The Effectiveness of Conservation Agriculture (Pfumvudza/Intwasa) in Enhancing Smallholder Farmer Resilience to Drought in Shamva District, Zimbabwe

DISSERTATION

FOR THE MASTER OF SCIENCE DEGREE IN FOOD SECURITY AND SUSTAINABLE AGRICULTURAL PRODUCTION/POLICY

Bindura University of Science Education

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DECLARATION

I hereby declare that the research project entitled **The Effectiveness of Conservation Agriculture (Pfumvudza/Intwasa) in Enhancing Smallholder Farmer Resilience to Drought in Shamva District, Zimbabwe**, submitted to Bindura University of Science Education, Department of Agricultural Economics, Education and Extension is a record of an original work done by me under the guidance and supervision of **M. Manyumwa** and this work is submitted in partial fulfilment of the requirements for the award of a Master of Science Degree in Food Security and Sustainable Agriculture. The results embodied in this thesis have not been submitted to any University or Institute for the award of any degree of diploma.

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DEDICATION

I dedicate this to my family and friends.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to all those who contributed to the success of this study.

My heartfelt gratitude goes to my supervisor M. Manyumwa for his invaluable guidance, constructive criticism and unwavering support throughout the study. His expertise and encouragement played a vital role in shaping this research.

I am also deeply grateful to the management and staff of different organisations and institutions that provided necessary data and support.

ABSTRACT

The study focused on understanding the impact which conversation agriculture has on drought resilience and food security for smallholder farmers in Shamva District. The study approach for smallholder farmers who were actively engaged in conservation agriculture practices particularly the Pfumvudza program. The main objections of the study were to identify the conditions which were obtaining in this community regarding conservation agriculture. The other objective was to establish the key impact which Pfumvudza has had on the sustainable food security and drought resilience of the local community in the area. The study also sought to understand the policy recommendations and challenges which were being faced by the small holder farmers in their endeavours towards conservation agriculture. The aim was to enhance their drought resilience and food security. Relevant literature for the study was analysed to gain understanding on the agricultural practices. The sustainable development theory was used in the study as well as the transformation change theory. The study was based on the pragmaticism research philosophy and used a mixed methods approach. The study was based on case study of Shamva District. The study focused on smallholder farmers in the district who were active participants. The target population was obtained from the GMB database of active Pfumvudza participants. In addition, sampling was done using Yamane's

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List of abbreviations

GMB – Grain Marketing Board

ANOVA – Analysis of Variance

C.A – Conservation Agriculture

CHAPTER I

INTRODUCTION

1.1 Background of the study

Food insecurity remains one of the major challenges in development, exacerbated by climate change effects such as drought (Moyo et al., 2025). Millions are still hungry and malnourished, with smallholder farmers affected the most. Conservation Agriculture (CA) is an alternative that is considered sustainable, and has been recommended to develop better soils and increase retention capacity (Michler et al., 2019). By restoring ecological conditions, CA can directly benefit farmers in poor regions, and is also included as a solution to Zero Hunger (SDG 2), one of the United Nations Sustainable Development Goals to achieve by changing agricultural production (Mavhura et al., 2021). While there have been some positive changes, the uptake of CA practices has been variable between countries leading to mixed impacts. In cases where successful practices are found, these are often a combination of CA and customary knowledge with modern agricultural practices (Madamombe et al., 2024). With the increasing prevalence of extreme weather and natural disasters, CA offers a potential means of reducing risks and addressing global vulnerabilities in food production and the food supply chain. Therefore, researching the circumstances under which CA will be effective is of utmost importance to the livelihoods of smallholder producers and food security and sustainable agriculture at large (Marongwe et al., 2011).

A large number of African countries rely heavily on rain-fed agriculture, which exposes them to the impacts of drought (Dube-Takaza et al., 2023). Erratic precipitation, higher temperatures, and shifting rainfall patterns threaten the harvests of numerous Sub-Saharan African countries (Grey et al., 2020). Yet the enormous majority of smallholder farmers in Sub-Saharan Africa have limited ability to adapt to climate variations. Conservation agriculture has been proposed as a means to reduce crop production losses under drought in smallholder farming communities (Thierfelder & Wall, 2010).

Zimbabwe also relies on rain-fed agriculture, where smallholders are vulnerable to climate shocks and droughts (Mavesere & Dzawanda, 2022). What evidence can you provide of the effects of climate shocks on smallholder farmers? At least three articles. Make a synthesis and proceed to the paragraph on conservation agriculture.

The Pfumvudza/Intwasa program is a national program being implemented in Zimbabwe to promote CA with the aim of food security and resilience of smallholder farmers (Mavesere & Dzawanda, 2022). This means that the Pfumvudza/Intwasa program seeks to stop hunger for the smallholder farmers and communal farmers by raising maize yield as a basic product. It uses minimum tillage, crop rotation and mulching, which help to climate-proof agriculture, or help a project maintain its goals in spite of possible climate change impacts (Makate et al., 2019).

Shamva District suffers from regular droughts and food shortages (Dube-Takaza et al., 2023).

There are many reasons for this low agricultural productivity, including drought, and smallholders not having access to seeds and fertilizers. However, if smallholder farmers adopt conservation agriculture, this can be helpful for food security (Thierfelder & Wall, 2008).

1.2 Statement of the Problem

Despite the efforts by government to reduce food insecurity, most parts of the country are food insecure even with the Pfumvudza/Intwasa scheme intended to improve food security at household level. However, it is not known to what extent the practice of conservation agriculture (Pfumvudza/Intwasa) builds the resilience of households. Therefore, the word resilience needs to be unpacked so that it is strongly defined and operationalized for this study, lest we miss opportunities for adapting conservation agriculture to suit the needs of the heterogeneous population of smallholder farmers. What needs have been met so far through this project? The overarching objective of this study is to explore whether and how conservation agriculture builds the resilience of smallholder farmers in different agro-ecological and socio-economic contexts.

The smallholder farmer is perpetually under pressure to earn a living and make profits during a drought but if resilience is not improved, the cycle of food shortage and food insecurity continues and perpetuates the poverty of the smallholder farmer and continues to threaten food security. The study was motivated by the fact that if the resilience of the farmer is improved the farmer will be able to achieve food security and also a decent living or entrepreneurial livelihood through smallholder farming. The objective of the study was to

investigate the moderating effect of practices such as Conservation Agriculture in promoting food security resilience for smallholder farmers in the Shamva District. It is hoped that a better understanding of this will produce evidence based solutions to increase C.A use as a means to improving the resilience of the smallholder farmer to food insecurity, drought and hunger.

1.3 Objectives of the study

The following section shows the objectives of the study.

Main objective

The study aims to analyse the extent to which conservation agriculture builds the resilience of smallholder farmers for improved food security

Specific objectives

1.3.1 To assess the adoption of Conservation Agriculture (C.A) among smallholder farmers in Shamva District.

1.3.2 To characterise the coping strategies smallholder farmers in the face of drought and food shortages which best suit the Shamva District smallholder farmers.

1.3.3 To assess the factors facilitating/inhibiting household food security for smallholder farmers practicing conservation agriculture

1.4 Research Questions

1.4.1 How smallholder farmers ensure their resilience in the face of drought and food shortage in Shamva District?

1.4.2 What factors are facilitating/inhibiting household food security for smallholder farmers practicing conservation agriculture?

1.4.3 Which framework can be used to ensure that C.A practices are incorporated into resilience building strategies towards food security of smallholder farmers in Shamva District?

1.5 Hypotheses

H0: The use of C.A strategies does not have a significant moderating effect on the resilience of smallholder farmers towards food security against drought and food shortage in Shamva District.

H1: The use of C.A strategies has a statistically significant moderating effect on the resilience of smallholder farmers towards food security against drought and food shortage in Shamva District.

1.6 Significance of the study /Justification

The study is significant to the following stakeholders:

1.6.1 Significance to theory

The practical contribution that the study makes is to give the theory a platform to add to the existing literature for a field which is under researched in Zimbabwe. This is particularly a critical issue that needs to be addressed because the issues of sustainability currently matter and are highly meaningful. This means that this study contributes to an important theoretical perspective leading to a more thorough understanding of the phenomenon.

1.6.2 Significance to practice

The greatest benefit goes to the smallholder farmer because the information the farmer gains from the study gives them a good foundation in the calculated decisions made in deciding the conservation agriculture strategy taken and how it affects their livelihoods. The major benefit for the smallholder farmer is that the study provides options and considerations towards building resilience against drought and food insecurity. Further, it would improve smallholder farmer efficiency in the utilization of the conservation agriculture strategies and improve smallholder farmer transformative capability.

1.6.3 Significance to policy

This can be used by policy makers to understand the quality of the policy and its impact. The impact which the government programs have and how those in charge of the governance are impacting the local communities towards resilience have been evaluated by the study. Thus, the study lays a monitoring and evaluation role towards the policy makers by relying on the actual data collected and reported by the users of the policy. This gives the study a unique opportunity to give feedback to the policy makers about their efforts, where to improve and where they are doing well. With enough consideration however, it leads to a better service from the policy makers, and also from evidence based decisions.

1.7 Scope/Delimitations and Limitations of the study

The following sections show the delimitation which was made to the scope of the study:

1.7.1 Geographical scope delimitation

The study was based on Shamva District in the Mashonaland Central Province of Zimbabwe.

1.7.2 Participant scope delimitation

The study only targeted smallholder farmers in the C.A programs and experts from the Grain Marketing Board of Zimbabwe.

1.7.3 Theoretical scope delimitation

The theory of sustainable development, systems theory and Schultz theory of agriculture were used as the theoretical scope.

1.7.4 Methodological scope delimitation

This constrained the study within a scope of pragmatism, specifically the implications of practical research philosophy and the knowledge of mixed methods abductive research approach.

1.8 Definition of key terms

Conservation agriculture- protects soil from erosion and degradation, increases biodiversity and potential for crop yield, motivating the agricultural sector to practice sustainability.

Smallholder farmer- a marginal or sub-marginal agricultural household whose total owned and cultivated area is between 2 and 10 hectares.

Drought: Scanty rainfall during the rainy season.

1.9 Study layout

Chapter 1: Introduction

Chapter One covers background, the statement of the problem, the objectives, the research questions, the rationale, limitations and delimitations, and the outline of the proposed thesis.

Chapter 2: Literature Review

Then the chapter reviews the CA literature in relation to food security, the sensitivity of the food security objectives to CA practices and the theoretical/conceptual frameworks and research gaps.

Chapter 3: Research Methodology

Chapter three deals with research methodology, it discusses on research methodology, research design, study area, target population, sampling of respondents, data collection methods which includes Surveys, Interviews and Focus groups, data analysis which deals with qualitative data analysis and quantitative data analysis, validity and reliability and ethical considerations.

Chapter 4: Data Presentation and Analysis

In Chapter 4, the results are presented, and the chapter ends with a summary of the most important results.

Chapter 5: Summary, Conclusions, and Recommendations

Chapter 5 discusses the findings in relation to those of other studies and makes recommendations for policy and practice.

1.10 Chapter summary

Chapter one presented the research problem outlining food security concerns and resilience strategies by smallholder farmers in drought-prone regions through conservation agriculture practices (the capabilities to manage shocks and stresses).

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

The last chapter introduced the study aims while this chapter concentrates on the theoretical framework of the study, the conceptual framework of the study, and the empirical evidence of the study area. The chapter describes what researchers have found in previous studies and other literature related to this study.

2.2 Theoretical framework

The theoretical framework of this study was based on Bronfenbrenner's ecological theory, Brundtland's sustainable development theory and the behavioral theory.

2.2.1 Ecological theory

By leveraging Bronfenbrenner's ecological systems framework, which includes the various systems that influence an individual's development, one can gain understanding into the applicability of Conservation Agriculture (CA) practices, such as Pfumvudza/Intwasa, in strengthening smallholder farmers' adaptive capacities to withstand drought impact in Zimbabwe's Shamva District. For instance, at the ecological microsystem level, CA practices such as minimum tillage, mulching, crop rotation and intercropping directly affect soil quality and improve water retention in the soil, thereby strengthening farmers' capacities to withstand drought stress and food shortages (Taulu, 2025; Thierfelder et al., 2017). The mesosystem comprises interactions between farmers and local institutions (extension services) that influence the uptake of CA and the development of effective coping strategies (Kayusi et al., 2025; Manyakaidze et al., 2025). The exosystem is represented by the socio-economic environment outside the household, and includes access to credit, markets, and climate policies indirectly affecting food security and resilience at the household level (Kayusi et al., 2025). At macrosystem level, cultural norms and values, agricultural policy and economic situation of the country determine CA and resilience-building (Amede et al., 2023). The theory informs the analysis of how CA serves to moderate smallholders' building transformational capacity, by linking promotion of ecological measures and social backing to food security improving during drought. A study by Feng et al. (2025) also found that while CA has long-run benefits for adaptation and resilience, socio-economic conditions, and institutional support are important conditions for successful CA adoption. The study further confirmed Bronfenbrenner's model of multi-level influences on CA adoption with the resulting and benefits of increased resilience to climate change among smallholder farmers.

2.2.2 Sustainability theory

Using the Brundtland (1987) definition, you have to consider the three pillars of sustainability: environment, economy and society when assessing whether the Pfumvudza/Intwasa system is sustainable or not. The questions you need to be thinking about when answering if CA improves food security and resilience to droughts in Shamva are

whether it maintains or improves the resource base (soil, water, biodiversity), and whether it is socially and institutionally equitable and sustainable over the long term.

In semi arid Zimbabwe and Southern Africa, CA and Pfumvudza practices (including conservation agriculture such as minimum tillage, mulching, soil moisture conservation and drought-tolerant crops) are promoted as climate smart "win win" practices that can stabilize yield and conserve soil and water, in ways that make farmers more resilient to drought and climate variability (Tembo et al., 2025). Empirical evidence has shown that these practices can increase soil moisture and yield stability, reduce erosion, and improve resilience and reduce food aid dependency (Taulu, 2025). Thus, the broad hypothesis that CA has a moderating effect on the transformative potential of smallholder farmers to secure food supply during drought conditions intersects with the Brundtland lens of long run livelihood resilience versus short run production (Mathe, 2023).

The first objective, to assess the adoption of CA practices by smallholder farmers in Shamva, relates to the Brundtland imperative of social and institutional conditions that must be realized for sustainably managed land use practices to succeed. These studies in Zimbabwe and the region suggest that farmers were generally well aware of climate change and knowledge of improved land and water management practices. Adoption and full implementation of CA (basins, rotations, mulching, timely planting) remains limited by lack of access to water, quality seed, technology, finance and knowledge (Katunzi et al., 2025). Multiple adoption of CA with other CSIs was strongly influenced by education, access to credit and extension, land size and participation in community-based programs (Amede et al., 2023). When analyzed in terms of who adopts it, at what level and under what enabling conditions, one can judge whether this 'sustainable' technology is actually socially embedded in ways that make it sustainable, a key concern of sustainability theory.

Characterizing coping strategies to droughts and food shortages reflects Brundtland's objective to avoid coping strategies that weaken future wellbeing (erosive coping). A survey of farmers in Zimbabwe and neighboring countries identified a spectrum of coping strategies: from sustainable soil water conservation, early planting, Pfumvudza, drought tolerant and early maturing crops, diversification and water harvesting (Amede et al., 2023; Katunzi et al., 2025) to distress sales of livestock, food aid, cheap and inferior food staples, migration and asset depletion (Mkomwa et al., 2016). Sustainability theory distinguishes between coping/adaptation as a reactive strategy where local farmers improve their production to help

out poor rural households affected by a current bad farming season and adaptive and transformative capacity, i.e. the ability to reorganize farming systems so that they remain productive and food secure under recurrent drought (Mkomwa et al., 2016). Pfumvudza as a conservation land management coping/adaptation strategy falls under the latter, long-term resilience building, category, assuming adequate support (Amede et al., 2023).

Third, the objective to identify factors limiting or promoting CA practising farmers' household food security draws on Brundtland's interlinking of the environmental, economic and social dimension. In Zimbabwe, in Zambia and in the wider region, CA and similar practices improve soil and water retention, and sometimes crop yields and incomes. However, food security outcomes are context-specific (Katunzi et al., 2025). In Zimbabwe, the consumption score does not considerably increase in sites where farmers practice CA, which the authors attribute to small land areas using CA and the fact that farmers have not adopted the complete CA package and the complementary inputs (Taulu, 2025). However, the most positive impacts were recorded when multiple innovations were used cumulatively with CA (e.g., drought tolerant maize and improved legumes), a reliable supply of inputs, information, markets and climate services was provided, and socio-economic constraints were addressed (e.g., labour bottlenecks and small landholding). Thus, sustainability theory could frame your analysis of "facilitating/inhibiting factors" as the extent to which Pfumvudza is embedded in a system of institutions, resources and knowledge that can deliver sustained, intergenerational food security, rather than one-off yield gains.

Interpreting the null and alternative hypotheses establishes whether Pfumvudza/CA can be considered a sustainability improving innovation in the Brundtland sense. Rejection of H0, through statistically important moderation of transformative capacity and food security by CA, concludes that Pfumvudza can be considered to contribute to sustainable development in the Brundtland sense because it contributes to households' capacity to meet their food needs without depleting the resource base and reliance on aid (Amede et al., 2025). Equally, if the study fails to reject H0 the results may be seen as supportive of research showing that without an adequate scale of adoption, inputs and institutional support, CA may have limited or heterogeneous effects on food security for poorer or constrained households (Mkomwa et al. 2016). One interpretation of this under the Brundtland theory is that it does not reject the goal of sustainability per se, but suggests that the relevant conditions to meet it (e.g. equitable access to land, water, finance, information and supportive policy) do not yet exist in Shamva District.

2.2.3 Behavioural theory

Behavioral theory (Protection Motivation Theory and extensions of the Theory of Planned Behavior) can provide insights into smallholder farmers' adoption of Conservation Agriculture (C.A.) for drought adaptation. PMT theory posits that perceived severity, vulnerability, self-efficacy, response efficacy, and perceived rewards and costs affect motivation and coping capacity. This theoretical framework aligns with examining smallholder farmers' adoption and coping strategies in the Shamva District (Moriti et al., 2025). Studies reveal that self-efficacy (one's belief that they have the capabilities to execute the desired behavior) is a major driver of farmers' technical and non-technical adaptation to drought stress (Gebrehiwot & Van Der Veen, 2015). Place attachment, social norms and moral obligation are other strong drivers of adoption of sustainable practices by farmers, indicating that social and cultural factors are important for the food security of practitioners of C.A (Keshavarz & Karami, 2016). According to behavioral theories, behavioral characteristics such as specific extension services, timing of early warning and financial assistance to overcome perceived costs and mistrust play a moderating role in improving the potential for smallholders to achieve food security during droughts (Zobeidi et al., 2021). The usage of behavioral theory in this work shows that C.A strategies increase smallholder resilience by influencing adaptive behavior and intentions through cognitive-behavioral and social processes (Moriti et al., 2025).

2.3 Conservation agriculture (alternative systems)

The "C" in CA stands for conserving and protecting soil, water and biodiversity while maintaining or improving crop yield levels (Taulu, 2025). For Pfumvudza/Intwasa in Shamva District, CA means adopting conservation agriculture practices such as minimum soil disturbance, maintaining permanent soil cover and using crop rotations and intercropping to conserve soil and water and increase resilience to drought (Tembo et al., 2025). The conservative practices of soil moisture conservation and soil fertility enhancement by smallholder farmers may increase the resilience of agriculture and improve food security on a variable climate. Therefore, the study intended to assess the adoption of CA systems, characterize the drought coping strategies and identify the factors that cause food insecurity (Mathe, 2023). Testing the moderating effect of CA on transformative capacity aligns with the broader debate of whether conservative agriculture enables farmers to adapt and produce food by improving different agricultural areas during drought episodes (Katunzi et al., 2025). However, due to its labor-intensive nature, and restricted access to inputs and support

services, full CA adoption is impeded (Amede et al., 2023). Overall, the "conservative" aspect of CA, which focuses on the sustainable use of resources, increases the resilience of smallholder farmers to climate-related hazards.

2.4 Resilience

Resilience is the ability of smallholder farmers to switch to more fundamental adjustments to the components of the production system after a shock, e.g. a drought, to achieve long-term resilience (Nzeyiana et al., 2021). In the context of CA (Pfumvudza/Intwasa) in Shamva District, resilience is defined as the farmer's ability to practice improved CA technologies and practices that improve soil health, plant water retention and biodiversity allowing farmers to maintain food production through the drought (Teklu et al., 2023). Transformative capacity goes beyond absorptive and adaptive capacity. Transformation involves structural change of farm systems, making them less vulnerable, and more sustainable, to climate change. Such transformation includes new technologies, new crop production, livestock production, and new resource (agricultural and natural) management methods (Malherbe et al., 2024). The hypothesis that CA moderates resilience is supported by evidence that CA can increase transformative capacity through resource use efficiency and through easing the transformation to more resilient agricultural livelihoods (Makate et al., 2019). Yet social and political aspects, including access to resources, information, institutions, and support for adaptive innovation (Chisadza et al., 2025), are likewise important for this transition to succeed. It is also important to investigate how CA adoption promotes resilience; in this case, both for addressing immediate drought impacts, but also for enabling systemic transformation towards sustainable food security among smallholder farmers in Shamva District.

2.5 Conservation agriculture in developing countries

C.A is based on three principles: minimal soil disturbance, soil cover and crop rotation. It promotes agronomic sustainability, improved soil health and resilience to land degradation and climate change in developing countries such as Zimbabwe. Studies show that C.A resulted in increased crop yield, water use efficiency and profitability while reducing environmental concerns. It is a proven strategy for smallholder farmers addressing drought and food insecurity (Chisadza et al., 2025). However, low uptake of C.A in smallholder regions has been impeded by labor requirements, limited access to inputs such as straw for mulching, lack of site-specific adaptation to local conditions, and socio-economic constraints

such as market access and knowledge of C.A technology (Makate et al., 2019). Understanding these dynamics is vital to inform C.A uptake and its impact on the resilience of food systems to drought-induced food shortages in Shamva District of Zimbabwe. Overall, evidence shows a moderate potential for yield improvement under dryland conditions when evaluated as a package. However, C.A benefits are usually context-specific and require local solutions and support systems (Nzaiyana et al., 2021). This suggests the need for an analysis of socio-economic conditions under which C.A strategies would empower smallholder farmers to improve their food security situation along with the potential agronomic benefits of the practice (Amade et al., 2023).

2.6 Adoption of conservation agriculture by smallholder farmers

The adoption of Conservation Agriculture (CA) principles and practices among smallholder farmers can contribute to building crop resilience to drought. These principles include reduced tillage, mulch cover and crop rotations. The uptake of CA among smallholder farmers in the Southern Africa region, such as Shamva District, remains low. Adoption is obstructed by inadequate training, inputs, credit, and equipment, and by socio-economic factors like labor availability and short-term expectations from these crops (Moriti et al., 2025). However, adoption is influenced by education, extension services, membership in farmer groups, and diversified income sources, which allow farmers to access new knowledge and necessary resources (Quandt, 2021). The focus on CA adoption is justified since evidence shows continuous CA adoption is enabled by prolonged support, farmer-centric and participatory (peer learning) approaches, and bridging perception gaps (Mdoda et al., 2025). Similarly, the support for the hypothesis on CA's moderating effect on transformative capacity is supported by findings showing important food security improvements accompanying the full CA adoption from improved soil structure and drought resistance (Mtengwa et al., 2023). Low-quality and erratic rainfall, pest infestations, and dis-adoption due to unmet expectations, among others, have shown that context-specific, agro-ecologically and socio-economically relevant interventions are necessary for enduring adoption and impactful change (Nyanga, 2012).

2.7 Coping strategies employed by smallholder farmers to deal with drought and food scarcity

Factors easing household food security in others C.A-practicing HF C.A. smallholders include access to extension services, education, land size, and farmer group membership

enabling increased knowledge, resource access and collective action (Quandt, 2021). Associated with better food security and nutrition in crop-livestock farmers adopting C.A practices are crop diversification, improved seeds, crop rotation and land preparation a month or more before sowing (Bahta, 2022). Access to credit is also important when investing in inputs or adopting more labor-intensive C.A practices (Hawkins et al., 2022). However, other constraints may include access to inputs such as planting seed and mulch materials, land tenure security, climate factors such as erratic and unreliable rainfall, and lack of mechanization assistance, which increase the input requirements of smallholders but decrease the sustainability of their production systems (Muthelo et al., 2019). Social factors such as weak farmer organization and gender inequalities also prevent adoption and food security benefits through limited access to information and resources (Mdoda et al., 2024; Fanadzo et al., 2021). Taken together, these facilitators and barriers may influence whether C.A strategies increase the transformative capacity of smallholder farmers to improve their drought resilience and food security, as hypothesized in the study.

2.8 Factors easing/inhibiting household food security for smallholder farmers practicing conservation agriculture

In structures similar to that of Shamva District, smallholder farmers practicing C.A were found to have household food security that was associated with extension services, education, land size, and belonging to a farmer organization/group that provide information, resources, and collective action necessary in the adoption of C.A (Opoku-Acheampong et al., 2024). Crop diversification, use of improved seed, crop rotation, and early tillage were strongly associated with improved food availability and diversified diets among C.A adopters (Jumbe & Nyambose, 2016). In general, appropriate access to credit and finances is key for adoption of labor-intensive C.A practices and purchasing inputs (Nyanga, 2012). On the contrary, labor-intensive practices, lack of planting seed, and mulch materials, insecure land tenure systems, erratic rainfall patterns, and lack of mechanization services that create more labor pressure on smallholders are C.A adoption barriers that constitute sustainability issues (Setsoafia & Renwick, 2022). Between the identified facilitators, like lack of farmer organization and gender roles, and barriers limiting access to information and other resources (Legesse et al., 2024), both this study's facilitators and barriers play a role determining whether the identified C.A strategies could stimulate smallholders' transformational capacity with respect to drought resilience and food security.

CA can either ease or inhibit food security for each of the households and small-scale farmer actors, depending on the adopted production practices and institutional context. For example, CA practices such as crop rotation, cover cropping, row planting and improved seed have been reported to have a positive effect on productivity, which in turn increases food availability and reduces the need for extra food coping strategies (such as skipping a meal or selling an asset) for households (Wekesa et al., 2018). In Malawi, CA users reported greater than 50% increases in maize harvest, greater year-round food security, and higher proportion of three meals per day, compared to non CA users (Nyanga, 2012). In Ghana and Ethiopia, CA and other similar CSA practices improved household incomes, and dietary diversity and food consumption scores (measures of food security) (Benson et al., 2019). The advantages of CA are greater when they are carried out together (CA with soil fertility management, irrigation, diversification) than with each practiced separately (Lee & Gambiza, 2022). CA also indirectly contributes to food security through crop diversification (including legumes and pulses), which can improve diets and provide cash. In Zambia, pulse production and cash income were increased among CA users, who also consumed pulses more frequently and curtailed seasonal hunger days (Antwi-Agyei et al. 2021). CA adoption creates conducive conditions, including access to extension services and CA training, more land areas under CA, education, membership in groups and cooperatives, and timely access to inputs and secure land tenure, to foster broad and correct adoption of CA (Mango et al. 2017).

However, limitations exist. Multi country analysis from Zimbabwe, Malawi and Mozambique finds that CA does not improve food consumption scores in Zimbabwe and Malawi, largely because farmers devote only small plots to CA and rarely implement the full set of required practices, so the biophysical benefits never translate into meaningful surplus food or income (Enyew & Gobie, 2025). Key constraints to adoption of the practice, or adoption on a partial or temporary basis, at low economic benefit, include: labor-intensiveness (particularly for hand weeding and planting), competition between residues for mulching, fodder, and fuel use, and lack of access to growing tools. Additional constraints include costly or unavailable seeds, fertilizer, and herbicides (Lee & Gambiza, 2022). Low incomes, lack of access to credit, and poor engagement with markets obstruct the realization of gains from yield improvement and encourage monocropping. Gendered barriers to land tenure, decision making, and access to extension services may also limit women's engagement with CA programmes. This is concerning as women are responsible for a large

portion of food acquisition in the household (Kone & Uzmay, 2024). Some evidence from Burkina Faso and elsewhere shows that investments in so-called 'sustainable' or climate smart practices may improve some dimensions of food security (availability, dietary diversity) without addressing others (stability, economic access) in the absence of conducive policies, infrastructure and safety nets (Mutengwa et al., 2023). In general terms, CA supports household food security where it is adopted as a part of a wider, well supported CA package, and on sufficient land area, but has had limited, insignificant or even negative impacts when adoption has been piecemeal, resources scarce, and institutional support inadequate.

2.9 Conservation agriculture and resilience of smallholder farmers in Shamva District.

In Zimbabwe, CA is part of broader CSA extension efforts, like the Pfumvudza/Intwasa programme, which seeks to "climate proof" smallholder production through the adoption of CA on small plots (Kone & Uzmay, 2024). Studies using national panel data show that CA does not bring about a yield increase compared to conventional tillage during years with normal rainfall, but does lead to a reduced yield loss during dry and wet rainfall shocks (Lee & Gambiza, 2022). Therefore CA works as an insurance policy: its main advantage is avoiding production loss under climate extremes, not increasing production under average years, and it seems more of a resilience effect.

Other studies from Zimbabwe found that CA and other CSA practices (small cereals, soil water conservation and drought-tolerant seeds) helped smallholders avoid complete crop failure during repeated drought years, particularly with extension and input support (Mutengwa et al., 2023). However, large-sample impact evaluations have found no important impacts on food security under CA in Zimbabwe or Malawi. This is likely due to the small land area on which CA practices are applied, and the need to complement CA with full adoption of the other components (mulching, rotation and timely weeding) for the full yield increase to be realized (Fanadzo et al., 2021). Adoption constraints include labour demands, competition with mulch for livestock feed, financial constraints, and institutional weakness (Mango et al., 2017), which means that while the biophysical resilience benefits of CA in Zimbabwe are clear, the economic resilience and food security ones have been less strong and more context dependent.

In Southern Africa, CA combined with other climate smart practices (drought tolerant maize and improved legumes) leads to higher productivity, increased incomes and higher economic resilience (Teklu et al., 2023). In Malawi and Zimbabwe, farm productivity and incomes

increase mainly by those who have access to credit, information, service providers, and sufficient land to benefit from multiple practices (Feng et al., 2025). In Zambia, 75% of surveyed smallholders reported practicing CA. Minimum tillage, crop rotation and cover crops have positive impacts on soil health and moisture and increased resilience to climate change, particularly complemented with soil fertility interventions and mixed systems (Muthelo et al., 2019). A regional review covering Eastern and Southern Africa found that while CA can be simultaneously productive and adaptive, performance varies according to agroecology, labor and capital opportunities, and the adaptation of CA practices to local farm systems (Katunzi et al., 2025).

Outside Africa, systematic reviews of CA components like zero/minimum tillage, mulching, soil and water conservation and crop rotation in CSAPs in Kenya and South Africa found that bundling these components increased food and nutrition security, and reduced food insecurity index if adopted at scale (Makate et al., 2019). In Ethiopia and other SSA countries, smallholders adopting crop, soil and livestock CSAPs with CA components have resilience indices 28 to 41% higher than non-adopters mostly due to their education, livestock ownership, and access to extension services (Katunzi et al., 2025).

In short, with regards to the relationship between CA and smallholder resilience in Zimbabwe and other developing countries:

- Biophysical resilience: CA does contribute to reducing soil erosion and improving soil moisture, helping in stabilizing yields against rainfall shocks even if yield improvements are small on average (Mutengwa et al., 2023).

- Livelihood resilience: With sufficient land and institutional support, CA has been shown to increase productivity, income, and the resilience of farming households to external shocks when coupled with other CSA practices (Lee & Gambiza, 2019).

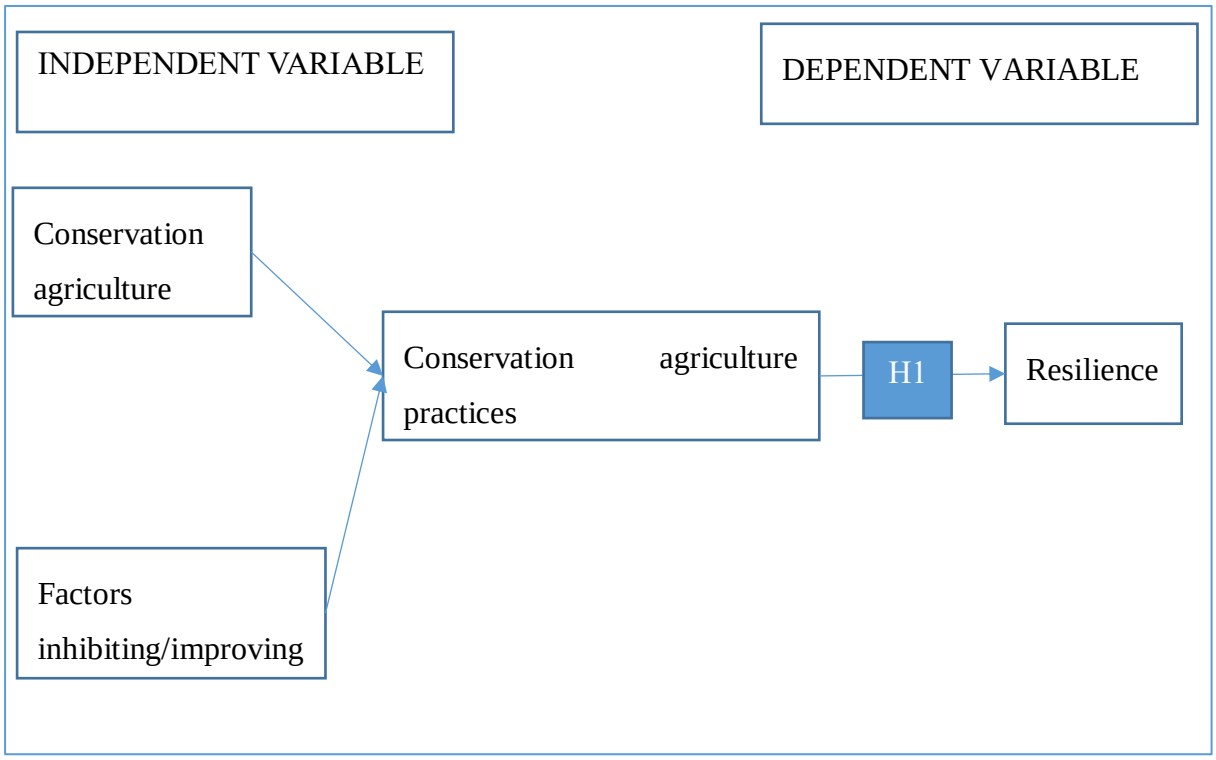
- Partial adoption: In Zimbabwe and similar places, CA's resilience potential is not fully realized due to low adoption rates, capacity and resource gaps, and limited policies and extension services, with mixed evidence on whether CA improves food security (Moriti et al., 2025).

Thus, conservation agriculture is not a stand-alone tool, but an essential building block for climate smart, multi-practice systems that can considerably increase resilience of

smallholders in the right social, economic and institutional contexts, needed for broader transformations on the ground.

2.10 Conceptual framework

The research developed the following conceptual framework for the study.



Source: Researcher (2025)

The above conceptual framework indicates the understanding of the research objectives. The study intends to understand the impact which conservation agriculture practices have on the resilience of the smallholder farmers. A study on the impact of conservation agriculture on smallholder farmers' resilience can help explore how small-holder farmers can cope with and reduce the effects of drought. The hypothesis of the study is a statistical relationship between conservation agriculture and resilience.

2.11 Chapter summary

The above chapter was therefore devoted to discussion about the literature in the study; it centered on understanding what the study area has established regarding the interest of the study and the relationship between the variables of the study. The chapter ends with a conceptual framework. The chapter presents the conclusion which the study came to with regards to the interests of the study and the relationships between the variables in the study in

the form of a conceptual framework. The next chapter explains the research methodology used in the study.

References

Amede, T., Konde, A., Muhinda, J., & Bigirwa, G. (2023). Sustainable Farming in Practice: Building Resilient and Profitable Smallholder Agricultural Systems in Sub-Saharan Africa. *Sustainability*. https://doi.org/10.3390/su15075731.

Amede, T., Konde, A., Muhinda, J., & Bigirwa, G. (2023). Sustainable Farming in Practice: Building Resilient and Profitable Smallholder Agricultural Systems in Sub-Saharan Africa. *Sustainability*. https://doi.org/10.3390/su15075731.

Antwi-Agyei, P., Abalo, E., Dougill, A., & Baffour-Ata, F. (2021). Motivations, enablers and barriers to the adoption of climate-smart agricultural practices by smallholder farmers: Evidence from the transitional and savannah agroecological zones of Ghana. *Regional Sustainability*. https://doi.org/10.1016/j.regsus.2022.01.005.

Bahta, Y. (2020). Smallholder livestock farmers coping and adaptation strategies to agricultural drought. *AIMS Agriculture and Food*. https://doi.org/10.3934/agrfood.2020.4.964.

Bahta, Y. (2022). Nexus between Coping Strategies and Households' Agricultural Drought Resilience to Food Insecurity in South Africa. *Land*. https://doi.org/10.3390/land11060893.

Chisadza, B., Gwate, O., Musinguzi, S., Mpofu, N., Macherera, M., & Dube, T. (2025). Resilient agriculture in semi-arid Zimbabwe: adaptation strategies and influencers among smallholder farmers. *Discover Agriculture*, 3. https://doi.org/10.1007/s44279-025-00234-3.

Enyew, S., & Gobie, W. (2025). Adoption of climate smart agricultural practices impact on food security of smallholder farmers in North Western Ethiopia. *Discover Sustainability*, 6. https://doi.org/10.1007/s43621-025-01793-7.

Fanadzo, M., Ncube, B., French, A., & Belete, A. (2021). Smallholder farmer coping and adaptation strategies during the 2015-18 drought in the Western Cape, South Africa. *Physics and Chemistry of The Earth*, 102986. https://doi.org/10.1016/j.pce.2021.102986.

Feng, Q., Si, Z., & Scott, S. (2025). Adapting to climate change on the farm: Experiences of small-scale ecological farmers in two regions of China. *Journal of Agriculture, Food Systems, and Community Development*. https://doi.org/10.5304/jafscd.2025.144.011.

Gebrehiwot, T., & Van Der Veen, A. (2015). Farmers Prone to Drought Risk: Why Some Farmers Undertake Farm-Level Risk-Reduction Measures While Others Not?. *Environmental Management*, 55, 588-602. https://doi.org/10.1007/s00267-014-0415-7.

Hawkins, P., Geza, W., Mabhaudhi, T., Sutherland, C., Queenan, K., Dangour, A., & Scheelbeek, P. (2022). Dietary and agricultural adaptations to drought among smallholder farmers in South Africa: A qualitative study. *Weather and Climate Extremes*, 35. https://doi.org/10.1016/j.wace.2022.100413.

Jew, E., Whitfield, S., Dougill, A., Mkwambisi, D., & Steward, P. (2020). Farming systems and Conservation Agriculture: Technology, structures and agency in Malawi. *Land Use Policy*. https://doi.org/10.1016/j.landusepol.2020.104612.

Jumbe, C., & Nyambose, W. (2016). Does Conservation Agriculture Enhance Household Food Security? Evidence from Smallholder Farmers in Nkhotakota in Malawi. *Sustainable Agriculture Research*, 5, 118. https://doi.org/10.5539/sar.v5n1p118.

Kapari, M., Hlophe-Ginindza, S., Nhamo, L., & Mpandeli, S. (2023). Contribution of smallholder farmers to food security and opportunities for resilient farming systems. *Frontiers in Sustainable Food Systems*. https://doi.org/10.3389/fsufs.2023.1149854.

Katunzi, A., Mlengera, N., Mng'ong'o, M., Mwamlima, B., Mvile, B., Mtama, J., & Lukasumbusa, R. (2025). Enhancing climate resilience of smallholder farmers through conservation agriculture in the southern highlands of Tanzania. *Frontiers in Sustainable Food Systems*. https://doi.org/10.3389/fsufs.2025.1706205.

Katunzi, A., Mlengera, N., Mng'ong'o, M., Mwamlima, B., Mvile, B., Mtama, J., & Lukasumbusa, R. (2025). Enhancing climate resilience of smallholder farmers through conservation agriculture in the southern highlands of Tanzania. *Frontiers in Sustainable Food Systems*. https://doi.org/10.3389/fsufs.2025.1706205.

Kayusi, F., Ngala, D., & Chavula, P. (2025). Assessing the Unfulfilled Promises of Agroforestry and Conservation Agriculture as Climate-Smart Solutions for Food Security in Kenya, Tanzania, Uganda, and Zimbabwe. *East African Journal of Agriculture and Biotechnology*. https://doi.org/10.37284/eajab.8.1.2975.

Keshavarz, M., & Karami, E. (2016). Farmers' pro-environmental behavior under drought: Application of protection motivation theory. *Journal of Arid Environments*, 127, 128-136. https://doi.org/10.1016/j.jaridenv.2015.11.010.

Kone, S., & Uzmay, A. (2024). Impact assessment of sustainable agricultural practices on smallholder households food security: evidence from Burkina Faso. *Climate and Development*, 17, 255 - 269. https://doi.org/10.1080/17565529.2024.2357183.

Lee, M., & Gambiza, J. (2022). The adoption of conservation agriculture by smallholder farmers in southern Africa: A scoping review of barriers and enablers. *Journal of Rural Studies*. https://doi.org/10.1016/j.jrurstud.2022.03.031.

Legesse, T., Ganewo, Z., Alemu, A., Ashebir, A., Samuel, A., & Abayneh, Y. (2024). Does Adoption of Multiple Climate-Smart Agriculture Practices Improve Rural Farm Households' Food Security in Ethiopia?. *Food and Energy Security*. https://doi.org/10.1002/fes3.70021.

Makate, C., Makate, M., Mango, N., & Siziba, S. (2019). Increasing resilience of smallholder farmers to climate change through multiple adoption of proven climate-smart agriculture innovations. Lessons from Southern Africa. *Journal of environmental management*, 231, 858-868. https://doi.org/10.1016/j.jenvman.2018.10.069.

Malherbe, W., Biggs, R., & Sitas, N. (2024). Comparing apples and pears: Linking capitals and capacities to assess the resilience of commercial farming operations. *Agricultural Systems*. https://doi.org/10.1016/j.agsy.2024.103934.

Mango, N., Siziba, S., & Makate, C. (2017). The impact of adoption of conservation agriculture on smallholder farmers' food security in semi-arid zones of southern Africa. *Agriculture & Food Security*, 6, 1-8. https://doi.org/10.1186/s40066-017-0109-5.

Manyakaidze, P., Musavengane, R., & Maponga, R. (2025). Rural Farmer-Managed Wetland Agroecosystems Promote Climate Resilience in Semi-Arid Savannah: Case of Nyororo Wetland, Mberengwa District, Zimbabwe. *Climate Resilience and Sustainability*. https://doi.org/10.1002/cli2.70011.

Mathe, P. (2023). An Assessment of the Sustainability of Conservation Farming in Promoting Food Security Among Smallholder Farmers in Change Ward. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4585280.

Mathe, P. (2023). An Assessment of the Sustainability of Conservation Farming in Promoting Food Security Among Smallholder Farmers in Change Ward. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4585280.

Mdoda, L., Naidoo, D., Ncoyini-Manciya, Z., Nontu, Y., Govender, L., Tamako, N., & Mdiya, L. (2024). Adaptation Measures to Drought Risk Perceived by Smallholder Crop Farmers in the Eastern Cape Province, South Africa: Implications for Food and Nutrition Security. *Sustainability*. https://doi.org/10.3390/su162411154.

Moridi, M., Rahimian, M., Movahed, R., Molavi, H., Gholamrezai, S., & Payamani, K. (2025). Policy Insights for Drought Adaptation: Farmers' Behavior and Sustainable Agricultural Development. *Environmental and Sustainability Indicators*. https://doi.org/10.1016/j.indic.2025.100603.

Mutengwa, C., Mnkeni, P., & Kondwakwenda, A. (2023). Climate-Smart Agriculture and Food Security in Southern Africa: A Review of the Vulnerability of Smallholder Agriculture and Food Security to Climate Change. *Sustainability*. https://doi.org/10.3390/su15042882.

Muthelo, D., Owusu-Sekyere, E., & Ogundeji, A. (2019). Smallholder Farmers' Adaptation to Drought: Identifying Effective Adaptive Strategies and Measures. *Water*. https://doi.org/10.3390/w11102069.

Nyanga, P. (2012). Food security, conservation agriculture and pulses: evidence from smallholder farmers in Zambia.. *Journal of Field Robotics*, 1, 120-138. https://doi.org/10.5539/jfr.v1n2p120.

Nzeyimana, L., Danielsson, Å., Andersson, L., & Gyberg, V. (2021). Success and failure factors for increasing Sub-Saharan African smallholders' resilience to drought through water management. *International Journal of Water Resources Development*, 39, 273 - 293. https://doi.org/10.1080/07900627.2021.1991285.

Opoku-Acheampong, K., Tham-Agyekum, E., Ankuyi, F., Okorley, E., Bakang, J., & Nimoh, F. (2024). Effect of adoption of conservation agriculture on household food security of smallholder maize farmers in Ghana. *Environmental and Sustainability Indicators*. https://doi.org/10.1016/j.indic.2024.100436.

Quandt, A. (2021). Coping with drought: Narratives from smallholder farmers in semi-arid Kenya. *International Journal of Disaster Risk Reduction*. https://doi.org/10.1016/j.ijdrr.2021.102168.

Setsoafia, E., , W., & Renwick, A. (2022). Effects of sustainable agricultural practices on farm income and food security in northern Ghana. *Agricultural and Food Economics*, 10. https://doi.org/10.1186/s40100-022-00216-9.

Taulu, S. (2025). Climate resilience through conservation farming: A review of adaptive practices among smallholder farmers. *International Journal of Science and Research Archive*. https://doi.org/10.30574/ijsra.2025.15.3.1817.

Taulu, S. (2025). Climate resilience through conservation farming: A review of adaptive practices among smallholder farmers. *International Journal of Science and Research Archive*. https://doi.org/10.30574/ijsra.2025.15.3.1817.

Taulu, S. (2025). Climate resilience through conservation farming: A review of adaptive practices among smallholder farmers. *International Journal of Science and Research Archive*. https://doi.org/10.30574/ijsra.2025.15.3.1817.

Teklu, A., Simane, B., & Bezabih, M. (2023). Effect of Climate Smart Agriculture Innovations on Climate Resilience among Smallholder Farmers: Empirical Evidence from the Choke Mountain Watershed of the Blue Nile Highlands of Ethiopia. *Sustainability*. https://doi.org/10.3390/su15054331.

Tembo, A., Muyabe, O., Musenge, D., Mhango, J., & Nkomanga, G. (2025). Impact of Sustainable Agricultural Practices on Farm Productivity, Yield, and Climate Resilience Among Smallholder Farmers in Zambia. *Journal of Agriculture, Aquaculture, and Animal Science*. https://doi.org/10.69739/jaaas.v2i1.212.

Tembo, A., Muyabe, O., Musenge, D., Mhango, J., & Nkomanga, G. (2025). Impact of Sustainable Agricultural Practices on Farm Productivity, Yield, and Climate Resilience Among Smallholder Farmers in Zambia. *Journal of Agriculture, Aquaculture, and Animal Science*. https://doi.org/10.69739/jaaas.v2i1.212.

Thierfelder, C., Chivenge, P., Mupangwa, W., Rosenstock, T., Lamanna, C., & Eyre, J. (2017). How climate-smart is conservation agriculture (CA)? – its potential to deliver on

adaptation, mitigation and productivity on smallholder farms in southern Africa. *Food Security*, 9, 537-560. https://doi.org/10.1007/s12571-017-0665-3.

Wekesa, B., Ayuya, O., & Lagat, J. (2018). Effect of climate-smart agricultural practices on household food security in smallholder production systems: micro-level evidence from Kenya. *Agriculture & Food Security*, 7. https://doi.org/10.1186/s40066-018-0230-0.

Zobeidi, T., Yazdanpanah, M., Komendantova, N., Sieber, S., & Löhr, K. (2021). Factors affecting smallholder farmers' technical and non-technical adaptation responses to drought in Iran. *Journal of environmental management*, 298, 113552. https://doi.org/10.1016/j.jenvman.2021.113552.

CHAPTER III

RESEARCH METHODOLOGY

3.1 Brief description of study area/sites

Shamva District is located approximately 90 km North East of Harare and 28km to the East of Bindura of Mashonaland Central Province. The District borders Mt Darwin to the North and Mashonaland East to the East. The district has an area of approximately 2666.2 square kilometers, located at latitude 170S with an altitude of 310E. Chaminuka Rural District Council is charged with the running of the district. The district comprises of 29 wards, 3 peri urban wards, 16 wards in communal farms, 4 wards in old resettlement areas and 6 wards in large scale commercial farms which were turned into new resettlement areas as part of the land reform program. Shamva is mostly gold mining and its associated activities. Shamva Gold Mine is one of the largest depositors and employers. The district has an estimated population of 147,627 people, with 61,360 males and 62,290 females.

3.2 Research Design

The research philosophy of pragmatism was chosen, which required an understanding of the qualitative and quantitative aspects of C.A's moderating effect on the transformative capacity and drought resilience/food security of the Shamva District smallholder farmers. The abductive research approach used in this study enabled the researcher to apply mixed methods in this research study. The quantitative data collected for this study was heavily more relied upon than the qualitatively collected data, making this a sequential mixed methods approach as the quantitative data was analyzed first, followed by the qualitative data in order to gain a better understanding of the problem. One limitation of this study is that it was cross sectional, that is, only one data collection time point was used. The data gathering was conducted within the first half of 2026 and the research method used in this study was a survey. The data was collected from a sample of respondents using questionnaires and follow

up interviews detailed in the following section. Interview guides were used for both the questionnaires and interviews.

3.3 Sampling procedure

Smallholder farmers in Shamva District were the target population. The sampling frame used is the list of smallholder farmers in the Zimbabwe GMB database who participated in government's Conservative Agriculture programs. At the time of the study, there were 3482 smallholder farmers in the database. They were further grouped into the smaller units called Wards. As A Ward is a sub-category of a District (there were a total of 29 Wards), the wards were arranged in clusters for equal representation of all the clusters as well. The sample size was determined using Yamane's formula:

n = \frac{N}{1+Ne^2}, where N is the population (3482) and e is the margin of error (0.05).

n = 3482/(34820.050.05)

n = 400

A sample size of 400 respondents was chosen.

3.4 Data collection methods

Both a questionnaire and series of expert interviews were used to guide the research. The questionnaire was designed using a Likert scale ranging from 1 to 5. The interview was a semi-structured interview, with a questionnaire section meant for smallholder farmers, and an interview section meant for the expert administrating and implementing the Conservative Agriculture scheme at GMB.

3.5 Data analysis methods

The study's quantitative data were analyzed using structural equation modeling (SEM) to test whether conservative agriculture moderates the effect of food insecurity on Shamva District smallholder farmers' transformative capacity.

To arrive at these themes, qualitative data collected during the FGDs and semi-structured interviews were analyzed using thematic analysis which further categorized some of the challenges and solutions to using C.A as a source of transformation for smallholder farmers in Shamva District on food security.

3.6 Ethical Considerations

The content was submitted for consent from participants beforehand, and no respondent was forced to participate. The information was only for academic purposes and was confidential. Study participants were not paid for their involvement.

References

Amede, T., Konde, A., Muhinda, J., & Bigirwa, G. (2023). Sustainable Farming in Practice: Building Resilient and Profitable Smallholder Agricultural Systems in Sub-Saharan Africa. *Sustainability*. https://doi.org/10.3390/su15075731.

Amede, T., Konde, A., Muhinda, J., & Bigirwa, G. (2023). Sustainable Farming in Practice: Building Resilient and Profitable Smallholder Agricultural Systems in Sub-Saharan Africa. *Sustainability*. https://doi.org/10.3390/su15075731.

Antwi-Agyei, P., Abalo, E., Dougill, A., & Baffour-Ata, F. (2021). Motivations, enablers and barriers to the adoption of climate-smart agricultural practices by smallholder farmers: Evidence from the transitional and savannah agroecological zones of Ghana. *Regional Sustainability*. https://doi.org/10.1016/j.regsus.2022.01.005.

Bahta, Y. (2020). Smallholder livestock farmers coping and adaptation strategies to agricultural drought. *AIMS Agriculture and Food*. https://doi.org/10.3934/agrfood.2020.4.964.

Bahta, Y. (2022). Nexus between Coping Strategies and Households' Agricultural Drought Resilience to Food Insecurity in South Africa. *Land*. https://doi.org/10.3390/land11060893.

Chisadza, B., Gwate, O., Musinguzi, S., Mpofu, N., Macherera, M., & Dube, T. (2025). Resilient agriculture in semi-arid Zimbabwe: adaptation strategies and influencers among smallholder farmers. *Discover Agriculture*, 3. https://doi.org/10.1007/s44279-025-00234-3.

Enyew, S., & Gobie, W. (2025). Adoption of climate smart agricultural practices impact on food security of smallholder farmers in North Western Ethiopia. *Discover Sustainability*, 6. https://doi.org/10.1007/s43621-025-01793-7.

Fanadzo, M., Ncube, B., French, A., & Belete, A. (2021). Smallholder farmer coping and adaptation strategies during the 2015-18 drought in the Western Cape, South Africa. *Physics and Chemistry of The Earth*, 102986. https://doi.org/10.1016/j.pce.2021.102986.

Feng, Q., Si, Z., & Scott, S. (2025). Adapting to climate change on the farm: Experiences of small-scale ecological farmers in two regions of China. *Journal of Agriculture, Food Systems, and Community Development*. https://doi.org/10.5304/jafscd.2025.144.011.

Gebrehiwot, T., & Van Der Veen, A. (2015). Farmers Prone to Drought Risk: Why Some Farmers Undertake Farm-Level Risk-Reduction Measures While Others Not?. *Environmental Management*, 55, 588-602. https://doi.org/10.1007/s00267-014-0415-7.

Hawkins, P., Geza, W., Mabhaudhi, T., Sutherland, C., Queenan, K., Dangour, A., & Scheelbeek, P. (2022). Dietary and agricultural adaptations to drought among smallholder farmers in South Africa: A qualitative study. *Weather and Climate Extremes*, 35. https://doi.org/10.1016/j.wace.2022.100413.

Jew, E., Whitfield, S., Dougill, A., Mkwambisi, D., & Steward, P. (2020). Farming systems and Conservation Agriculture: Technology, structures and agency in Malawi. *Land Use Policy*. https://doi.org/10.1016/j.landusepol.2020.104612.

Jumbe, C., & Nyambose, W. (2016). Does Conservation Agriculture Enhance Household Food Security? Evidence from Smallholder Farmers in Nkhotakota in Malawi. *Sustainable Agriculture Research*, 5, 118. https://doi.org/10.5539/sar.v5n1p118.

Kapari, M., Hlophe-Ginindza, S., Nhamo, L., & Mpandeli, S. (2023). Contribution of smallholder farmers to food security and opportunities for resilient farming systems. *Frontiers in Sustainable Food Systems*. https://doi.org/10.3389/fsufs.2023.1149854.

Katunzi, A., Mlengera, N., Mng'ong'o, M., Mwamlima, B., Mvile, B., Mtama, J., & Lukasumbusa, R. (2025). Enhancing climate resilience of smallholder farmers through conservation agriculture in the southern highlands of Tanzania. *Frontiers in Sustainable Food Systems*. https://doi.org/10.3389/fsufs.2025.1706205.

Katunzi, A., Mlengera, N., Mng'ong'o, M., Mwamlima, B., Mvile, B., Mtama, J., & Lukasumbusa, R. (2025). Enhancing climate resilience of smallholder farmers through conservation agriculture in the southern highlands of Tanzania. *Frontiers in Sustainable Food Systems*. https://doi.org/10.3389/fsufs.2025.1706205.

Kayusi, F., Ngala, D., & Chavula, P. (2025). Assessing the Unfulfilled Promises of Agroforestry and Conservation Agriculture as Climate-Smart Solutions for Food Security in Kenya, Tanzania, Uganda, and Zimbabwe. *East African Journal of Agriculture and Biotechnology*. https://doi.org/10.37284/eajab.8.1.2975.

Keshavarz, M., & Karami, E. (2016). Farmers' pro-environmental behavior under drought: Application of protection motivation theory. *Journal of Arid Environments*, 127, 128-136. https://doi.org/10.1016/j.jaridenv.2015.11.010.

Kone, S., & Uzmay, A. (2024). Impact assessment of sustainable agricultural practices on smallholder households food security: evidence from Burkina Faso. *Climate and Development*, 17, 255 - 269. https://doi.org/10.1080/17565529.2024.2357183.

Lee, M., & Gambiza, J. (2022). The adoption of conservation agriculture by smallholder farmers in southern Africa: A scoping review of barriers and enablers. *Journal of Rural Studies*. https://doi.org/10.1016/j.jrurstud.2022.03.031.

Legesse, T., Ganewo, Z., Alemu, A., Ashebir, A., Samuel, A., & Abayneh, Y. (2024). Does Adoption of Multiple Climate-Smart Agriculture Practices Improve Rural Farm Households' Food Security in Ethiopia?. *Food and Energy Security*. https://doi.org/10.1002/fes3.70021.

Makate, C., Makate, M., Mango, N., & Siziba, S. (2019). Increasing resilience of smallholder farmers to climate change through multiple adoption of proven climate-smart agriculture innovations. Lessons from Southern Africa. *Journal of environmental management*, 231, 858-868. https://doi.org/10.1016/j.jenvman.2018.10.069.

Malherbe, W., Biggs, R., & Sitas, N. (2024). Comparing apples and pears: Linking capitals and capacities to assess the resilience of commercial farming operations. *Agricultural Systems*. https://doi.org/10.1016/j.agsy.2024.103934.

Mango, N., Siziba, S., & Makate, C. (2017). The impact of adoption of conservation agriculture on smallholder farmers' food security in semi-arid zones of southern Africa. *Agriculture & Food Security*, 6, 1-8. https://doi.org/10.1186/s40066-017-0109-5.

Manyakaidze, P., Musavengane, R., & Maponga, R. (2025). Rural Farmer-Managed Wetland Agroecosystems Promote Climate Resilience in Semi-Arid Savannah: Case of Nyororo Wetland, Mberengwa District, Zimbabwe. *Climate Resilience and Sustainability*. https://doi.org/10.1002/cli2.70011.

Mathe, P. (2023). An Assessment of the Sustainability of Conservation Farming in Promoting Food Security Among Smallholder Farmers in Change Ward. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4585280.

Mathe, P. (2023). An Assessment of the Sustainability of Conservation Farming in Promoting Food Security Among Smallholder Farmers in Change Ward. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4585280.

Mdoda, L., Naidoo, D., Ncoyini-Manciya, Z., Nontu, Y., Govender, L., Tamako, N., & Mdiya, L. (2024). Adaptation Measures to Drought Risk Perceived by Smallholder Crop Farmers in the Eastern Cape Province, South Africa: Implications for Food and Nutrition Security. *Sustainability*. https://doi.org/10.3390/su162411154.

Moridi, M., Rahimian, M., Movahed, R., Molavi, H., Gholamrezai, S., & Payamani, K. (2025). Policy Insights for Drought Adaptation: Farmers' Behavior and Sustainable Agricultural Development. *Environmental and Sustainability Indicators*. https://doi.org/10.1016/j.indic.2025.100603.

Mutengwa, C., Mnkeni, P., & Kondwakwenda, A. (2023). Climate-Smart Agriculture and Food Security in Southern Africa: A Review of the Vulnerability of Smallholder Agriculture and Food Security to Climate Change. *Sustainability*. https://doi.org/10.3390/su15042882.

Muthelo, D., Owusu-Sekyere, E., & Ogundeji, A. (2019). Smallholder Farmers' Adaptation to Drought: Identifying Effective Adaptive Strategies and Measures. *Water*. https://doi.org/10.3390/w11102069.

Nyanga, P. (2012). Food security, conservation agriculture and pulses: evidence from smallholder farmers in Zambia.. *Journal of Field Robotics*, 1, 120-138. https://doi.org/10.5539/jfr.v1n2p120.

Nzeyimana, L., Danielsson, Å., Andersson, L., & Gyberg, V. (2021). Success and failure factors for increasing Sub-Saharan African smallholders' resilience to drought through water management. *International Journal of Water Resources Development*, 39, 273 - 293. https://doi.org/10.1080/07900627.2021.1991285.

Opoku-Acheampong, K., Tham-Agyekum, E., Ankuyi, F., Okorley, E., Bakang, J., & Nimoh, F. (2024). Effect of adoption of conservation agriculture on household food security of smallholder maize farmers in Ghana. *Environmental and Sustainability Indicators*. https://doi.org/10.1016/j.indic.2024.100436.

Quandt, A. (2021). Coping with drought: Narratives from smallholder farmers in semi-arid Kenya. *International Journal of Disaster Risk Reduction*. https://doi.org/10.1016/j.ijdrr.2021.102168.

Setsoafia, E., , W., & Renwick, A. (2022). Effects of sustainable agricultural practices on farm income and food security in northern Ghana. *Agricultural and Food Economics*, 10. https://doi.org/10.1186/s40100-022-00216-9.

Taulu, S. (2025). Climate resilience through conservation farming: A review of adaptive practices among smallholder farmers. *International Journal of Science and Research Archive*. https://doi.org/10.30574/ijsra.2025.15.3.1817.

Taulu, S. (2025). Climate resilience through conservation farming: A review of adaptive practices among smallholder farmers. *International Journal of Science and Research Archive*. https://doi.org/10.30574/ijsra.2025.15.3.1817.

Taulu, S. (2025). Climate resilience through conservation farming: A review of adaptive practices among smallholder farmers. *International Journal of Science and Research Archive*. https://doi.org/10.30574/ijsra.2025.15.3.1817.

Teklu, A., Simane, B., & Bezabih, M. (2023). Effect of Climate Smart Agriculture Innovations on Climate Resilience among Smallholder Farmers: Empirical Evidence from the Choke Mountain Watershed of the Blue Nile Highlands of Ethiopia. *Sustainability*. https://doi.org/10.3390/su15054331.

Tembo, A., Muyabe, O., Musenge, D., Mhango, J., & Nkomanga, G. (2025). Impact of Sustainable Agricultural Practices on Farm Productivity, Yield, and Climate Resilience Among Smallholder Farmers in Zambia. *Journal of Agriculture, Aquaculture, and Animal Science*. https://doi.org/10.69739/jaaas.v2i1.212.

Tembo, A., Muyabe, O., Musenge, D., Mhango, J., & Nkomanga, G. (2025). Impact of Sustainable Agricultural Practices on Farm Productivity, Yield, and Climate Resilience Among Smallholder Farmers in Zambia. *Journal of Agriculture, Aquaculture, and Animal Science*. https://doi.org/10.69739/jaaas.v2i1.212.

Thierfelder, C., Chivenge, P., Mupangwa, W., Rosenstock, T., Lamanna, C., & Eyre, J. (2017). How climate-smart is conservation agriculture (CA)? – its potential to deliver on

adaptation, mitigation and productivity on smallholder farms in southern Africa. *Food Security*, 9, 537-560. https://doi.org/10.1007/s12571-017-0665-3.

Wekesa, B., Ayuya, O., & Lagat, J. (2018). Effect of climate-smart agricultural practices on household food security in smallholder production systems: micro-level evidence from Kenya. *Agriculture & Food Security*, 7. https://doi.org/10.1186/s40066-018-0230-0.

Zobeidi, T., Yazdanpanah, M., Komendantova, N., Sieber, S., & Löhr, K. (2021). Factors affecting smallholder farmers' technical and non-technical adaptation responses to drought in Iran. *Journal of environmental management*, 298, 113552. https://doi.org/10.1016/j.jenvman.2021.113552.

CHAPTER IV

ADOPTION OF CONSERVATION AGRICULTURE AMONG SMALLHOLDER FARMERS IN SHAMVA DISTRICT

Chapter IV Abstract

This chapter presents the analysis conducted to address the first objective of the study on the adoption of Conservation Agriculture (CA) among smallholder farmers in Shamva District. It outlines the study procedures, including the description of the study area, research design, sampling procedure, data collection, and data analysis approaches, consistent with the methodology in Chapter 3. Data were collected through procedures described in the previous chapter, and the analysis relied on the quantitative and qualitative information generated for this objective. Challenges encountered during data collection included limited access to some respondents and language barriers, which were managed by explaining concepts in Shona and translating responses into English. Results show that farmers generally perceive CA as beneficial for sustaining household food availability, particularly through post-harvest practices, favorable climate conditions, and government expert assistance. However, perceptions of timely input supply were comparatively lower. Thematic findings further indicate that CA implementation is strongly shaped by manual practices, delayed inputs, limited capital investment, small degraded land, and persistent drought risk.

4.1 Introduction

The next chapter shall show the analysis which has been made for the first objective of the study. The chapter shows the creating of the research methodology and the effort which has been taken to address

4.2 Materials and methods

4.2.1 Description of study area

The description of the study area is given in chapter 3.

4.2.2 Research design

The research design of the study was described in the research methodology chapter of the study.

4.2.3 Sampling procedure

The details of the study sampling procedure were included in the research methodology chapter of this study.

4.2.4 Data collection procedure

The data were collected through the procedures as laid out in the previous chapter of this research study.

4.2.5 Data analysis procedure

The analysis of data done for this chapter is based on the information given in the previous chapter of the study.

4.2.6 Hardships encountered during data collection

Getting access to some of the respondents was a major challenge that the study encountered. The language barrier between the smallholder farmers and the researcher, as well as some respondents' lack of familiarity with the English used in the research instruments. Instead, the researcher explained these concepts in Shona, then translated the responses into English.

4.3 Results and discussion

The study came up with the following findings:

4.3.1 Conservation agriculture adoption by smallholder farmers

Descriptive Statistics					
	N	Mean	Std. Dev	Skewness	
	Statistic	Statistic	Statistic	Statistic	Std. Error
The government C.A inputs often come on time	372	3.0645	2.10663	.548	.126

The climate conditions, rain patterns and weather in our community remains favourable to flourish in conservation agriculture practices	372	5.5054	2.03804	-1.226	.126
Other business engagements such as mining, dealing in retail business, restaurants and bars have overtaken conservation agriculture in our community	372	3.0538	2.17492	.550	.126
There is adequate support from government in the form of expert assistance to ensure that conservation agriculture production brings the maximum yield.	372	5.4624	1.67788	-.878	.126
The post-harvest practices for C.A yield can be kept for sustainably long enough to safeguard against food shortages both in the short and long run.	372	5.8387	1.74548	-1.476	.126
Valid N (listwise)	372				

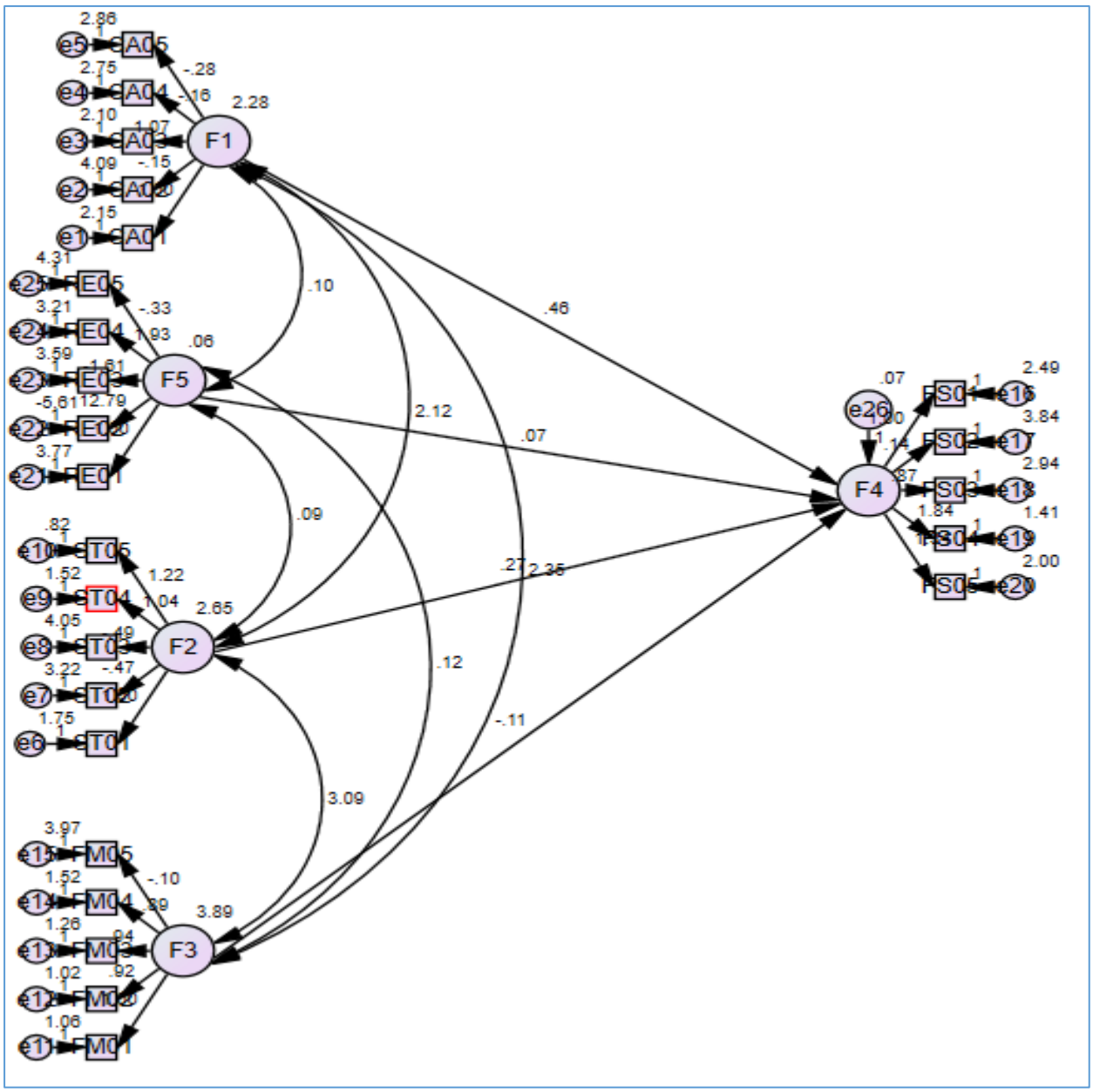
Perceptions and experiences of smallholder farmers in Shamva District with conservation agriculture (CA) under the Pfumvudza/Intwasa programme were assessed. Generally farmers agreed with the statements that several conditions or supports influence successful CA implementation. For instance, the statement on post-harvest practices for CA yields can be preserved for long enough to safeguard against food shortages had the highest mean score (Mean = 5.8387, SD = 1.7455). This shows that farmers believed in preservation/storage practices for their contribution to household food availability in times of food shortage and before harvest.

Equally, farmers believed that climate, rain and general weather conditions were favorable for successful CA adoption (Mean = 5.5054, SD = 2.0380) and that expert advice obtained through government assistance was important for maximizing output through CA (Mean = 5.4624, SD = 1.6779). This indicates that extension advice especially through agricultural officers is important for CA adoption.

While perceptions of timeliness of the supply of government CA inputs (Mean = 3.0645, SD = 2.1066), and of CA being displaced by other business activities in the community (Mean = 3.0538, SD = 2.1749) were relatively lower, they indicated that, the community may have experienced problems in the timely supply of inputs for the implementation of CA programs and livelihood diversification in the form of business activities may have occurred but without completely displacing CA.

The thematic interviews suggested farmers viewed CA as manual, dependent on inputs that often arrived late, rain-fed and unsuitable for planning ahead and making investments in capital. While access to technology (boreholes, solar energy) were key improvements, seasonal uncertainty and declining land productivity were most often cited as barriers. Perceptions of land size and health were considerable with land being viewed as small and degraded to the point that productivity gains are hampered under CA, explaining why it does not eliminate food insecurity due to drought-related variability.

Correlation of conservation strategies, coping strategies, moderating factors to food security, and resilience.



CA shows the conservation practices being used by smallholder farmers

FM shows the factors moderating effective conservation agriculture programs

FE shows coping strategies

ST show the strategies to improve resilience

FS shows food security in terms of resilience

4.3.2 Thematic analysis from interviews regarding conservation agriculture adoption by smallholder farmers

The following table shows the thematic analysis which was done for the study and the results obtained thereof:

Theme: Conservation agriculture used by smallholder farmers

Subthemes: Methods used in conservation agriculture; Results of conservation agriculture; Land size and land quality

PRELIMINARY CODE	RESPONSES	EMERGING THEME
Methods used	• Manual farming • Farming after inputs arrive, no preplanning • Reliance on rain water • Improving technologies allowing access to borehole services, solar etc	• Farming is manual • Delayed inputs • No capital investment in farming, relying on natural cycles
Average yield	• Enough for family consumption • Good seasons can see sales of grain • Droughts and challenges lead to hunger • Heavy reliance on grain output	• Yield is adequate for consumption • Extreme conditions significantly influence output
Land size and land quality	• Small communal land • Land is degraded • Artificial fertilizer effects showing	• Land is small • Land is degraded

The interviews show that the enabling environment for CA adoption in Shamva was the household's resource endowment and farm-level realities rather than CA knowledge. Farmers

had to work with customary manual tillage when inputs were not available. However, when inputs were available, CA was adopted. Moreover, capital investment was low, and farmers were still at the mercy of seasonal rainfall cycles and did not have strong buffering systems (e.g. irrigation). This implies that at least part of farmers' adoption is mediated by capital availability, with persisting drought risk as there is still exposure to rainfall variability (which buffering could cover).

Farmers reported CA yields provided food for their households and, in better years, surplus grain for sale. Droughts and extreme weather shocks negatively impacted CA system performance, as farmers learned that variability in climatic conditions reduced output and increased hunger and insecurity. Therefore, CA may buffer food availability in favorable years, but it does not completely obviate vulnerability when there is a failure of rains.

For size and quality information, there were frequent mentions of small common lands and degraded lands. Since CA can increase water capacity and yields over time, but both limited

References

Amede, T., Konde, A., Muhinda, J., & Bigirwa, G. (2023). Sustainable Farming in Practice: Building Resilient and Profitable Smallholder Agricultural Systems in Sub-Saharan Africa. *Sustainability*. https://doi.org/10.3390/su15075731.

Amede, T., Konde, A., Muhinda, J., & Bigirwa, G. (2023). Sustainable Farming in Practice: Building Resilient and Profitable Smallholder Agricultural Systems in Sub-Saharan Africa. *Sustainability*. https://doi.org/10.3390/su15075731.

Antwi-Agyei, P., Abalo, E., Dougill, A., & Baffour-Ata, F. (2021). Motivations, enablers and barriers to the adoption of climate-smart agricultural practices by smallholder farmers: Evidence from the transitional and savannah agroecological zones of Ghana. *Regional Sustainability*. https://doi.org/10.1016/j.regsus.2022.01.005.

Bahta, Y. (2020). Smallholder livestock farmers coping and adaptation strategies to agricultural drought. *AIMS Agriculture and Food*. https://doi.org/10.3934/agrfood.2020.4.964.

Bahta, Y. (2022). Nexus between Coping Strategies and Households' Agricultural Drought Resilience to Food Insecurity in South Africa. *Land*. https://doi.org/10.3390/land11060893.

Chisadza, B., Gwate, O., Musinguzi, S., Mpofu, N., Macherera, M., & Dube, T. (2025). Resilient agriculture in semi-arid Zimbabwe: adaptation strategies and influencers among smallholder farmers. *Discover Agriculture*, 3. https://doi.org/10.1007/s44279-025-00234-3.

Enyew, S., & Gobie, W. (2025). Adoption of climate smart agricultural practices impact on food security of smallholder farmers in North Western Ethiopia. *Discover Sustainability*, 6. https://doi.org/10.1007/s43621-025-01793-7.

Fanadzo, M., Ncube, B., French, A., & Belete, A. (2021). Smallholder farmer coping and adaptation strategies during the 2015-18 drought in the Western Cape, South Africa. *Physics and Chemistry of The Earth*, 102986. https://doi.org/10.1016/j.pce.2021.102986.

Feng, Q., Si, Z., & Scott, S. (2025). Adapting to climate change on the farm: Experiences of small-scale ecological farmers in two regions of China. *Journal of Agriculture, Food Systems, and Community Development*. https://doi.org/10.5304/jafscd.2025.144.011.

Gebrehiwot, T., & Van Der Veen, A. (2015). Farmers Prone to Drought Risk: Why Some Farmers Undertake Farm-Level Risk-Reduction Measures While Others Not?. *Environmental Management*, 55, 588-602. https://doi.org/10.1007/s00267-014-0415-7.

Hawkins, P., Geza, W., Mabhaudhi, T., Sutherland, C., Queenan, K., Dangour, A., & Scheelbeek, P. (2022). Dietary and agricultural adaptations to drought among smallholder farmers in South Africa: A qualitative study. *Weather and Climate Extremes*, 35. https://doi.org/10.1016/j.wace.2022.100413.

Jew, E., Whitfield, S., Dougill, A., Mkwambisi, D., & Steward, P. (2020). Farming systems and Conservation Agriculture: Technology, structures and agency in Malawi. *Land Use Policy*. https://doi.org/10.1016/j.landusepol.2020.104612.

Jumbe, C., & Nyambose, W. (2016). Does Conservation Agriculture Enhance Household Food Security? Evidence from Smallholder Farmers in Nkhotakota in Malawi. *Sustainable Agriculture Research*, 5, 118. https://doi.org/10.5539/sar.v5n1p118.

Kapari, M., Hlophe-Ginindza, S., Nhamo, L., & Mpandeli, S. (2023). Contribution of smallholder farmers to food security and opportunities for resilient farming systems. *Frontiers in Sustainable Food Systems*. https://doi.org/10.3389/fsufs.2023.1149854.

Katunzi, A., Mlengera, N., Mng'ong'o, M., Mwamlima, B., Mvile, B., Mtama, J., & Lukasumbusa, R. (2025). Enhancing climate resilience of smallholder farmers through conservation agriculture in the southern highlands of Tanzania. *Frontiers in Sustainable Food Systems*. https://doi.org/10.3389/fsufs.2025.1706205.

Katunzi, A., Mlengera, N., Mng'ong'o, M., Mwamlima, B., Mvile, B., Mtama, J., & Lukasumbusa, R. (2025). Enhancing climate resilience of smallholder farmers through conservation agriculture in the southern highlands of Tanzania. *Frontiers in Sustainable Food Systems*. https://doi.org/10.3389/fsufs.2025.1706205.

Kayusi, F., Ngala, D., & Chavula, P. (2025). Assessing the Unfulfilled Promises of Agroforestry and Conservation Agriculture as Climate-Smart Solutions for Food Security in Kenya, Tanzania, Uganda, and Zimbabwe. *East African Journal of Agriculture and Biotechnology*. https://doi.org/10.37284/eajab.8.1.2975.

Keshavarz, M., & Karami, E. (2016). Farmers' pro-environmental behavior under drought: Application of protection motivation theory. *Journal of Arid Environments*, 127, 128-136. https://doi.org/10.1016/j.jaridenv.2015.11.010.

Kone, S., & Uzmay, A. (2024). Impact assessment of sustainable agricultural practices on smallholder households food security: evidence from Burkina Faso. *Climate and Development*, 17, 255 - 269. https://doi.org/10.1080/17565529.2024.2357183.

Lee, M., & Gambiza, J. (2022). The adoption of conservation agriculture by smallholder farmers in southern Africa: A scoping review of barriers and enablers. *Journal of Rural Studies*. https://doi.org/10.1016/j.jrurstud.2022.03.031.

Legesse, T., Ganewo, Z., Alemu, A., Ashebir, A., Samuel, A., & Abayneh, Y. (2024). Does Adoption of Multiple Climate-Smart Agriculture Practices Improve Rural Farm Households' Food Security in Ethiopia?. *Food and Energy Security*. https://doi.org/10.1002/fes3.70021.

Makate, C., Makate, M., Mango, N., & Siziba, S. (2019). Increasing resilience of smallholder farmers to climate change through multiple adoption of proven climate-smart agriculture innovations. Lessons from Southern Africa. *Journal of environmental management*, 231, 858-868. https://doi.org/10.1016/j.jenvman.2018.10.069.

Malherbe, W., Biggs, R., & Sitas, N. (2024). Comparing apples and pears: Linking capitals and capacities to assess the resilience of commercial farming operations. *Agricultural Systems*. https://doi.org/10.1016/j.agsy.2024.103934.

Mango, N., Siziba, S., & Makate, C. (2017). The impact of adoption of conservation agriculture on smallholder farmers' food security in semi-arid zones of southern Africa. *Agriculture & Food Security*, 6, 1-8. https://doi.org/10.1186/s40066-017-0109-5.

Manyakaidze, P., Musavengane, R., & Maponga, R. (2025). Rural Farmer-Managed Wetland Agroecosystems Promote Climate Resilience in Semi-Arid Savannah: Case of Nyororo Wetland, Mberengwa District, Zimbabwe. *Climate Resilience and Sustainability*. https://doi.org/10.1002/cli2.70011.

Mathe, P. (2023). An Assessment of the Sustainability of Conservation Farming in Promoting Food Security Among Smallholder Farmers in Change Ward. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4585280.

Mathe, P. (2023). An Assessment of the Sustainability of Conservation Farming in Promoting Food Security Among Smallholder Farmers in Change Ward. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4585280.

Mdoda, L., Naidoo, D., Ncoyini-Manciya, Z., Nontu, Y., Govender, L., Tamako, N., & Mdiya, L. (2024). Adaptation Measures to Drought Risk Perceived by Smallholder Crop Farmers in the Eastern Cape Province, South Africa: Implications for Food and Nutrition Security. *Sustainability*. https://doi.org/10.3390/su162411154.

Moridi, M., Rahimian, M., Movahed, R., Molavi, H., Gholamrezai, S., & Payamani, K. (2025). Policy Insights for Drought Adaptation: Farmers' Behavior and Sustainable Agricultural Development. *Environmental and Sustainability Indicators*. https://doi.org/10.1016/j.indic.2025.100603.

Mutengwa, C., Mnkeni, P., & Kondwakwenda, A. (2023). Climate-Smart Agriculture and Food Security in Southern Africa: A Review of the Vulnerability of Smallholder Agriculture and Food Security to Climate Change. *Sustainability*. https://doi.org/10.3390/su15042882.

Muthelo, D., Owusu-Sekyere, E., & Ogundeji, A. (2019). Smallholder Farmers' Adaptation to Drought: Identifying Effective Adaptive Strategies and Measures. *Water*. https://doi.org/10.3390/w11102069.

Nyanga, P. (2012). Food security, conservation agriculture and pulses: evidence from smallholder farmers in Zambia.. *Journal of Field Robotics*, 1, 120-138. https://doi.org/10.5539/jfr.v1n2p120.

Nzeyimana, L., Danielsson, Å., Andersson, L., & Gyberg, V. (2021). Success and failure factors for increasing Sub-Saharan African smallholders' resilience to drought through water management. *International Journal of Water Resources Development*, 39, 273 - 293. https://doi.org/10.1080/07900627.2021.1991285.

Opoku-Acheampong, K., Tham-Agyekum, E., Ankuyi, F., Okorley, E., Bakang, J., & Nimoh, F. (2024). Effect of adoption of conservation agriculture on household food security of smallholder maize farmers in Ghana. *Environmental and Sustainability Indicators*. https://doi.org/10.1016/j.indic.2024.100436.

Quandt, A. (2021). Coping with drought: Narratives from smallholder farmers in semi-arid Kenya. *International Journal of Disaster Risk Reduction*. https://doi.org/10.1016/j.ijdrr.2021.102168.

Setsoafia, E., , W., & Renwick, A. (2022). Effects of sustainable agricultural practices on farm income and food security in northern Ghana. *Agricultural and Food Economics*, 10. https://doi.org/10.1186/s40100-022-00216-9.

Taulu, S. (2025). Climate resilience through conservation farming: A review of adaptive practices among smallholder farmers. *International Journal of Science and Research Archive*. https://doi.org/10.30574/ijsra.2025.15.3.1817.

Taulu, S. (2025). Climate resilience through conservation farming: A review of adaptive practices among smallholder farmers. *International Journal of Science and Research Archive*. https://doi.org/10.30574/ijsra.2025.15.3.1817.

Taulu, S. (2025). Climate resilience through conservation farming: A review of adaptive practices among smallholder farmers. *International Journal of Science and Research Archive*. https://doi.org/10.30574/ijsra.2025.15.3.1817.

Teklu, A., Simane, B., & Bezabih, M. (2023). Effect of Climate Smart Agriculture Innovations on Climate Resilience among Smallholder Farmers: Empirical Evidence from the Choke Mountain Watershed of the Blue Nile Highlands of Ethiopia. *Sustainability*. https://doi.org/10.3390/su15054331.

Tembo, A., Muyabe, O., Musenge, D., Mhango, J., & Nkomanga, G. (2025). Impact of Sustainable Agricultural Practices on Farm Productivity, Yield, and Climate Resilience Among Smallholder Farmers in Zambia. *Journal of Agriculture, Aquaculture, and Animal Science*. https://doi.org/10.69739/jaaas.v2i1.212.

Tembo, A., Muyabe, O., Musenge, D., Mhango, J., & Nkomanga, G. (2025). Impact of Sustainable Agricultural Practices on Farm Productivity, Yield, and Climate Resilience Among Smallholder Farmers in Zambia. *Journal of Agriculture, Aquaculture, and Animal Science*. https://doi.org/10.69739/jaaas.v2i1.212.

Thierfelder, C., Chivenge, P., Mupangwa, W., Rosenstock, T., Lamanna, C., & Eyre, J. (2017). How climate-smart is conservation agriculture (CA)? – its potential to deliver on

adaptation, mitigation and productivity on smallholder farms in southern Africa. *Food Security*, 9, 537-560. https://doi.org/10.1007/s12571-017-0665-3.

Wekesa, B., Ayuya, O., & Lagat, J. (2018). Effect of climate-smart agricultural practices on household food security in smallholder production systems: micro-level evidence from Kenya. *Agriculture & Food Security*, 7. https://doi.org/10.1186/s40066-018-0230-0.

Zobeidi, T., Yazdanpanah, M., Komendantova, N., Sieber, S., & Löhr, K. (2021). Factors affecting smallholder farmers' technical and non-technical adaptation responses to drought in Iran. *Journal of environmental management*, 298, 113552. https://doi.org/10.1016/j.jenvman.2021.113552.

CHAPTER V

COPING STRATEGIES IN THE FACE OF DROUGHT AND FOOD SHORTAGES

Abstract

This chapter examines coping strategies used by smallholder households in Shamva District in the face of drought and food shortages, aiming to understand how these strategies relate to food security and resilience. The chapter follows the same methodological principles used in the preceding chapters, describing the study area, research design, sampling approach, data collection procedures, and data analysis methods. Difficulties during data collection included limited access to some respondents and language barriers, which were resolved through explanation in Shona followed by English translation of responses. Quantitative results indicate that farmers rely more on financial reserves than on keeping agricultural reserves, suggesting that purchasing power is essential during drought periods. Systemic constraints—such as economic difficulties, limited technology and equipment, and health-related challenges—were strongly associated with reduced preparedness. Regression and ANOVA results show that CA-related food security dimensions significantly predict resilience perceptions, with government inputs and climate favorability having positive associations. Qualitative evidence supported these patterns and highlighted constraints related to storage space, pests, high costs of preservation, counterfeit chemicals, and limited market access due to lack of cash.

5.1 Introduction

The analysis which has been made for the first objective of the study is presented in the following chapter. The chapter shows the creating of the research methodology and the effort which have been taken to address.

5.2 Materials and methods

Materials and methods for the experiments in this chapter are described as follows.

5.2.1 Description of study area

The study area is discussed in more detail in chapter 3.

5.2.2 Research design

The research methodology chapter of this study also explains the methodology and design of the study.

5.2.3 Sampling procedure

The method used for sampling was described in the research methodology chapter of the study.

5.2.4 Data collection procedure

The data used for the study were collected according to the guidelines set out in the previous chapter.

5.2.5 Data analysis procedure

The data analysis carried out for this chapter is the same as that done in the previous chapter in the study.

5.2.6 Difficulties in gathering the data

The study encountered some challenges with accessing some of the respondents, and a language barrier with the smallholder farmers was also encountered. Not all respondents were conversant with the English language which was utilized in the research instruments that were administered during the study. The researcher circumvented this by explaining concepts in Shona and then translating participants' responses into English.

5.3 Results and discussion

The study made the following findings:

5.3.1 Coping strategies in the event of drought and food shortages

Descriptive Statistics					
	N	Mean	Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Std. Error

We keep reserves of agriculture products (maize, small-grains, etc) to use in the face of drought and food shortage.	372	2.8172	2.10222	.845	.126
We have financial reserves to use in the face of drought.	372	5.5054	1.95156	-1.273	.126
Preparedness for drought is hard because of the influences from external factors such as economic conditions, technological incapacity or health hazard implications	372	5.0538	2.16498	-.871	.126
There is adequate support from government and non-government partners which makes it easier for us to cope with drought	372	3.4194	2.09388	.334	.126
In the face of drought and food shortage, there are alternative activities which we do to sustain our livelihood like mining, retail or other non-farming activities.	372	3.2258	2.18857	.448	.126
Valid N (listwise)	372				

Farmers differed in their coping mechanisms and the extent to which they regarded their coping strategies as adequate to cope with drought and food shortages. Financial reserves to be used in times of drought (Mean = 5.5054, SD = 1.9516) were also seen as one of the major coping strategies, suggesting that access to financial reserves for the purchase of food, inputs and hiring labourers is an important part of farmers' drought coping strategies.

Farmers strongly agreed systemic constraints limited how prepared they could be for drought, such as economic difficulties, technology and equipment, and health challenges (Mean= 5.0538, SD = 2.1650). This suggests that a key limitation to resilience is that knowing about drought risk does not mean farmers will prepare if there are system constraints.

Keeping reserves (such as maize or small grains) for drought and famine situations received the lowest mean score (Mean = 2.8172, SD = 2.1022). This strategy is not always possible since household-level reserves depend on harvests and household-level storage losses from pests or spoilage reduce guarantees that food reserves are available.

Farmers felt moderately that they had adequate access to government and non-government actors to support coping (Mean = 3.4194, SD = 2.0939), and while there may be some access, the access may not be consistent, lack coverage, or be difficult to access for all households.

Diversifying income by mining, operating a shop or engaging in other non-farm activities is moderately supported as a strategy for adapting to climate change by households (Mean = 3.2258, SD = 2.1886), but is likely constrained by opportunities, finance or the economy.

5.3.2 Coping strategies and food security

Regression analysis, ANOVA and correlation analysis were employed to analyze the relationship between the coping strategies and the food security to determine the effect of the coping strategies on food security.

Regression model summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.733[a]	.537	.531	.85983

a. Predictors: (Constant), The post-harvest practices for C.A yield may be kept for sustainably long enough to safeguard against food shortages both in the short and long run. , The government C.A inputs often come on time, There is adequate support from government in the form of expert assistance to ensure that conservation agriculture production brings the maximum yield. , The climate conditions, rain patterns and weather in our community remains favorable to flourish in conservation agriculture practices, Other business

engagements such as mining, dealing in retail business, restaurants and bars have overtaken conservation agriculture in our community.

The relationship between CA-related food security and coping strategy was determined through regression and ANOVA. The Model Summary results indicate that the predictive variables accounted for a large portion of the variance in the model of the dependent variable (R = 0.733, R Square = 0.537, Adjusted R Square = 0.531). This suggests that CA dimensions (timely input acquisition, climate favourability, government support, and post-harvest retention) correlate positively with food security/resilience perceptions within the agricultural system.

ANOVA results

ANOVA[a]						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	314.464	5	62.893	85.069	.000[b]
	Residual	270.589	366	.739		
	Total	585.053	371			
a. Dependent Variable: AFS						

b. Predictors: (Constant), The post-harvest practices for C.A yield can be kept for sustainably long enough to safeguard against food shortages both in the short and long run. , The government C.A inputs often come on time, There is adequate support from government in the form of expert assistance to ensure that conservation agriculture production brings the maximum yield. , The climate conditions, rain patterns and weather in our community remains favorable to flourish in conservation agriculture practices, Other business engagements such as mining, dealing in retail business, restaurants and bars have overtaken conservation agriculture in our community.

Pairwise tests for between-subjects effects (ANOVA) were meaningful (F = 85.069, p = .000). It can thus be concluded that these predictors provide a statistically meaningful contribution to the prediction of food security/resilience. At the level of coefficients,

government inputs (CA) received on time were considerably and positively related to food security (Beta = 0.384, p = .000). A similar positive impact was found for favorable climactic conditions (Beta = 0.277, p = .000) and for government expert assistance (Beta = 0.164, p = .000), which suggests that reliable supply of these inputs and expertise is important to farmers' capacity to stabilize production and consumption.

Coefficients of regression

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.195	.237		5.032	.000
	The government C.A inputs often come on time	.229	.025	.384	9.066	.000
	The climate conditions, rain patterns and weather in our community remains favourable to flourish in conservation agriculture practices	.171	.024	.277	7.053	.000
	Other business engagements such as mining, dealing in retail business, restaurants and bars have overtaken conservation agriculture in our community	.248	.025	.429	9.853	.000
	There is adequate support from government in the form of expert assistance to ensure that conservation agriculture production brings the maximum yield.	.123	.028	.164	4.409	.000

	The post-harvest practices for C.A yield can be kept for sustainably long enough to safeguard against food shortages both in the short and long run.	-.119	.029	-.165	-4.044	.000
a. Dependent Variable: AFS						

Post-harvest practices are statistically important but with a negative coefficient (B = -0.119, Beta = -0.165, t = -4.044, p = .000). This may be because farmers who scored higher on this item are also those subject to the greatest shocks (drought), which may outweigh the positive effects of these practices. Other factors, such as pest infestation, spoilage, or lack of storage capacity, may mean that the "ability to keep produce" does not increase food security. The level of security is dependent on storage conditions, pest management, and affordability of preservation methods post-harvest.

5.3.3 Coping strategies for drought and food shortage undertaken by pastoralists and agro-pastoralists.

The following table is the analysis undertaken for the study, and the results that were found:

Theme: Coping strategies in the face of drought and food shortage

Subthemes: food storage, pest control, government assistance and private assistance, other alternatives in the face of shortage and distress.

PRELIMINARY CODE	RESPONSES	EMERGING THEME
Food storage	• Traditional storage methods • Chemicals to preserve • Storage space limited • Storage often affected by weather	• Traditional and chemical storage methods • Storage areas not up to good standard
Pest control during and after cropping	• Pests are a problem • Rodents after harvest, insects during cropping	• Pests during and after cropping • Expensive to store grain

	• Traditional pest control • Chemicals are often expensive and counterfeits are now being sold	post-harvest
Assistance (government and private)	• Government assists with knowledge and supervision • NGOs offer specialist services, but often have their programs already set for us • We are trained on newer methods and improvement by government	• Government assists • NGOs assist • Regular training
Alternatives	• In the face of food shortage we have limited options on food • Buying from stores is expensive and we often do not have cash • Reliance on output is more	• Alternatives are expensive • Reliance on output of farming is heavy

Some quantitative patterns were supported by qualitative interviews, where farmers' descriptions of their food storage practices as mostly customary and chemical, and a lack of space and exposure to weather as constraining. Some other problems were described as chronic, such as rodents after the harvest or insects during cropping. Farmers say that chemical control is expensive, that counterfeit chemicals may be sold, and that effectiveness and resistance are reduced.

Interviews suggested knowledge and oversight is generally government-led, with NGOs having small areas of expertise. However, programs were not aligned with local needs and were often pre-designed for specific target groups. Farmers largely find such support valuable, but often not sufficiently tailored, active, or broadly available in nature.

Finally, farmers said that choices were severely limited during times of drought, particularly because they did not always have cash to buy food in open markets. Consequently, households were largely self-sufficient in their consumption of food, but the amount of food they could produce was often limited by drought.

In summary, the coping results suggest that resilience is limited by the very production shocks (lower yield due to drought) and systemic conditions (storage, pest control, preservation cost, alternative income).

References

Amede, T., Konde, A., Muhinda, J., & Bigirwa, G. (2023). Sustainable Farming in Practice: Building Resilient and Profitable Smallholder Agricultural Systems in Sub-Saharan Africa. *Sustainability*. https://doi.org/10.3390/su15075731.

Amede, T., Konde, A., Muhinda, J., & Bigirwa, G. (2023). Sustainable Farming in Practice: Building Resilient and Profitable Smallholder Agricultural Systems in Sub-Saharan Africa. *Sustainability*. https://doi.org/10.3390/su15075731.

Antwi-Agyei, P., Abalo, E., Dougill, A., & Baffour-Ata, F. (2021). Motivations, enablers and barriers to the adoption of climate-smart agricultural practices by smallholder farmers: Evidence from the transitional and savannah agroecological zones of Ghana. *Regional Sustainability*. https://doi.org/10.1016/j.regsus.2022.01.005.

Bahta, Y. (2020). Smallholder livestock farmers coping and adaptation strategies to agricultural drought. *AIMS Agriculture and Food*. https://doi.org/10.3934/agrfood.2020.4.964.

Bahta, Y. (2022). Nexus between Coping Strategies and Households' Agricultural Drought Resilience to Food Insecurity in South Africa. *Land*. https://doi.org/10.3390/land11060893.

Chisadza, B., Gwate, O., Musinguzi, S., Mpofu, N., Macherera, M., & Dube, T. (2025). Resilient agriculture in semi-arid Zimbabwe: adaptation strategies and influencers among smallholder farmers. *Discover Agriculture*, 3. https://doi.org/10.1007/s44279-025-00234-3.

Enyew, S., & Gobie, W. (2025). Adoption of climate smart agricultural practices impact on food security of smallholder farmers in North Western Ethiopia. *Discover Sustainability*, 6. https://doi.org/10.1007/s43621-025-01793-7.

Fanadzo, M., Ncube, B., French, A., & Belete, A. (2021). Smallholder farmer coping and adaptation strategies during the 2015-18 drought in the Western Cape, South Africa. *Physics and Chemistry of The Earth*, 102986. https://doi.org/10.1016/j.pce.2021.102986.

Feng, Q., Si, Z., & Scott, S. (2025). Adapting to climate change on the farm: Experiences of small-scale ecological farmers in two regions of China. *Journal of Agriculture, Food Systems, and Community Development*. https://doi.org/10.5304/jafscd.2025.144.011.

Gebrehiwot, T., & Van Der Veen, A. (2015). Farmers Prone to Drought Risk: Why Some Farmers Undertake Farm-Level Risk-Reduction Measures While Others Not?. *Environmental Management*, 55, 588-602. https://doi.org/10.1007/s00267-014-0415-7.

Hawkins, P., Geza, W., Mabhaudhi, T., Sutherland, C., Queenan, K., Dangour, A., & Scheelbeek, P. (2022). Dietary and agricultural adaptations to drought among smallholder farmers in South Africa: A qualitative study. *Weather and Climate Extremes*, 35. https://doi.org/10.1016/j.wace.2022.100413.

Jew, E., Whitfield, S., Dougill, A., Mkwambisi, D., & Steward, P. (2020). Farming systems and Conservation Agriculture: Technology, structures and agency in Malawi. *Land Use Policy*. https://doi.org/10.1016/j.landusepol.2020.104612.

Jumbe, C., & Nyambose, W. (2016). Does Conservation Agriculture Enhance Household Food Security? Evidence from Smallholder Farmers in Nkhotakota in Malawi. *Sustainable Agriculture Research*, 5, 118. https://doi.org/10.5539/sar.v5n1p118.

Kapari, M., Hlophe-Ginindza, S., Nhamo, L., & Mpandeli, S. (2023). Contribution of smallholder farmers to food security and opportunities for resilient farming systems. *Frontiers in Sustainable Food Systems*. https://doi.org/10.3389/fsufs.2023.1149854.

Katunzi, A., Mlengera, N., Mng'ong'o, M., Mwamlima, B., Mvile, B., Mtama, J., & Lukasumbusa, R. (2025). Enhancing climate resilience of smallholder farmers through conservation agriculture in the southern highlands of Tanzania. *Frontiers in Sustainable Food Systems*. https://doi.org/10.3389/fsufs.2025.1706205.

Katunzi, A., Mlengera, N., Mng'ong'o, M., Mwamlima, B., Mvile, B., Mtama, J., & Lukasumbusa, R. (2025). Enhancing climate resilience of smallholder farmers through conservation agriculture in the southern highlands of Tanzania. *Frontiers in Sustainable Food Systems*. https://doi.org/10.3389/fsufs.2025.1706205.

Kayusi, F., Ngala, D., & Chavula, P. (2025). Assessing the Unfulfilled Promises of Agroforestry and Conservation Agriculture as Climate-Smart Solutions for Food Security in Kenya, Tanzania, Uganda, and Zimbabwe. *East African Journal of Agriculture and Biotechnology*. https://doi.org/10.37284/eajab.8.1.2975.

Keshavarz, M., & Karami, E. (2016). Farmers' pro-environmental behavior under drought: Application of protection motivation theory. *Journal of Arid Environments*, 127, 128-136. https://doi.org/10.1016/j.jaridenv.2015.11.010.

Kone, S., & Uzmay, A. (2024). Impact assessment of sustainable agricultural practices on smallholder households food security: evidence from Burkina Faso. *Climate and Development*, 17, 255 - 269. https://doi.org/10.1080/17565529.2024.2357183.

Lee, M., & Gambiza, J. (2022). The adoption of conservation agriculture by smallholder farmers in southern Africa: A scoping review of barriers and enablers. *Journal of Rural Studies*. https://doi.org/10.1016/j.jrurstud.2022.03.031.

Legesse, T., Ganewo, Z., Alemu, A., Ashebir, A., Samuel, A., & Abayneh, Y. (2024). Does Adoption of Multiple Climate-Smart Agriculture Practices Improve Rural Farm Households' Food Security in Ethiopia?. *Food and Energy Security*. https://doi.org/10.1002/fes3.70021.

Makate, C., Makate, M., Mango, N., & Siziba, S. (2019). Increasing resilience of smallholder farmers to climate change through multiple adoption of proven climate-smart agriculture innovations. Lessons from Southern Africa. *Journal of environmental management*, 231, 858-868. https://doi.org/10.1016/j.jenvman.2018.10.069.

Malherbe, W., Biggs, R., & Sitas, N. (2024). Comparing apples and pears: Linking capitals and capacities to assess the resilience of commercial farming operations. *Agricultural Systems*. https://doi.org/10.1016/j.agsy.2024.103934.

Mango, N., Siziba, S., & Makate, C. (2017). The impact of adoption of conservation agriculture on smallholder farmers' food security in semi-arid zones of southern Africa. *Agriculture & Food Security*, 6, 1-8. https://doi.org/10.1186/s40066-017-0109-5.

Manyakaidze, P., Musavengane, R., & Maponga, R. (2025). Rural Farmer-Managed Wetland Agroecosystems Promote Climate Resilience in Semi-Arid Savannah: Case of Nyororo Wetland, Mberengwa District, Zimbabwe. *Climate Resilience and Sustainability*. https://doi.org/10.1002/cli2.70011.

Mathe, P. (2023). An Assessment of the Sustainability of Conservation Farming in Promoting Food Security Among Smallholder Farmers in Change Ward. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4585280.

Mathe, P. (2023). An Assessment of the Sustainability of Conservation Farming in Promoting Food Security Among Smallholder Farmers in Change Ward. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4585280.

Mdoda, L., Naidoo, D., Ncoyini-Manciya, Z., Nontu, Y., Govender, L., Tamako, N., & Mdiya, L. (2024). Adaptation Measures to Drought Risk Perceived by Smallholder Crop Farmers in the Eastern Cape Province, South Africa: Implications for Food and Nutrition Security. *Sustainability*. https://doi.org/10.3390/su162411154.

Moridi, M., Rahimian, M., Movahed, R., Molavi, H., Gholamrezai, S., & Payamani, K. (2025). Policy Insights for Drought Adaptation: Farmers' Behavior and Sustainable Agricultural Development. *Environmental and Sustainability Indicators*. https://doi.org/10.1016/j.indic.2025.100603.

Mutengwa, C., Mnkeni, P., & Kondwakwenda, A. (2023). Climate-Smart Agriculture and Food Security in Southern Africa: A Review of the Vulnerability of Smallholder Agriculture and Food Security to Climate Change. *Sustainability*. https://doi.org/10.3390/su15042882.

Muthelo, D., Owusu-Sekyere, E., & Ogundeji, A. (2019). Smallholder Farmers' Adaptation to Drought: Identifying Effective Adaptive Strategies and Measures. *Water*. https://doi.org/10.3390/w11102069.

Nyanga, P. (2012). Food security, conservation agriculture and pulses: evidence from smallholder farmers in Zambia.. *Journal of Field Robotics*, 1, 120-138. https://doi.org/10.5539/jfr.v1n2p120.

Nzeyimana, L., Danielsson, Å., Andersson, L., & Gyberg, V. (2021). Success and failure factors for increasing Sub-Saharan African smallholders' resilience to drought through water management. *International Journal of Water Resources Development*, 39, 273 - 293. https://doi.org/10.1080/07900627.2021.1991285.

Opoku-Acheampong, K., Tham-Agyekum, E., Ankuyi, F., Okorley, E., Bakang, J., & Nimoh, F. (2024). Effect of adoption of conservation agriculture on household food security of smallholder maize farmers in Ghana. *Environmental and Sustainability Indicators*. https://doi.org/10.1016/j.indic.2024.100436.

Quandt, A. (2021). Coping with drought: Narratives from smallholder farmers in semi-arid Kenya. *International Journal of Disaster Risk Reduction*. https://doi.org/10.1016/j.ijdrr.2021.102168.

Setsoafia, E., , W., & Renwick, A. (2022). Effects of sustainable agricultural practices on farm income and food security in northern Ghana. *Agricultural and Food Economics*, 10. https://doi.org/10.1186/s40100-022-00216-9.

Taulu, S. (2025). Climate resilience through conservation farming: A review of adaptive practices among smallholder farmers. *International Journal of Science and Research Archive*. https://doi.org/10.30574/ijsra.2025.15.3.1817.

Taulu, S. (2025). Climate resilience through conservation farming: A review of adaptive practices among smallholder farmers. *International Journal of Science and Research Archive*. https://doi.org/10.30574/ijsra.2025.15.3.1817.

Taulu, S. (2025). Climate resilience through conservation farming: A review of adaptive practices among smallholder farmers. *International Journal of Science and Research Archive*. https://doi.org/10.30574/ijsra.2025.15.3.1817.

Teklu, A., Simane, B., & Bezabih, M. (2023). Effect of Climate Smart Agriculture Innovations on Climate Resilience among Smallholder Farmers: Empirical Evidence from the Choke Mountain Watershed of the Blue Nile Highlands of Ethiopia. *Sustainability*. https://doi.org/10.3390/su15054331.

Tembo, A., Muyabe, O., Musenge, D., Mhango, J., & Nkomanga, G. (2025). Impact of Sustainable Agricultural Practices on Farm Productivity, Yield, and Climate Resilience Among Smallholder Farmers in Zambia. *Journal of Agriculture, Aquaculture, and Animal Science*. https://doi.org/10.69739/jaaas.v2i1.212.

Tembo, A., Muyabe, O., Musenge, D., Mhango, J., & Nkomanga, G. (2025). Impact of Sustainable Agricultural Practices on Farm Productivity, Yield, and Climate Resilience Among Smallholder Farmers in Zambia. *Journal of Agriculture, Aquaculture, and Animal Science*. https://doi.org/10.69739/jaaas.v2i1.212.

Thierfelder, C., Chivenge, P., Mupangwa, W., Rosenstock, T., Lamanna, C., & Eyre, J. (2017). How climate-smart is conservation agriculture (CA)? – its potential to deliver on

adaptation, mitigation and productivity on smallholder farms in southern Africa. *Food Security*, 9, 537-560. https://doi.org/10.1007/s12571-017-0665-3.

Wekesa, B., Ayuya, O., & Lagat, J. (2018). Effect of climate-smart agricultural practices on household food security in smallholder production systems: micro-level evidence from Kenya. *Agriculture & Food Security*, 7. https://doi.org/10.1186/s40066-018-0230-0.

Zobeidi, T., Yazdanpanah, M., Komendantova, N., Sieber, S., & Löhr, K. (2021). Factors affecting smallholder farmers' technical and non-technical adaptation responses to drought in Iran. *Journal of environmental management*, 298, 113552. https://doi.org/10.1016/j.jenvman.2021.113552.

CHAPTER VI

FACTORS INFLUENCING FOOD SECURITY FOR SMALLHOLDER FARMERS PRACTICING CONSERVATION AGRICULTURE

Abstract

This chapter identifies and evaluates factors influencing food security among smallholder farmers practicing Conservation Agriculture in Shamva District, with emphasis on both direct and moderated pathways. The chapter uses the established research design and methodology from earlier sections, including consistent descriptions of the study area, sampling procedure, data collection, and data analysis. Challenges encountered in gathering data were addressed through language adaptation and clarification during interviews. Findings reveal that the Pfumvudza/Intwasa programme is perceived as significant for household food security, although its benefits vary across participants. Government involvement through expert guidance from AGRITEX officers was associated with better yields. Irrigation schemes and material support were rated relatively low, implying underutilization or insufficient development to reduce drought risk effectively. External factors such as politics, economics, technology, environment, and law were not strongly perceived as determinants of CA practices improving food security; however, climate change and shifting weather patterns were highlighted as major threats to drought resilience and food security. Moderation analysis (Hayes PROCESS Model 4) indicated that moderation effects were not statistically observed for the examined moderating factor, suggesting that CA effects operate more directly through programme support and CA practices.

6.1 Introduction

The following chapter shows the analysis which has been made for the first objective of the study. The chapter shows the crafting of the research methodology and the effort which have been taken to address

6.2 Materials and methods

6.2.1 Description of study area

The study area was discussed in chapter 3 of the study.

6.2.2 Research design

The research design of the study was explained in the research methodology chapter of the study.

6.2.3 Sampling procedure

The sampling procedure of the study was laid out in the research methodology chapter of the study.

6.2.4 Data collection procedure

The collection of data followed the process which was laid out in the previous chapter of the study.

6.2.5 Data analysis procedure

The data analysis which was done for the chapter followed the descriptions in the previous chapter of the study.

6.2.6 Challenges encountered during data collection

The challenges faced in the collection of data included the d

6.3 Results and discussion

The study came up with the following findings:

6.3.1 Factors influencing conservation agriculture among smallholder farmers

Descriptive Statistics					
	N	Mean	Std. Dev	Skewness	
	Statistic	Statistic	Statistic	Statistic	Std. Error
The Pfumvudza/Inthwasa program is significant in helping us achieve food security in our homes	372	3.3118	2.22690	.475	.126

Government's involvement in providing expert guidance from the AGRITEX officers leads to better yields	372	3.1828	2.07642	.510	.126
Irrigation schemes and other material support from government and other development partners towards C.A leads to improved yield	372	2.9247	2.16434	.777	.126
External factors (politics, economics, technology, environment and law) do not significantly influence which conservation agriculture practices have on improving food security in our community	372	2.9462	2.14999	.672	.126
Changes in weather patterns, climate change and global warming have negatively affected the implementation of conservation agriculture leading to risks on food security	372	5.1290	2.00391	-.922	.126
Valid N (listwise)	372				

Factors that influenced the household food security of CA users included moderation and mediation effects. Farmers also ranked the Pfumvudza/Intwasa programme as important for household food security (mean score was 3.3118 out of 5). The government would have a moderate impact on agricultural practices through government policy papers and information communicated by AGRITEX officers in the programme (Mean = 3.1828). The impact means that CA in the programme was associated with better food security and nutrition; however, this was not the case for every participant.

Similarly, farmers' mean score (Mean = 2.9247) for the role of irrigation schemes and material support from government and development partners in increasing yield was low, suggesting that irrigation schemes and supplementary material support may have been underutilized or not sufficiently developed to effectively lower the risk of drought.

The other factors of politics, economics, technology, environment, and law do not have a big impact on the CA practices that are relevant for food security (Mean = 2.9462). However, the change in the weather, climate change, and global warming affecting the implementation of CA practices and increasing food security risk is the greatest concern (mean = 5.1290 overall). The current study focuses on drought resilience since climate shocks will worsen food insecurity even after CA adoption.

6.3.2 Moderating effect of factors affecting conservation agriculture on the relationship between conservation agriculture strategies and food security

Run MATRIX procedure:

**** PROCESS Procedure for SPSS Version 3.5 ****

****

Model : 4

Y : ACA

X : AFS

M : AFM

Sample

Size: 372

****

OUTCOME VARIABLE:

AFM

Model Summary

R	R-sq	MSE	F	df1	df2	p
.6570	.4316	1.3964	280.9784	1.0000	370.0000	.0000

Model

	coeff	se	t	p	LLCI	ULCI

constant .5773 .1848 3.1245 .0019 .2140 .9406

AFS .8189 .0489 16.7624 .0000 .7228 .9150

****

OUTCOME VARIABLE:

ACA

Model Summary

R R-sq MSE F df1 df2 p

.5480 .3003 .6512 79.1937 2.0000 369.0000 .0000

Model

coeff se t p LLCI ULCI

constant 3.0935 .1278 24.2018 .0000 2.8422 3.3449

AFS .4285 .0443 9.6829 .0000 .3415 .5155

AFM -.0107 .0355 -.3006 .7639 -.0805 .0591

********** DIRECT AND INDIRECT EFFECTS OF X ON Y **********

Direct effect of X on Y

Effect se t p LLCI ULCI

.4285 .0443 9.6829 .0000 .3415 .5155

Indirect effect(s) of X on Y:

Effect BootSE BootLLCI BootULCI

AFM -.0087 .0320 -.0676 .0602

********** ANALYSIS NOTES AND ERRORS **********

Level of confidence for all confidence intervals in output:

95.0000

Number of bootstrap samples for percentile bootstrap confidence intervals:

5000

------ END MATRIX -----

For moderation analysis, (Hayes PROCESS Model 4), the output of the model indicated that when AFS was added to the model predicting ACA and ACA was affected by AFM (moderating factors), moderation effect was not observed. For AFM to ACA, the slope was small, slightly negative, and not important (t = -0.3006, p = 0.7639, 95% CI LL = -0.0805, UL = 0.0591).

In other words, the moderating factor included here plays no role in the relationship between food security and CA implementation outcomes in the sample. Likewise, it implies that CA's ability to impact resilience/food security is probably driven more directly by the CA practices and the programme supports. This is consistent with the lack of important interaction effects for this moderating factor operationalized in this study.

While the direct effects of predictors on outcomes remain meaningful given the meaningful p-values of the regression (.0000), the study results do not provide statistical evidence for the claim that CA and food security are considerably and conditionally affected by the moderating effect of the variable in the present model.

6.3.3 Thematic analysis of interviews on smallholder farmers' adoption of conservation agriculture

The table given below presents the thematic analysis done for the study and the respective results:

Considerations when improving resilience. Considerations for resilience.

Subthemes: Food security, Improvements, External factors influencing results

PRELIMINARY CODE	RESPONSES	EMERGING THEME
Food security	• Our output has improved because of Pfumvudza • We often have enough to last a	• Improved food security and yield • Seasonal climate

	year, except in drought where we supplement • Bad seasons leave us in hunger • There is a significant improvement in our livelihoods regarding food security	dependence
What can be done?	• We need assistance with irrigation, inputs and fertilisers • Technical support should be readily available when we face challenges • Proper records should be kept so that we can use our output from Pfumvudza to secure loans and improve our farming	• Assistance is required • Sources of finance • Technical support
External factors affecting food security	• Laws should allow us to get finance, assistance and even markets if we participate in Pfumvudza • The use of cooperatives should be common to allow power of unity • Technology is important in our production • Skills and knowledge of modern practices and indigenous knowledge systems affects output.	• Legal issues • Financial support • Technology use

Qualitative interviews with farmers confirmed that the increase in food and money production was due to Pfumvudza. Farmers reported that they had only needed to purchase food to fill their needs when the area was affected by drought. That said,

though CA increases resilience, the severity of drought was sufficient to generate hunger and disturb the annual food supply.

Farmers stated what is required for this to happen: to address their challenges, farmers requested irrigation support, inputs and fertilizers, and timely access to technical assistance. Another approach that could be pursued to support resilience is keeping records that CA output could be used as collateral to access loans.

Enablers within the theme of external influences on food security included: legal and institutional (access to finance and markets); the use of cooperatives for collective action and bargaining power; and technology, skills and knowledge (modern and customary). Overall, the theme shows how resilience is multi-dimensional, where farmers practicing CA are dependent on a resilient enabler of finance, policy, training and technology. Without a resilient enabler, food production systems are unlikely to be continued during shocks.

References

Amede, T., Konde, A., Muhinda, J., & Bigirwa, G. (2023). Sustainable Farming in Practice: Building Resilient and Profitable Smallholder Agricultural Systems in Sub-Saharan Africa. *Sustainability*. https://doi.org/10.3390/su15075731.

Amede, T., Konde, A., Muhinda, J., & Bigirwa, G. (2023). Sustainable Farming in Practice: Building Resilient and Profitable Smallholder Agricultural Systems in Sub-Saharan Africa. *Sustainability*. https://doi.org/10.3390/su15075731.

Antwi-Agyei, P., Abalo, E., Dougill, A., & Baffour-Ata, F. (2021). Motivations, enablers and barriers to the adoption of climate-smart agricultural practices by smallholder farmers: Evidence from the transitional and savannah agroecological zones of Ghana. *Regional Sustainability*. https://doi.org/10.1016/j.regsus.2022.01.005.

Bahta, Y. (2020). Smallholder livestock farmers coping and adaptation strategies to agricultural drought. *AIMS Agriculture and Food*. https://doi.org/10.3934/agrfood.2020.4.964.

Bahta, Y. (2022). Nexus between Coping Strategies and Households' Agricultural Drought Resilience to Food Insecurity in South Africa. *Land*. https://doi.org/10.3390/land11060893.

Chisadza, B., Gwate, O., Musinguzi, S., Mpofu, N., Macherera, M., & Dube, T. (2025). Resilient agriculture in semi-arid Zimbabwe: adaptation strategies and influencers among smallholder farmers. *Discover Agriculture*, 3. https://doi.org/10.1007/s44279-025-00234-3.

Enyew, S., & Gobie, W. (2025). Adoption of climate smart agricultural practices impact on food security of smallholder farmers in North Western Ethiopia. *Discover Sustainability*, 6. https://doi.org/10.1007/s43621-025-01793-7.

Fanadzo, M., Ncube, B., French, A., & Belete, A. (2021). Smallholder farmer coping and adaptation strategies during the 2015-18 drought in the Western Cape, South Africa. *Physics and Chemistry of The Earth*, 102986. https://doi.org/10.1016/j.pce.2021.102986.

Feng, Q., Si, Z., & Scott, S. (2025). Adapting to climate change on the farm: Experiences of small-scale ecological farmers in two regions of China. *Journal of Agriculture, Food Systems, and Community Development*. https://doi.org/10.5304/jafscd.2025.144.011.

Gebrehiwot, T., & Van Der Veen, A. (2015). Farmers Prone to Drought Risk: Why Some Farmers Undertake Farm-Level Risk-Reduction Measures While Others Not?. *Environmental Management*, 55, 588-602. https://doi.org/10.1007/s00267-014-0415-7.

Hawkins, P., Geza, W., Mabhaudhi, T., Sutherland, C., Queenan, K., Dangour, A., & Scheelbeek, P. (2022). Dietary and agricultural adaptations to drought among smallholder farmers in South Africa: A qualitative study. *Weather and Climate Extremes*, 35. https://doi.org/10.1016/j.wace.2022.100413.

Jew, E., Whitfield, S., Dougill, A., Mkwambisi, D., & Steward, P. (2020). Farming systems and Conservation Agriculture: Technology, structures and agency in Malawi. *Land Use Policy*. https://doi.org/10.1016/j.landusepol.2020.104612.

Jumbe, C., & Nyambose, W. (2016). Does Conservation Agriculture Enhance Household Food Security? Evidence from Smallholder Farmers in Nkhotakota in Malawi. *Sustainable Agriculture Research*, 5, 118. https://doi.org/10.5539/sar.v5n1p118.

Kapari, M., Hlophe-Ginindza, S., Nhamo, L., & Mpandeli, S. (2023). Contribution of smallholder farmers to food security and opportunities for resilient farming systems. *Frontiers in Sustainable Food Systems*. https://doi.org/10.3389/fsufs.2023.1149854.

Katunzi, A., Mlengera, N., Mng'ong'o, M., Mwamlima, B., Mvile, B., Mtama, J., & Lukasumbusa, R. (2025). Enhancing climate resilience of smallholder farmers through conservation agriculture in the southern highlands of Tanzania. *Frontiers in Sustainable Food Systems*. https://doi.org/10.3389/fsufs.2025.1706205.

Katunzi, A., Mlengera, N., Mng'ong'o, M., Mwamlima, B., Mvile, B., Mtama, J., & Lukasumbusa, R. (2025). Enhancing climate resilience of smallholder farmers through conservation agriculture in the southern highlands of Tanzania. *Frontiers in Sustainable Food Systems*. https://doi.org/10.3389/fsufs.2025.1706205.

Kayusi, F., Ngala, D., & Chavula, P. (2025). Assessing the Unfulfilled Promises of Agroforestry and Conservation Agriculture as Climate-Smart Solutions for Food Security in Kenya, Tanzania, Uganda, and Zimbabwe. *East African Journal of Agriculture and Biotechnology*. https://doi.org/10.37284/eajab.8.1.2975.

Keshavarz, M., & Karami, E. (2016). Farmers' pro-environmental behavior under drought: Application of protection motivation theory. *Journal of Arid Environments*, 127, 128-136. https://doi.org/10.1016/j.jaridenv.2015.11.010.

Kone, S., & Uzmay, A. (2024). Impact assessment of sustainable agricultural practices on smallholder households food security: evidence from Burkina Faso. *Climate and Development*, 17, 255 - 269. https://doi.org/10.1080/17565529.2024.2357183.

Lee, M., & Gambiza, J. (2022). The adoption of conservation agriculture by smallholder farmers in southern Africa: A scoping review of barriers and enablers. *Journal of Rural Studies*. https://doi.org/10.1016/j.jrurstud.2022.03.031.

Legesse, T., Ganewo, Z., Alemu, A., Ashebir, A., Samuel, A., & Abayneh, Y. (2024). Does Adoption of Multiple Climate-Smart Agriculture Practices Improve Rural Farm Households' Food Security in Ethiopia?. *Food and Energy Security*. https://doi.org/10.1002/fes3.70021.

Makate, C., Makate, M., Mango, N., & Siziba, S. (2019). Increasing resilience of smallholder farmers to climate change through multiple adoption of proven climate-smart agriculture innovations. Lessons from Southern Africa. *Journal of environmental management*, 231, 858-868. https://doi.org/10.1016/j.jenvman.2018.10.069.

Malherbe, W., Biggs, R., & Sitas, N. (2024). Comparing apples and pears: Linking capitals and capacities to assess the resilience of commercial farming operations. *Agricultural Systems*. https://doi.org/10.1016/j.agsy.2024.103934.

Mango, N., Siziba, S., & Makate, C. (2017). The impact of adoption of conservation agriculture on smallholder farmers' food security in semi-arid zones of southern Africa. *Agriculture & Food Security*, 6, 1-8. https://doi.org/10.1186/s40066-017-0109-5.

Manyakaidze, P., Musavengane, R., & Maponga, R. (2025). Rural Farmer-Managed Wetland Agroecosystems Promote Climate Resilience in Semi-Arid Savannah: Case of Nyororo Wetland, Mberengwa District, Zimbabwe. *Climate Resilience and Sustainability*. https://doi.org/10.1002/cli2.70011.

Mathe, P. (2023). An Assessment of the Sustainability of Conservation Farming in Promoting Food Security Among Smallholder Farmers in Change Ward. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4585280.

Mathe, P. (2023). An Assessment of the Sustainability of Conservation Farming in Promoting Food Security Among Smallholder Farmers in Change Ward. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4585280.

Mdoda, L., Naidoo, D., Ncoyini-Manciya, Z., Nontu, Y., Govender, L., Tamako, N., & Mdiya, L. (2024). Adaptation Measures to Drought Risk Perceived by Smallholder Crop Farmers in the Eastern Cape Province, South Africa: Implications for Food and Nutrition Security. *Sustainability*. https://doi.org/10.3390/su162411154.

Moridi, M., Rahimian, M., Movahed, R., Molavi, H., Gholamrezai, S., & Payamani, K. (2025). Policy Insights for Drought Adaptation: Farmers' Behavior and Sustainable Agricultural Development. *Environmental and Sustainability Indicators*. https://doi.org/10.1016/j.indic.2025.100603.

Mutengwa, C., Mnkeni, P., & Kondwakwenda, A. (2023). Climate-Smart Agriculture and Food Security in Southern Africa: A Review of the Vulnerability of Smallholder Agriculture and Food Security to Climate Change. *Sustainability*. https://doi.org/10.3390/su15042882.

Muthelo, D., Owusu-Sekyere, E., & Ogundeji, A. (2019). Smallholder Farmers' Adaptation to Drought: Identifying Effective Adaptive Strategies and Measures. *Water*. https://doi.org/10.3390/w11102069.

Nyanga, P. (2012). Food security, conservation agriculture and pulses: evidence from smallholder farmers in Zambia.. *Journal of Field Robotics*, 1, 120-138. https://doi.org/10.5539/jfr.v1n2p120.

Nzeyimana, L., Danielsson, Å., Andersson, L., & Gyberg, V. (2021). Success and failure factors for increasing Sub-Saharan African smallholders' resilience to drought through water management. *International Journal of Water Resources Development*, 39, 273 - 293. https://doi.org/10.1080/07900627.2021.1991285.

Opoku-Acheampong, K., Tham-Agyekum, E., Ankuyi, F., Okorley, E., Bakang, J., & Nimoh, F. (2024). Effect of adoption of conservation agriculture on household food security of smallholder maize farmers in Ghana. *Environmental and Sustainability Indicators*. https://doi.org/10.1016/j.indic.2024.100436.

Quandt, A. (2021). Coping with drought: Narratives from smallholder farmers in semi-arid Kenya. *International Journal of Disaster Risk Reduction*. https://doi.org/10.1016/j.ijdrr.2021.102168.

Setsoafia, E., , W., & Renwick, A. (2022). Effects of sustainable agricultural practices on farm income and food security in northern Ghana. *Agricultural and Food Economics*, 10. https://doi.org/10.1186/s40100-022-00216-9.

Taulu, S. (2025). Climate resilience through conservation farming: A review of adaptive practices among smallholder farmers. *International Journal of Science and Research Archive*. https://doi.org/10.30574/ijsra.2025.15.3.1817.

Taulu, S. (2025). Climate resilience through conservation farming: A review of adaptive practices among smallholder farmers. *International Journal of Science and Research Archive*. https://doi.org/10.30574/ijsra.2025.15.3.1817.

Taulu, S. (2025). Climate resilience through conservation farming: A review of adaptive practices among smallholder farmers. *International Journal of Science and Research Archive*. https://doi.org/10.30574/ijsra.2025.15.3.1817.

Teklu, A., Simane, B., & Bezabih, M. (2023). Effect of Climate Smart Agriculture Innovations on Climate Resilience among Smallholder Farmers: Empirical Evidence from the Choke Mountain Watershed of the Blue Nile Highlands of Ethiopia. *Sustainability*. https://doi.org/10.3390/su15054331.

Tembo, A., Muyabe, O., Musenge, D., Mhango, J., & Nkomanga, G. (2025). Impact of Sustainable Agricultural Practices on Farm Productivity, Yield, and Climate Resilience Among Smallholder Farmers in Zambia. *Journal of Agriculture, Aquaculture, and Animal Science*. https://doi.org/10.69739/jaaas.v2i1.212.

Tembo, A., Muyabe, O., Musenge, D., Mhango, J., & Nkomanga, G. (2025). Impact of Sustainable Agricultural Practices on Farm Productivity, Yield, and Climate Resilience Among Smallholder Farmers in Zambia. *Journal of Agriculture, Aquaculture, and Animal Science*. https://doi.org/10.69739/jaaas.v2i1.212.

Thierfelder, C., Chivenge, P., Mupangwa, W., Rosenstock, T., Lamanna, C., & Eyre, J. (2017). How climate-smart is conservation agriculture (CA)? – its potential to deliver on

adaptation, mitigation and productivity on smallholder farms in southern Africa. *Food Security*, 9, 537-560. https://doi.org/10.1007/s12571-017-0665-3.

Wekesa, B., Ayuya, O., & Lagat, J. (2018). Effect of climate-smart agricultural practices on household food security in smallholder production systems: micro-level evidence from Kenya. *Agriculture & Food Security*, 7. https://doi.org/10.1186/s40066-018-0230-0.

Zobeidi, T., Yazdanpanah, M., Komendantova, N., Sieber, S., & Löhr, K. (2021). Factors affecting smallholder farmers' technical and non-technical adaptation responses to drought in Iran. *Journal of environmental management*, 298, 113552. https://doi.org/10.1016/j.jenvman.2021.113552.

CHAPTER VII

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Chapter VII Abstract

This chapter synthesizes the study's overall outcomes by presenting summary of findings, conclusions, and recommendations derived from Chapters IV, V, and VI. Chapter VII begins by summarizing conservation agriculture practices in Shamva District, showing that adoption is strongly mediated by programme support, timely input availability, extension services, and favorable climate perceptions, while being constrained by delayed inputs, limited capital investment, manual dependence, land degradation, and rainfall variability. The chapter further summarizes how CA influences food security and drought resilience: quantitative evidence indicates meaningful predictive relationships between CA-related factors and food security/resilience perceptions, while qualitative evidence confirms that CA can buffer hunger in favorable seasons but does not fully prevent food insecurity during severe drought. The chapter also summarizes coping challenges, including storage limitations, pests, preservation costs, and reduced access to markets due to lack of cash. Conclusions and recommendations emphasize improving input timeliness, strengthening extension and locally responsive programme design, expanding drought-risk reduction through irrigation and water buffering, enhancing post-harvest and storage support, and strengthening finance and cooperative mechanisms to improve long-term resilience.

7.1 Introduction

This chapter presents the summary of the study's findings, conclusions, and recommendations drawn from Chapters IV, V, and VI. Chapter IV focused on the adoption of Conservation Agriculture (CA) among smallholder farmers in Shamva District, specifically under the Pfumvudza/Intwasa programme. It examined the research methodology, data collection processes, and the descriptive results on farmers' perceptions and experiences with CA implementation, including supports, constraints, and the influence of land conditions. The chapter also used thematic insights to explain how resource limitations and seasonal rainfall realities shape adoption and outcomes.

Chapter V examined coping strategies used by households facing drought and food shortages, and how these strategies relate to food security and resilience. Quantitative results (regression and ANOVA) showed that CA-linked conditions related to food availability and stability were statistically meaningful predictors of food security/resilience perceptions, while qualitative findings highlighted recurring challenges such as storage limitations, pests, and constrained coping options due to lack of cash during shocks.

Chapter VI investigated factors influencing food security for smallholder CA farmers, including moderating pathways. It also assessed how programme supports and climate risks affect food security outcomes. Overall, this chapter synthesizes these results to provide practical recommendations for improving CA effectiveness and strengthening drought resilience in Shamva District.

7.2 Summary of findings

7.2.1 Conservation agriculture practices

The study found that CA adoption among smallholder farmers in Shamva District is supported by specific programme and environmental conditions, but it is constrained by delayed inputs, limited investment capacity, and land degradation. Quantitative descriptive results indicated that farmers most strongly valued post-harvest practices and believed these help protect household food availability in both short and long-term periods (highest mean score). Farmers also agreed that climate, rainfall patterns, and general weather in their community remain favourable for CA practice, and that expert guidance through government support is important for improved CA yields. However, perceptions of timely delivery of government inputs were relatively lower, suggesting delays or unreliable supply affecting farmers' ability to prepare in advance. Thematic interviews further showed that CA is often practised in a manual and input-dependent manner. Farmers commonly applied CA methods only after inputs became available, meaning planning and capital investment were limited. Land size and land quality were frequently described as major constraints: communal lands were often small and degraded, limiting the extent to which CA can recover productivity over time.

7.2.2 Impact of conservation agriculture on food security and drought resilience

Findings indicated that CA under the Pfumvudza/Intwasa programme contributes to improved household food security and drought resilience, though it does not fully eliminate vulnerability during severe drought. Quantitative regression and ANOVA results showed that CA-linked predictors accounted for a large proportion of the variance in food security/resilience perceptions, with strong statistical significance. Government-related components, particularly the timely provision of CA inputs and expert support, were positively associated with food security outcomes. Climatic favourability also showed a positive relationship, highlighting that CA performance depends on the seasonal environment.

Post-harvest retention practices were statistically important but showed a negative coefficient in the regression model. This was interpreted as reflecting the reality that households most affected by drought may experience storage constraints and shock-related disruptions that outweigh potential benefits of preservation. Qualitative evidence confirmed that CA yields often support household consumption and, in favourable years, may generate surplus grain for sale. Yet, droughts and extreme weather shocks reduce performance and still lead to hunger and insecurity. Farmers therefore viewed CA as buffering food availability during good seasons, but not sufficient when rains fail.

7.2.3 Challenges and Recommendations for enhanced food security and drought resilience

Major challenges affecting adoption and resilience included delays in input supply, weak preparedness linked to seasonal uncertainty, limited irrigation and buffering systems, pests and storage constraints, and restricted coping options due to lack of cash and limited income diversification. In Chapter V, storage space was often inadequate and grain preservation was vulnerable to weather exposure. Pest control costs were high, and counterfeit inputs were also reported as a concern, reducing effectiveness. Farmers also described that government and NGO assistance was valuable but sometimes not sufficiently tailored, timely, or broadly accessible. Recommendations emerging from the study include improving timely supply chains for CA inputs, strengthening extension support and ensuring it is responsive to local needs and timing requirements. There is also a need to expand drought-risk reduction measures such as irrigation support and other forms of water buffering. Finally, policies should support farmers to access finance and markets, potentially through cooperative approaches and systems that help farmers use CA outputs as credible collateral for loans. Strengthening record-keeping and farmer training were also identified as practical pathways to improve continuity of CA benefits and resilience during shocks.

7.3 Conclusions

7.3.1 Conservation agriculture practices

The study concludes that Conservation Agriculture adoption in Shamva District is not purely knowledge-driven; it is strongly shaped by household resources, timing of input availability, and realities of farm conditions. Farmers' perceptions showed that they associate CA success with supportive programme factors (especially post-harvest handling, expert extension, and favourable climate conditions). At the same time, the adoption process is constrained by delayed or unreliable input supply, which reduces farmers' ability to plan and invest effectively. Thematic findings confirm that CA practices are largely manual and become more feasible when inputs are received. Limited access to capital and weak buffering systems against rainfall variability mean farmers remain vulnerable to drought even when CA is adopted. Land degradation and small farm sizes further restrict the long-term productivity gains that CA can generate, slowing recovery of soil health and limiting yield improvements. Overall, the study concludes that CA adoption exists as a coping-oriented practice within constrained farming systems rather than as a fully autonomous production transformation for all households.

7.3.2 Impact of conservation agriculture on food security and drought resilience

The study concludes that CA improves food security and resilience primarily when programme supports function effectively and when climatic conditions allow CA performance. Quantitative results demonstrated that timely inputs and government expert guidance have statistically meaningful positive associations with food security/resilience perceptions. This indicates that CA's benefits depend on reliable delivery systems and agricultural advisory services that help farmers optimize yields and management decisions. However, the study also concludes that CA does not fully prevent food insecurity under severe drought. When rains fail or are highly variable, farmers experience reduced output and increased vulnerability. Qualitative evidence showed that households may still go hungry in bad seasons and may need to supplement food from markets, which can be difficult without cash. Post-harvest practices were not sufficient to guarantee food security when storage capacity, pests, and shock severity undermine preservation. Therefore, CA should be treated as a risk-reduction strategy rather than a complete solution to drought-related hunger.

7.3.3 Challenges and Recommendations for enhanced food security and drought resilience

The study concludes that resilience is constrained by both production shocks (reduced yields due to drought and extreme weather) and systemic limitations (storage and pest management, preservation costs, limited irrigation, and restricted income alternatives during crises). Farmers reported that coping options become narrow during drought because cash shortages limit market purchases and alternative livelihoods may not be accessible when conditions worsen. Storage limitations, pest challenges, and the affordability and quality of preservation inputs further reduce the ability of households to extend food availability after harvest.

The study also concludes that assistance from government and NGOs, while generally appreciated, may not always be timely, flexible, or sufficiently aligned with local needs. Therefore, enhanced food security and drought resilience require integrated support: improving input timeliness, strengthening adaptive extension, expanding irrigation/water buffering options, improving pest and storage support systems, and strengthening access to finance and markets through cooperative and policy interventions.

7.4 Recommendations

7.4.1 Conservation agriculture practices

First, the study recommends improving the timeliness and reliability of government CA input deliveries in Shamva District. Since delays were reflected in lower mean perceptions of input availability, strengthening supply chains, distribution planning, and forecasting mechanisms should reduce missed planting windows and support better preparedness. Second, government and extension providers (such as AGRITEX officers) should intensify practical farmer support, with training delivered at the right time in the farming calendar. Expert guidance was strongly associated with better outcomes, so extension should focus on implementation quality, maintenance of CA principles, and farmer decision-making under local conditions.

Third, recommendations include scaling interventions that address land degradation and fertility constraints, such as targeted soil support and improved management packages suitable for degraded and small landholdings. CA benefits are limited where land is too degraded to respond adequately; thus, supporting soil recovery must be part of CA programming. Finally, programme design should consider that adoption is strongly mediated by resource availability. Therefore, complementary initiatives—such as labour-saving practices, community-based support, and access to affordable technologies—should be promoted to help households apply CA consistently.

7.4.2 Impact of conservation agriculture on food security and drought resilience

The study recommends that CA programming should be strengthened as an integrated resilience strategy rather than focusing only on field-level practice. Farmers indicated that drought severity still overrides the buffering benefits of CA. Therefore, expanding irrigation schemes, water harvesting, and other buffering systems is critical to reduce dependence on rainfall variability. Where full irrigation is not immediately feasible, investments in partial water solutions can still stabilize production and reduce year-to-year hunger risks.

Second, the study recommends strengthening post-harvest support. Although farmers believed in preservation value, regression findings suggest storage realities can negate benefits during shocks. Extension and development partners should support improved storage infrastructure, affordable pest control options, and training on effective preservation methods. Counterfeit inputs should be addressed through stronger quality assurance and market regulation for chemicals and related inputs. Third, farmers should be supported to maintain food reserves through practical interventions that reduce losses from pests and spoilage, improving the effectiveness of CA in bad seasons.

7.4.3 Challenges and Recommendations for enhanced food security and drought resilience

To address challenges identified in the study, the following recommendations are made. Government and partner organizations should tailor support packages to local conditions and ensure wider coverage. Farmers indicated that some assistance is pre-designed and may not align fully with local needs. Programmes should incorporate community feedback mechanisms so that timing, training topics, and input types reflect actual farmer constraints, including drought realities, storage limitations, and labour capacity. Second, the study recommends improving access to finance and markets for smallholder farmers adopting CA. Farmers suggested that legal/institutional support and cooperative action can strengthen the ability to obtain finance and sell produce. Therefore, policy reforms should reduce barriers to credit access, and financial institutions should be supported to develop products aligned with CA output cycles. Third, training on record-keeping should be expanded so farmers can document CA performance and use credible information to support loan applications and program eligibility. Finally, drought response planning should include support for coping strategies—such as targeted food access or input support during shocks—so that households are not left with limited options when cash and storage systems fail.

This chapter presents the summary of the study's findings, conclusions, and recommendations drawn from Chapters IV, V, and VI. Chapter IV focused on the adoption of Conservation Agriculture (CA) among smallholder farmers in Shamva District, specifically under the Pfumvudza/Intwasa programme. It examined the research methodology, data collection processes, and the descriptive results on farmers' perceptions and experiences with CA implementation, including supports, constraints, and the influence of land conditions. The chapter also used thematic insights to explain how resource limitations and seasonal rainfall realities shape adoption and outcomes.

Chapter V examined coping strategies used by households facing drought and food shortages, and how these strategies relate to food security and resilience. Quantitative results (regression and ANOVA) showed that CA-linked conditions related to food availability and stability were statistically meaningful predictors of food security/resilience perceptions, while qualitative findings highlighted recurring challenges such as storage limitations, pests, and constrained coping options due to lack of cash during shocks.

Chapter VI investigated factors influencing food security for smallholder CA farmers, including moderating pathways. It also assessed how programme supports and climate risks affect food security outcomes. Overall, this chapter synthesizes these results to provide practical recommendations for improving CA effectiveness and strengthening drought resilience in Shamva District.

7.2 Summary of findings

7.2.1 Conservation agriculture practices

The study found that CA adoption among smallholder farmers in Shamva District is supported by specific programme and environmental conditions, but it is constrained by delayed inputs, limited investment capacity, and land degradation. Quantitative descriptive results indicated that farmers most strongly valued post-harvest practices and believed these help protect household food availability in both short and long-term periods (highest mean score). Farmers also agreed that climate, rainfall patterns, and general weather in their community remain favourable for CA practice, and that expert guidance through government support is important for improved CA yields. However, perceptions of timely delivery of government inputs were relatively lower, suggesting delays or unreliable supply affecting farmers' ability to prepare in advance. Thematic interviews further showed that CA is often practised in a manual and input-dependent manner. Farmers commonly applied CA methods only after inputs became available, meaning planning and capital investment were limited. Land size and land quality were frequently described as major constraints: communal lands were often small and degraded, limiting the extent to which CA can recover productivity over time.

7.2.2 Impact of conservation agriculture on food security and drought resilience

Findings indicated that CA under the Pfumvudza/Intwasa programme contributes to improved household food security and drought resilience, though it does not fully eliminate vulnerability during severe drought. Quantitative regression and ANOVA results showed that CA-linked predictors accounted for a large proportion of the variance in food security/resilience perceptions, with strong statistical significance. Government-related components, particularly the timely provision of CA inputs and expert support, were positively associated with food security outcomes. Climatic favourability also showed a positive relationship, highlighting that CA performance depends on the seasonal environment.

Post-harvest retention practices were statistically important but showed a negative coefficient in the regression model. This was interpreted as reflecting the reality that households most affected by drought may experience storage constraints and shock-related disruptions that outweigh potential benefits of preservation. Qualitative evidence confirmed that CA yields often support household consumption and, in favourable years, may generate surplus grain for sale. Yet, droughts and extreme weather shocks reduce performance and still lead to hunger and insecurity. Farmers therefore viewed CA as buffering food availability during good seasons, but not sufficient when rains fail.

7.2.3 Challenges and Recommendations for enhanced food security and drought resilience

Major challenges affecting adoption and resilience included delays in input supply, weak preparedness linked to seasonal uncertainty, limited irrigation and buffering systems, pests and storage constraints, and restricted coping options due to lack of cash and limited income diversification. In Chapter V, storage space was often inadequate and grain preservation was vulnerable to weather exposure. Pest control costs were high, and counterfeit inputs were also reported as a concern, reducing effectiveness. Farmers also described that government and NGO assistance was valuable but sometimes not sufficiently tailored, timely, or broadly accessible. Recommendations emerging from the study include improving timely supply chains for CA inputs, strengthening extension support and ensuring it is responsive to local needs and timing requirements. There is also a need to expand drought-risk reduction measures such as irrigation support and other forms of water buffering. Finally, policies should support farmers to access finance and markets, potentially through cooperative approaches and systems that help farmers use CA outputs as credible collateral for loans. Strengthening record-keeping and farmer training were also identified as practical pathways to improve continuity of CA benefits and resilience during shocks.

7.3 Conclusions

7.3.1 Conservation agriculture practices

The study concludes that Conservation Agriculture adoption in Shamva District is not purely knowledge-driven; it is strongly shaped by household resources, timing of input availability, and realities of farm conditions. Farmers' perceptions showed that they associate CA success with supportive programme factors (especially post-harvest handling, expert extension, and favourable climate conditions). At the same time, the adoption process is constrained by delayed or unreliable input supply, which reduces farmers' ability to plan and invest effectively. Thematic findings confirm that CA practices are largely manual and become more feasible when inputs are received. Limited access to capital and weak buffering systems against rainfall variability mean farmers remain vulnerable to drought even when CA is adopted. Land degradation and small farm sizes further restrict the long-term productivity gains that CA can generate, slowing recovery of soil health and limiting yield improvements. Overall, the study concludes that CA adoption exists as a coping-oriented practice within constrained farming systems rather than as a fully autonomous production transformation for all households.

7.3.2 Impact of conservation agriculture on food security and drought resilience

The study concludes that CA improves food security and resilience primarily when programme supports function effectively and when climatic conditions allow CA performance. Quantitative results demonstrated that timely inputs and government expert guidance have statistically meaningful positive associations with food security/resilience perceptions. This indicates that CA's benefits depend on reliable delivery systems and agricultural advisory services that help farmers optimize yields and management decisions. However, the study also concludes that CA does not fully prevent food insecurity under severe drought. When rains fail or are highly variable, farmers experience reduced output and increased vulnerability. Qualitative evidence showed that households may still go hungry in bad seasons and may need to supplement food from markets, which can be difficult without cash. Post-harvest practices were not sufficient to guarantee food security when storage capacity, pests, and shock severity undermine preservation. Therefore, CA should be treated as a risk-reduction strategy rather than a complete solution to drought-related hunger.

7.3.3 Challenges and Recommendations for enhanced food security and drought resilience

The study concludes that resilience is constrained by both production shocks (reduced yields due to drought and extreme weather) and systemic limitations (storage and pest management, preservation costs, limited irrigation, and restricted income alternatives during crises). Farmers reported that coping options become narrow during drought because cash shortages limit market purchases and alternative livelihoods may not be accessible when conditions worsen. Storage limitations, pest challenges, and the affordability and quality of preservation inputs further reduce the ability of households to extend food availability after harvest.

The study also concludes that assistance from government and NGOs, while generally appreciated, may not always be timely, flexible, or sufficiently aligned with local needs. Therefore, enhanced food security and drought resilience require integrated support: improving input timeliness, strengthening adaptive extension, expanding irrigation/water buffering options, improving pest and storage support systems, and strengthening access to finance and markets through cooperative and policy interventions.

7.4 Recommendations

7.4.1 Conservation agriculture practices

First, the study recommends improving the timeliness and reliability of government CA input deliveries in Shamva District. Since delays were reflected in lower mean perceptions of input availability, strengthening supply chains, distribution planning, and forecasting mechanisms should reduce missed planting windows and support better preparedness. Second, government and extension providers (such as AGRITEX officers) should intensify practical farmer support, with training delivered at the right time in the farming calendar. Expert guidance was strongly associated with better outcomes, so extension should focus on implementation quality, maintenance of CA principles, and farmer decision-making under local conditions.

Third, recommendations include scaling interventions that address land degradation and fertility constraints, such as targeted soil support and improved management packages suitable for degraded and small landholdings. CA benefits are limited where land is too degraded to respond adequately; thus, supporting soil recovery must be part of CA programming. Finally, programme design should consider that adoption is strongly mediated by resource availability. Therefore, complementary initiatives—such as labour-saving practices, community-based support, and access to affordable technologies—should be promoted to help households apply CA consistently.

7.4.2 Impact of conservation agriculture on food security and drought resilience

The study recommends that CA programming should be strengthened as an integrated resilience strategy rather than focusing only on field-level practice. Farmers indicated that drought severity still overrides the buffering benefits of CA. Therefore, expanding irrigation schemes, water harvesting, and other buffering systems is critical to reduce dependence on rainfall variability. Where full irrigation is not immediately feasible, investments in partial water solutions can still stabilize production and reduce year-to-year hunger risks.

Second, the study recommends strengthening post-harvest support. Although farmers believed in preservation value, regression findings suggest storage realities can negate benefits during shocks. Extension and development partners should support improved storage infrastructure, affordable pest control options, and training on effective preservation methods. Counterfeit inputs should be addressed through stronger quality assurance and market regulation for chemicals and related inputs. Third, farmers should be supported to maintain food reserves through practical interventions that reduce losses from pests and spoilage, improving the effectiveness of CA in bad seasons.

7.4.3 Challenges and Recommendations for enhanced food security and drought resilience

To address challenges identified in the study, the following recommendations are made. Government and partner organizations should tailor support packages to local conditions and ensure wider coverage. Farmers indicated that some assistance is pre-designed and may not align fully with local needs. Programmes should incorporate community feedback mechanisms so that timing, training topics, and input types reflect actual farmer constraints, including drought realities, storage limitations, and labour capacity. Second, the study recommends improving access to finance and markets for smallholder farmers adopting CA. Farmers suggested that legal/institutional support and cooperative action can strengthen the ability to obtain finance and sell produce. Therefore, policy reforms should reduce barriers to credit access, and financial institutions should be supported to develop products aligned with CA output cycles. Third, training on record-keeping should be expanded so farmers can document CA performance and use credible information to support loan applications and program eligibility. Finally, drought response planning should include support for coping strategies—such as targeted food access or input support during shocks—so that households are not left with limited options when cash and storage systems fail.

Research instruments

Questionnaire

Introduction

Dear Respondent

My name is Faustina, I am a post-graduate student with Bindura University of Science Education pursuing a Master of Science degree in Food security and sustainable agriculture policy. In partial fulfilment of the requirements of my program, I am required to complete a dissertation which you have been selected to take part in. this study seeks to establish the

effectiveness of conservation agriculture on drought resilience focusing on Shamva District. You are being asked to consent to the study before continuation (please tick the consent box below to show consent)

Consent: ☐

You are not forced to participate in this study, therefore you can choose to stop participating at any time you feel like. There are no financial rewards for participating in this study as this study is for academic purposes only. Please do not indicate your identification on the questionnaire, your anonymity is key in this study. For questions that are in a Likert scale manner, please be guided by the following key:

SD – Strongly disagree; D – Disagree; N – Neutral; A – Agree; SA – Strongly agree

Section A: Demographic data

Gender of conservation agriculture participant

Male		Female	

Age range of conservation agriculture participant

18-25 years		26-35 years		36-45 years		46-55 years		Above 55 years	

Family size of the conservation agriculture participant

Below 5		5-10		11-15		Above 15	

Education level of the conservation agriculture participant

Ordinary level	
Advanced level	
Diploma/course	

Degree	
Post graduate/ professional qualification	

Land size of the conservation agriculture participant

Below 1 hectare	
1 to 2 hectares	
2 to 5 hectares	
6-10 hectares	
Above 10 hectares	

Average yield from conservation agriculture

Below 1 tonne		1 to 3 tonnes		4 to 6 tonnes		7 to 10 tonnes		Above 10 tonnes	

Do you participate in the Pfumvudza/Inthwasa program?

Yes		No	

If yes, how long have you participated in the program?

Below 3 times		3-5 times		Above 5 times	

Section B: Conservation agriculture among smallholder farmers in Shamva District

Question/phrase	**SD**	**D**	**N**	**A**	**SA**
The government C.A inputs often come on time					
The climate conditions, rain patterns and weather in our					

community remains favourable to flourish in conservation agriculture practices					
Other business engagements such as mining, dealing in retail business, restaurants and bars have overtaken conservation agriculture in our community					
There is adequate support from government in the form of expert assistance to ensure that conservation agriculture production brings the maximum yield.					
The post-harvest practices for C.A yield can be kept for sustainably long enough to safeguard against food shortages both in the short and long run.					

Section C: Coping strategies for smallholder farmers in the face of drought and food shortages

Question/phrase	**SD**	**D**	**N**	**A**	**SA**
We keep reserves of agriculture products (maize, small-grains, etc) to use in the face of drought and food shortage.					
We have financial reserves to use in the face of drought.					
Preparedness for drought is hard because of the influences from external factors such as economic conditions, technological incapacity or health hazard implications					
There is adequate support from government and non-government partners which makes it easier for us to cope with drought					
In the face of drought and food shortage, there are alternative activities which we do to sustain our livelihood like mining, retail or other non-farming activities.					

Section D: Factors moderating the effect of conservation agriculture programs on household food security

Question/phrase	SD	D	N	A	SA
The Pfumvudza/Inthwasa program is significant in helping us achieve food security in our homes					
Government's involvement in providing expert guidance from the AGRITEX officers leads to better yields					
Irrigation schemes and other material support from government and other development partners towards C.A leads to improved yield					
External factors (politics, economics, technology, environment and law) do not significantly influence which conservation agriculture practices have on improving food security in our community					
Changes in weather patterns, climate change and global warming have negatively affected the implementation of conservation agriculture leading to risks on food security					

Section E: Smallholder resilience building strategies

Question/phrase	SD	D	N	A	SA
Including financial knowledge in our business and communal practices might lead to significant improvement in our resilience					
Training and education on better harvest and post-harvest practices can improve our resilience to drought and food shortages					
The use of technology in farming leads to improved capacity to become resilient to food shortages.					
Food shortages remain a threat despite efforts made to safeguard against it					
Poverty is a key driver in the food shortage and lack of resilience in our community.					

Section F: Resilience

Question/phrase	SD	D	N	A	SA
Has your family had enough food supplies to last the whole season and the foreseeable future					
When faced with a shock such as a drought, crop disease, or price changes, how confident are you that your household can maintain access to food for at least 3 months.					
How many different food sources or income activities does your household rely on to ensure food security					
To what extent do you have access to resources that help maintain food production during difficult seasons such as seeds, water, tools, credit or extension services.					
After a poor harvest or food shortage, hw long does it usually take your household to recover and return to normal food consumption levels					

Interview guide

Introduction

Dear Respondent

My name is Faustina, I am a post-graduate student with Bindura University of Science Education pursuing a Master of Science degree in Food security and sustainable agriculture policy. In partial fulfilment of the requirements of my program, I am required to complete a dissertation which you have been selected to take part in. this study seeks to establish the effectiveness of conservation agriculture on drought resilience focusing on Shamva District. You are being asked to consent to the study before continuation (please tick the consent box below to show consent)

Consent: ☐

You are not forced to participate in this study, therefore you can choose to stop participating at any time you feel like. There are no financial rewards for participating in this study as this study is for academic purposes only. Please do not indicate your identification on the questionnaire, your anonymity is key in this study.

QUESTIONS

1. Do you participate in Pfumvudza/Inthwasa?
2. How big is your land?
3. What is your average yield after a good season? How about a bad season?
4. Describe your crop storage and post-harvest practices
5. Try to quantify your harvest and post-harvest loss
6. What factors do you think affect your yield? Are they mainly internal or external factors?
7. Is your yield sustainable for your family to last you and entire year?
8. Which farming methods are in use? Chemicals and fertilisers?
9. Are you food secure?
10. In the face of drought what do you do to counteract the negative externalities?
11. Are these strategies adequate to sustain you?
12. Which stakeholders play a significant role towards your food security in times of drought or food shortage?
13. Which factors do you feel are the most significant threat to your food security?

14. What do you think should be done to improve your resilience to drought and food shortage?

References

Dube-Takaza, T., Maumbe, B., & Parwada, C. (2023). Agricultural technology adoption for smallholder small grain farmers in Zimbabwe. Implications for food system transformation and sustainability. *International Food and Agribusiness Management Review*. https://doi.org/10.22434/ifamr2022.0114.

Dube-Takaza, T., Maumbe, B., & Parwada, C. (2024). Vulnerability to resilience for smallholder, small grain farmers in Southern Zimbabwe: The case of semi-arid regions of Southern Zimbabwe. *International Journal on Food System Dynamics*. https://doi.org/10.18461/ijfsd.v15i6.n8.

Grey, M., Masunungure, C., & Manyani, A. (2020). Integrating local indigenous knowledge to enhance risk reduction and adaptation strategies to drought and climate variability: The plight of smallholder farmers in Chirumhanzu district, Zimbabwe. *Jàmbá : Journal of Disaster Risk Studies*, 12. https://doi.org/10.4102/jamba.v12i1.924.

Madamombe, S., Ng'ang'a, S., Öborn, I., Nyamadzawo, G., Chirinda, N., Kihara, J., & Nkurunziza, L. (2024). Climate change awareness and adaptation strategies by smallholder farmers in semi-arid areas of Zimbabwe. *International Journal of Agricultural Sustainability*, 22. https://doi.org/10.1080/14735903.2023.2293588.

Makate, C., Makate, M., & Mango, N. (2019a). Wealth-related inequalities in adoption of drought-tolerant maize and conservation agriculture in Zimbabwe. *Food Security*, 11, 881 - 896. https://doi.org/10.1007/s12571-019-00946-7.

Makate, C., Makate, M., Mango, N., & Siziba, S. (2019b). Increasing resilience of smallholder farmers to climate change through multiple adoption of proven climate-smart agriculture innovations. Lessons from Southern Africa.. *Journal of environmental management*, 231, 858-868 . https://doi.org/10.1016/j.jenvman.2018.10.069.

Marongwe, L., Kwazira, K., Jenrich, M., Thierfelder, C., Kassam, A., & Friedrich, T. (2011). An African success: the case of conservation agriculture in Zimbabwe. *International Journal of Agricultural Sustainability*, 9, 153 - 161. https://doi.org/10.3763/ijas.2010.0556.

Mavesere, F., & Dzawanda, B. (2022). Effectiveness of Pfumvudza as a resilient strategy against drought impacts in rural communities of Zimbabwe. *Geojournal*, 88, 3455 - 3470. https://doi.org/10.1007/s10708-022-10812-3.

Mavhura, E., Manyangadze, T., & Aryal, K. (2021). Perceived impacts of climate variability and change: an exploration of farmers' adaptation strategies in Zimbabwe's intensive farming region. *GeoJournal*, 87, 3669 - 3684. https://doi.org/10.1007/s10708-021-10451-0.

Michler, J., Baylis, K., Arends-Kuenning, M., & Mazvimavi, K. (2019). Conservation agriculture and climate resilience. *Journal of Environmental Economics and Management*, 93, 148 - 169. https://doi.org/10.1016/j.jeem.2018.11.008.

Moyo, M., Gonye, E., Dube, R., & Assan, N. (2025). Smallholder farmers in dryland agroecosystems: Understanding vulnerability to climate change and developing effective coping strategies in South Western Zimbabwe. *Advances in Modern Agriculture*. https://doi.org/10.54517/ama3144.

Thierfelder, C., & Wall, P. (2009). Effects of conservation agriculture techniques on infiltration and soil water content in Zambia and Zimbabwe. *Soil & Tillage Research*, 105, 217-227. https://doi.org/10.1016/j.still.2009.07.007.

Thierfelder, C., & Wall, P. (2010). Investigating Conservation Agriculture (CA) Systems in Zambia and Zimbabwe to Mitigate Future Effects of Climate Change. *Journal of Crop Improvement*, 24, 113 - 121. https://doi.org/10.1080/15427520903558484.

Twomlow, S., Urolov, J., Jenrich, M., & Oldrieve, B. (2008). Lessons from the field - Zimbabwe's Conservation Agriculture Task Force. .