	
2	Calf	
3	Oxen	
5	Donkey	
7	Goats	
8	Sheep	
9	Poultry	
10	Beehives	
11 (others)		

21. How do you rate your financial asset currently as compared to before?

22. How far is the market do you buy your agricultural inputs? ……..km
23. How far is the market do you sell your agricultural outputs? …….km

24. In undertaking your usual farming activities have you ever faced shortage of finance? For example, to purchase agricultural inputs like fertilizer, oxen, and transporting products to the market.
    (1) Yes (2) No

25. Do you have access to any formal credits in time?
    (1) Yes (2) No

26. Do you have access to agricultural extension services in?
    (1) Yes (2) No

27. Do you receive any support from agricultural extension which could help improve your farming activities?
    (1) Yes (2) No

28. Please specify any kind services you get from them.

.....

……

29. Have you ever got any kind of formal training which helps improve your farm productivity? This might be how to (protect soil from erosion, conserve rainwater, use modern agricultural inputs, reduce post-harvest loss)
    (1) Yes (2) No

30. Did you have non-formal training of the above kind from farmers, or did you give training to other farmers in your locality? (Farmers-to-farmers extension services)
    (1) Yes (2) No

Thanks for your co-operation

Appendix 4: Personal interview guide for the selected respondents

1. What is your department?
2. How do you contribute to the livelihoods of smallholder farmers in the district?
3. What is your duration of stay in the village?
4. What is your understanding of climate change concepts?
5. What are the indicators of climate change in Chirumanzu?
6. What are the other environmental changes occurring in responsible to climate change, particularly on natural vegetation cover, water resources, and animal resources?
7. How much effects have the climate and related environmental changes have on the local livelihoods? (crop yields, livestock production, food security, household income and welfare)
8. Can you comment on the Revitalisation Programme at Hama-Mavhaire Irrigation Scheme, Chirumanzu?
9. How are smallholder farmers adapting to the effects of climate change to ensure food security?
10. Are the adaptation strategies effective?
11. Are there other stakeholders/partners in the Ward assisting smallholder farmers to adapt with the effects of climate change?
12. Are their contributions effective to ensure smallholder farmers are adapting with the effects of climate change?
13. What would you suggest towards sustained climate change adapting strategies by smallholder?

Appendix 5: Focus Group Discussion guide for the selected respondents

1. Are there any changes occurring in the District (Chirumanzu) pertaining to climate change?
2. If the change if there, what are the indications concerning rainfall, temperature, and livelihoods?
3. What are the indicators of climate change in Chirumanzu District?

4. What are the other environmental changes occurring in responsible to climate change, particularly on natural vegetation cover, water resources, and animal resources?
5. How are smallholder coping with the effects of climate change? (Increasing water shortages, poor yields, scarcity of food, livestock mortality and household income and welfare
6. How are adaptation with the effects of climate change to ensure food security?
7. Are the adapting strategies effective?

8. Are there other stakeholders/partners in the Ward assisting the smallholder farmers to cope with the effects of climate change?

9. Are their contributions effective to ensure communities are coping with the effects of climate change?
10. What would you suggest towards sustained climate change adapting strategies for Chirumanzu?