Title: The role of sorghum in resilience building, women empowerment and enhancing Food security in Sanyati District, Mashonaland West, Zimbabwe.

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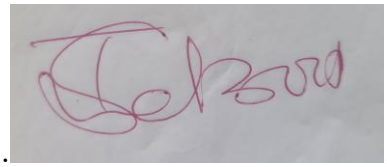
Signed………….

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DECLARATION

I hereby declare that the research project entitled "**The role of sorghum in resilience building, women empowerment and enhancing Food security in Sanyati District, Mashonaland West, 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 **Dr N. Mafuse** 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

This dissertation is dedicated to my family for their unwavering love, encouragement, patience, and support throughout my academic journey. Your sacrifices, prayers, and belief in my abilities have been a constant source of inspiration and motivation. I also dedicate this work to all women smallholder farmers in Sanyati District and beyond, whose resilience and determination continue to contribute to household food security and sustainable livelihoods.

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ABSTRACT

Climate change continues to pose significant challenges to agricultural production, food security, and rural livelihoods in Zimbabwe, particularly in semi-arid regions where rainfall is low and erratic. Sorghum has increasingly been promoted as a climate-resilient crop capable of enhancing household resilience, empowering women, and improving food security. This study examined the role of sorghum in resilience building, women empowerment, and enhancing food security among women smallholder farmers in Sanyati District, Mashonaland West Province, Zimbabwe.

A mixed-methods cross-sectional research design was employed. Quantitative data were collected from 369 women smallholder farmers using structured questionnaires, while qualitative data were gathered through key informant interviews with agricultural extension officers, farmer group leaders, grain buyers, and development practitioners. Quantitative data were analysed using descriptive statistics, independent samples t-tests, chi-square tests, multiple linear regression, and binary logistic regression, while qualitative data were analysed thematically.

The findings revealed a high sorghum adoption rate of 74% among women smallholder farmers, with nearly half of the adopters having cultivated sorghum for more than five years. Sorghum was found to contribute significantly to household resilience through reduced risk of crop failure, improved food availability during drought periods, provision of livestock feed, and superior grain storage characteristics. Households that adopted sorghum had a significantly higher Household Resilience Index (Mean = 0.919) than non-adopters (Mean = 0.697) ($t = 18.54$, $p < 0.001$).

The study further established that women play a central role throughout the sorghum value chain, including production, harvesting, storage, processing, and marketing. Women's participation in sorghum production was associated with increased financial independence, greater control over income, and improved household decision-making power. Access to extension services, training, credit facilities, farmer group membership, and participation in household decision-making were identified as significant factors influencing sorghum production and utilisation.

Regarding food security, households producing sorghum achieved significantly higher Household Dietary Diversity Scores (HDDS) than non-producing households ($t = 3.81$, $p < 0.001$). More than half (56.1%) of households attained high dietary diversity. Multiple linear regression analysis showed that sorghum production ($\beta = 0.004$, $p < 0.001$) and sorghum consumption ($\beta = 0.91$, $p < 0.001$) had positive and significant effects on household food security. The study concludes that sorghum is an important climate-resilient crop that strengthens household resilience, enhances women's empowerment, and improves food security among women smallholder farmers in semi-arid areas. The study recommends strengthening farmer training, extension services, access to credit, farmer organisations, market development, and gender-responsive agricultural policies to promote sorghum production and maximise its contribution to sustainable livelihoods and climate adaptation.

Keywords: Sorghum, resilience, women empowerment, food security, climate change.

LIST OF ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Meaning
BUSE	Bindura University of Science Education
CSA	Climate-Smart Agriculture
DFID	Department for International Development
FAO	Food and Agriculture Organization of the United Nations
FEWS NET	Famine Early Warning Systems Network
FGD	Focus Group Discussion
GAD	Gender and Development
HDDS	Household Dietary Diversity Score
HRI	Household Resilience Index
IPCC	Intergovernmental Panel on Climate Change
KII	Key Informant Interview
MAHFP	Months of Adequate Household Food Provisioning
NGO	Non-Governmental Organisation
OR	Odds Ratio
SD	Standard Deviation
SLF	Sustainable Livelihoods Framework
SPSS	Statistical Package for the Social Sciences
UN Women	United Nations Women
USDA	United States Department of Agriculture
WEAI	Women's Empowerment in Agriculture Index
ZIMSTAT	Zimbabwe National Statistics Agency

TABLE OF CONTENTS

RELEASE FORM i
APPROVAL FORM ii
DECLARATION iii
ABSTRACT vi
LIST OF ACRONYMS AND ABBREVIATIONS vii
TABLE OF CONTENTS viii
LIST OF TABLES xii
LIST OF FIGURES xiii
LIST OF APPENDICES xiv
CHAPTER 1: INTRODUCTION 1
1.1 Background to the Study 1
1.2 Problem Statement 1
1.3 Objectives 3
1.3.1 Main Objective 5
1.3.2 Specific Objectives 5
1.4 Research Questions 5
1.5 Study Justification 5
1.6 Scope / Delimitation of the Study and Limitations of the Study 5
1.7 Outline of Thesis 5
1.8 References 6
CHAPTER 2: LITERATURE REVIEW 8
2.1 Introduction 8
2.2 Climate Change and Smallholder Agriculture in Semi-Arid Zimbabwe 8
2.3 Sorghum as a Climate-Resilient Crop 8
2.4 Contribution of Sorghum to Household Resilience against Climate Shocks 9
2.5 Women's Participation and Empowerment in Sorghum Production and Value Chains 11
2.6 Contribution of Sorghum to Household Food Security 13
2.7 Theoretical Framework 13
2.8 Conceptual Framework 15
2.9 Summary of the Literature Review 18
2.10 References 20
CHAPTER 3: METHODOLOGY 22
3.1 Introduction 22

3.3 Research Design 23
3.4 Sampling Procedure 24
3.4.1 Target Population 24
3.4.2 Sample Size Determination 24
3.4.3 Key Informant Interviews (KIIs) 25
3.4.3 Sampling Technique 25
3.5 Data Collection Procedure 26
3.5.1 Primary Data Collection 26
3.5.2 Secondary Data 26
3.6 Data Analysis Procedure 27
3.6.1 Quantitative Data Analysis 27
3.6.2 Qualitative Data Analysis 27
3.7 Ethical Considerations 27
3.8 Summary 27
3.9 References 28
CHAPTER 4: Title: Sorghum Adoption and Its Contribution to Household Resilience Among Women Smallholder Farmers in Sanyati District, Zimbabwe 29
Abstract 29
4.1 Introduction 30
4.2 Materials and Methods 30
4.2.1 Description of the Study Area 31
4.2.2 Research Design 31
4.2.3 Sampling Procedure 32
4.2.4 Data Collection Procedure 32
4.2.5 Data Analysis Procedure 32
4.2.6 Challenges Encountered During Data Collection 33
4.3 Results 33
4.3.1 Socio-demographic Characteristics of Respondents 33
4.3.2 Sorghum Adoption among Women Smallholder Farmers in Sanyati District 34
4.3.3 Contribution of Sorghum Production to Household Resilience Against Climate-Related Shocks 36
4.4 Discussion 40
4.5 Recommendations 42
4.5.1 Strengthen Farmer Education and Agricultural Extension Services 44

4.5.2 Improve Access to Improved Sorghum Seed Varieties 44
4.5.3 Promote Climate-Smart Agriculture Programmes 44
4.5.4 Develop and Strengthen Sorghum Markets 44
4.5.5 Support Community-Based Grain Storage Systems 45
4.5.6 Enhance Women's Participation in Climate-Resilient Agriculture 45
4.5.7 Promote Value Addition and Agro-Processing 45
4.5.8 Strengthen Research on Small Grains 45
4.6 Conclusion 45
4.7 References 46
CHAPTER 5: Women's Participation in the Sorghum Value Chain and the Contribution of Sorghum Production to Household Food Security in Sanyati District, Zimbabwe 48
Abstract 48
5.1 Introduction 48
5.2 Materials and Methods 49
5.2.1 Description of the Study Area 50
5.2.2 Research Design 50
5.2.3 Sampling Procedure 50
5.2.4 Data Collection Procedure 51
5.2.5 Data Analysis Procedure 51
5.2.6 Challenges Encountered During Data Collection 53
5.3 Results 53
5.3.1 Women's Participation in the Sorghum Value Chain 53
5.3.2 Contribution of Sorghum Production and Utilisation to Household Food Security 58
5.3.3 Factors associated to sorghum production and utilization. 61
5.4 Discussion 62
5.5 Recommendations 67
5.5.1 Strengthen Women's Economic Empowerment 68
5.5.2 Improve Women's Access to Credit Facilities 69
5.5.3 Enhance Agricultural Extension and Training Services 69
5.5.4 Promote Sorghum Value Addition and Agro-Processing 69
5.5.5 Strengthen Market Access for Sorghum Products 69
5.5.6 Promote Sorghum Production as a Food Security Strategy 69
5.5.7 Support Household Nutrition Education Programmes 70
5.5.8 Strengthen Research and Development on Sorghum Value Chains 70

5.5.9 Address Factors Affecting Sorghum Production 70
5.6 Conclusion 71
5.7 References 71
CHAPTER 6: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS 74
6.1 Introduction 74
6.2 Research Summary 74
6.3 Conclusions 75
6.4 Policy Implications and Recommendations 76
6.5 Areas for Further Research 77
6.6 REFERENCES 78
6.7 Appendices: Data collection tools 80
1: SURVEY QUESTIONNAIRE 80
2: KEY INFORMANT INTERVIEW (KII) GUIDE 87

LIST OF TABLES

Table 4.0: Socio-demographic characteristics of respondents (n = 369) 33

Table 4.1: Sorghum adoption status among respondents (n = 369) 34

Table 4.2: Duration of sorghum cultivation among adopters (n = 300) 35

Table 4.3: Crop performance during drought years (n = 346) 36

Table 4.4: Household Resilience Indicators by Sorghum Adoption Status (n = 369) 38

Table 4.5: Household Resilience Index (HRI) Classification 39

Table 4.6: Household Resilience Index (HRI) by Sorghum Adoption Status 39

Table 4.7: Independent Samples t-Test Comparing Household Resilience Index by Sorghum Adoption Status 40

Table 5.1: Household decision-making on crop production (n = 369) 53

Table 5.2: Management of sorghum production (n = 369) 54

Table 5.3: Women's participation in sorghum value chain activities 54

Table 5.4: Sorghum products processed by women 55

Table 5.5: Control of income from sorghum sales (n = 369) 55

Table 5.6: Sorghum income and financial independence (n = 369) 56

Table 5.7: Access to productive resources and support services 56

Table 5.8: Sorghum production and household decision-making power (n = 369) 57

Table 5.9: Consumption of food groups during the previous 24 hours (n = 369) 58

Table 5.10: Household Dietary Diversity Categories 58

Table 5.11: HDDS comparison between sorghum producers and non-producers 59

Table 5.12: Multiple Linear Regression Results for Household Food Security (HDDS) ... 59

Table 5.13: Model Statistics 60

Table 5.14: Model Statistics 60

Table 5.15: Logistic Regression Results for Factors Influencing Sorghum Production 61

LIST OF FIGURES

3.2 Description of Study Site ..... **Error! Bookmark not defined.**

Figure 3.4 Sanyati homesteads ..... **Error! Bookmark not defined.**

LIST OF APPENDICES

Appendix 1: Survey Questionnaire 79

Appendix 2: Key Informant Interview (KII) Guide 85

CHAPTER 1: INTRODUCTION

1.1 Background to the Study

Climate change is one of the most serious global challenges to agricultural production, food security and rural livelihoods, especially in developing countries that rely on rain-fed agriculture. Increasing temperatures, changing rainfall patterns, longer droughts and extreme weather events are increasingly undermining the productivity of staple crops and the resilience of farming systems (IPCC, 2022). Sub-Saharan Africa is more severely affected due to its limited adaptive capacity, widespread poverty and heavy reliance on climate-sensitive agriculture (FAO, 2020).

Agriculture continues to be the backbone of rural livelihoods and national food security in Zimbabwe. However, food production per capita has kept falling, not matching population growth, primarily due to recurrent droughts and increasing climate variability (FAO, 2020). Most livelihoods depend on rain-fed crop production, which makes semi-arid districts like Sanyati in Mashonaland West Province particularly vulnerable. Sanyati is a food-deficit district despite about 66% of the land being arable, due to unpredictable rainfall, limited irrigation infrastructure and the reliance on maize as the staple crop (Dzavo et al., 2019).

Maize is dominant in the Zimbabwean food system, underpinned by strong cultural preferences and policy support. But maize is very susceptible to moisture stress and high temperature. Maize is a high-risk crop in the context of changing climatic conditions as even short dry spells during flowering can cause complete crop failure (FAO, 2020). Sorghum, on the other hand, is a drought-tolerant cereal crop that thrives in low rainfall, high temperatures and poor soil. Sorghum has adaptive traits including deep rooting systems, waxy leaf cuticles to reduce evapotranspiration, and a temporary dormancy during periods of severe drought, and the ability to resume growth when moisture is available (Chikowo et al., 2019).

The resilience of sorghum is the ability of the crop to tolerate, adapt to and recover from climatic stresses such as drought, heat and erratic rainfall. Agronomically, sorghum requires less rainfall to complete its growth cycle and is able to maintain productivity under conditions that cause maize crop failure (Chikowo et al., 2019). Physiologically sorghum is able to slow down its metabolism during stress and to resume normal growth when conditions become favourable again, enabling it to survive long dry periods.

Sorghum's resilience makes it a strategic crop for climate adaptation and resilience building in semi-arid regions. Sorghum is more tolerant to long dry spells and can yield grain when maize crops are lost, thereby reducing the risk of total crop failure and stabilising household food supplies (Maphosa et al., 2025). Sorghum is gluten free and packed with carbohydrates, protein, dietary fibre, iron and antioxidants, making it suitable for a variety of dietary needs. It can be consumed in a variety of forms such as porridge, flour, fermented beverages such as maheu, popped grains and animal feed, thus promoting dietary diversity and diversification of livelihoods.

Maize and sorghum have contrasting responses to climatic stress. Maize requires moderate to high rainfall and is extremely sensitive to drought, particularly during critical growth periods such as tasselling and grain filling (FAO, 2020). Increased temperatures lead to increased maize yield losses through increased crop development and water demand. This has increasingly undermined the reliability of maize production in semi-arid regions.

Sorghum has contributed to household food security in all the four dimensions, Availability, Access, Utilisation and Stability (FAO, 2020). It can produce grain under adverse climatic conditions and thus improve food availability, particularly in drought years. Income from sorghum sales increases household food access, and the good nutritional qualities of sorghum improve food utilisation and diet quality (Maphosa et al., 2025).

Diverse consumption pathways such as thick porridge, fermented beverages (maheu), popped grains and blended flours enhance dietary diversity. These products are particularly important for women and children, who are the most susceptible to malnutrition in food-insecure households (FEWSNET, 2025). However, negative perceptions and low awareness of the nutritional and economic value of sorghum continue to impede adoption and utilisation.

Women play a significant role in Zimbabwe's agricultural sector, accounting for approximately 70% of the agricultural labour force and producing 60–80% of the food consumed at household level (World Bank, 2019; UN Women, 2020). Despite this contribution, women smallholder farmers are confronted with systemic barriers in access to land, inputs, credit, extension services and markets, which limit their productivity and economic empowerment (Agarwal, 2018).

When women are supported through the whole value chain, sorghum is a significant opportunity to empower women. Access to climate smart agronomic training, improved

sorghum varieties and extension services responsive to the needs of women empower knowledge (Chikowo et al., 2019). Income generation from sales of sorghum grain and value-added products, and improved market participation through access to microfinance, savings groups and cooperative structures, are ways through which economic empowerment is achieved (Ndlovu & Moyo, 2021).

Participation of women in production, processing and marketing enhances the agency and decision making power of women. Women can add value to sorghum through processing activities such as milling, malting, brewing and packaging to produce sorghum porridge, maheu, traditional beverages and composite flours. These activities contribute to increased household income, better nutrition, and improved social and economic status of women within households and communities (UN Women, 2020).

Despite the benefits, sorghum is not well exploited in many parts of Zimbabwe including Sanyati District. The production levels are still low, adoption rates are limited and the crop is still marginalised in favour of maize. And this under-utilisation persists even as climate change increasingly exposes the fragility of maize-based farming systems, highlighting the need to reconsider crop choices and build more climate-resilient food systems.

1.2 Problem Statement

Sorghum is a drought tolerant cereal crop and is well adapted to semi-arid areas such as Sanyati District in Zimbabwe. Despite its strong agronomic advantages such as low input requirements than maize, resilience to heat and drought and suitability for marginal soils, its production and utilisation among smallholder farmers remains low and inconsistent (Mtambanengwe & Mapfumo, 2024; Chidoko et al., 2026). This is occurring in a context of growing climate variability and recurrent droughts which continue to undermine maize-based farming systems, the mainstay of local agriculture. As climate change progresses, sorghum has been championed as an important climate adaptation crop (Matshe et al., 2019; FAO, 2022). However, sorghum remains underutilised, with only 10–15% of the national cropped area dedicated to sorghum, compared to 45–50% for maize (Mtambanengwe & Mapfumo, 2024). National production statistics reveal the gap between the potential and actual contribution of sorghum to food security. According to the 2024/25 Post-Harvest Survey, national sorghum production was 288,344 metric tonnes compared to 1,819,819 metric tonnes of maize (ZIMSTAT, 2025).

Average sorghum yields among smallholder farmers in Sanyati District are 0.5 to 0.7 tonnes per hectare, well below the estimated rain-fed potential of 3–5 tonnes per hectare (Maphosa et al., 2025). Furthermore, sorghum productivity in smallholder farming conditions has been below 0.5 tonnes per hectare, signifying a consistent yield gap and underutilisation of a crop that could boost climate resilience and food security (Maphosa et al., 2025; FAO, 2022).

In Sanyati District, the continued underutilisation of sorghum is due to multiple interrelated constraints. These include limited access to improved seed, with approximately 87% of farmers relying on recycled seed because of the high cost and limited availability of certified varieties (Musara et al., 2019). Agricultural extension services and support programmes still tend to focus mainly on maize, with sorghum farmers getting little technical assistance (Matshe et al., 2019). Moreover, weak value chains, limited processing, poor price incentives and limited marketing opportunities reduce the commercial attractiveness of sorghum (Matshe et al., 2019; Musara et al., 2019). Maize is also preferred because of cultural preferences as it is Zimbabwe's dominant staple crop. Small grains are also often perceived as crops for poorer households (Matshe et al., 2019; Musara et al., 2019). These challenges are further exacerbated by gender inequalities. Women form the backbone of smallholder agriculture in Zimbabwe, contributing between 50% and 80% of agricultural food production, accounting for about 70% of agricultural labour and undertaking nearly 80% of food processing activities (Dzvimbo et al., 2020). Sorghum has the potential to improve household nutrition and resilience, but women's ability to fully benefit from sorghum production and participate in value addition activities is often hindered by limited access to land, credit, inputs, agricultural knowledge and labour resources despite their significant contribution (Dzvimbo et al., 2020).

While previous studies have acknowledged the importance of sorghum for climate change adaptation (Kazungu et al., 2023) there is limited context specific evidence to explain why its adoption and utilisation remains low amongst women smallholder farmers in drought prone areas such as Sanyati District. More specifically, the combined effects of socio-economic, institutional, market, cultural and gendered factors have not been sufficiently explored. Therefore, the study seeks to examine the factors influencing sorghum production and utilisation among women smallholder farmers in Sanyati District with the aim of informing targeted interventions to promote adoption, build climate resilience and improve household food security.

1.3 Objectives

1.3.1 Main Objective

To examine the role of sorghum in building household resilience, empowering women, and enhancing food security in Sanyati District, Mashonaland West Province, Zimbabwe.

1.3.2 Specific Objectives

1. To assess the adoption rate of sorghum among women smallholder farmers in Sanyati District.
2. To evaluate the contribution of sorghum production to household resilience against climate-related shocks.
3. To examine the role of women across the sorghum value chain in Sanyati District.
4. To assess the impact of sorghum production and utilisation on household food security.
5. To assess factors associated to sorghum production and utilisation in Sanyati District.

1.4 Research Questions

1. What is the level of sorghum adoption among women smallholder farmers in Sanyati District?
2. How does sorghum production contribute to household resilience to climate change?
3. What roles do women play in the sorghum value chain?
4. How does sorghum production and consumption affect household food security?
5. What are the factors associated to sorghum production and utilisation in Sanyati District.

1.5 Study Justification

This study extends the academic knowledge on climate-resilient agriculture, gender empowerment and food security. The findings will guide policy makers, development practitioners and extension services on strategies for scaling up sorghum production as a climate-smart and gender responsive intervention. The study identifies pathways through which sorghum can improve livelihoods and resilience in semi-arid areas at community level.

1.6 Scope / Delimitation of the Study and Limitations of the Study

The study was conducted among women smallholder farmers in Sanyati District, Mashonaland West Province. It explores sorghum and maize production under rain-fed conditions and does not take into account large-scale commercial or irrigated farming systems. Limitations include self reported data, limited historical yield records, and time and resource constraints. These will be mitigated by triangulation of data sources.

1.7 Outline of Thesis

Chapter One is the introduction and background of the study. Chapter Two reviews related literature. Chapter Three is the methodology outline. The results are presented in Chapter Four and the findings, conclusions and recommendations are discussed in Chapter Five.

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CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The chapter reviews literature on the role of sorghum in improving household resilience, women's empowerment and food security in semi-arid environments, focusing on Zimbabwe and similar contexts in sub-Saharan Africa. The review contextualises the study within ongoing academic debates on climate change, smallholder agriculture, gender and food systems, emphasising the role of sorghum as a climate-resilient crop within these dynamics. The chapter is arranged in clearly defined thematic sub-sections that correspond to the study objectives. These include climate change and the vulnerability of smallholder agriculture, sorghum as a drought-resilient crop, the contribution of sorghum to household resilience, women's roles and empowerment in the sorghum value chain, and the role of sorghum in household food security. The chapter also outlines the theoretical and conceptual frameworks that inform the study. The chapter ends with a summary of the major gaps in the existing literature that call for the current study in Sanyati District.

2.2 Climate Change and Smallholder Agriculture in Semi-Arid Zimbabwe

The smallholder agricultural systems in sub-Saharan Africa's semi-arid regions are particularly vulnerable to climate change due to their dependence on rain-fed crop production for livelihoods. Increasing temperatures, changing rainfall patterns, longer droughts and more frequent extreme weather events have disturbed traditional farming calendars and diminished crop productivity (IPCC, 2022). These impacts are particularly severe for smallholder farmers with limited access to irrigation, climate information and adaptive technologies.

During the past two decades climate variability has increased in Zimbabwe with El Nino related droughts recurring more often and becoming more severe. National assessments indicate continued reduction in rainfall reliability, shorter growing seasons and frequent mid-season dry spells, all of which impact negatively on crop performance (FAO, 2020; ZimStat, 2022). Semi-arid districts like Sanyati, mostly in Agro-ecological Regions III and IV are particularly vulnerable due to low and poorly distributed rainfall, high rates of evapotranspiration and fragile soils.

Maize production is the crop of choice for smallholder agriculture in these regions and is a crop highly sensitive to moisture stress and temperature extremes. Research has demonstrated that even short periods of drought during critical growth stages, such as flowering and grain filling, can lead to significant yield losses or total crop failure (FAO, 2020). With increasing climatic variability, maize-based farming systems have become more and more uncertain leading to recurrent food shortages and raising the vulnerability of households.

Socio-economic constraints such as poverty, limited access to agricultural inputs, inadequate extension services and weak market infrastructure faced by smallholder farmers exacerbate the effects of climate change (Thornton et al., 2018). Women farmers are disproportionately affected as gender-based inequalities in access to land, credit and decision-making power reduce their ability to adopt climate adaptation strategies (Agarwal, 2018).

To respond to these challenges, climate-smart agriculture and crop diversification have been extensively promoted as adaptation strategies. Introduction and scaling up of drought tolerant crops such as sorghum, millet and cowpeas are increasingly recognised as viable options for enhancing resilience and stabilising food production in semi-arid areas (IPCC, 2022). These crops are more suited to extreme climatic conditions and also offer opportunities to reduce the risks of over-dependence on maize.

Despite strong policy rhetoric around climate adaptation, the adoption of resilient crops remains limited in many parts of Zimbabwe. Cultural preferences, institutional biases in favour of maize and lack of support for small grains continue to hinder the move to more resilient farming systems (Dzavo et al., 2019). This underscores the importance of conducting context-specific research to understand how climate-resilient crops such as sorghum can be better integrated into smallholder farming systems to enhance resilience, especially for women farmers in drought-prone districts like Sanyati.

2.3 Sorghum as a Climate-Resilient Crop

Sorghum is considered a strategic crop in this study to enhance agricultural resilience in semi-arid environments such as Sanyati District. Sorghum (Sorghum bicolour) has been cited in the current literature as one of the most drought-tolerant cereal crops and particularly suitable for regions with low and erratic rainfall, high temperatures and poor soil fertility (Chikowo et al., 2019; FAO, 2020). Sorghum, unlike maize which is very sensitive to moisture stress, has evolved physiological and agronomic traits that allow it to survive and produce under tough climatic conditions .

From an agronomic standpoint, sorghum needs much less rainfall than maize to complete its growth cycle. Research shows sorghum can perform decently with as little as 400-600 mm of rainfall while maize usually requires more than 700 mm for best performance (FAO, 2020). In my opinion, this trait alone makes sorghum very relevant for districts like Sanyati, where rainfall is not only low but also badly distributed within the season.

On the physiological front, sorghum has developed deep and extensive root systems, waxy leaf cuticles that reduce water loss and the ability to enter temporary dormancy during periods of severe moisture stress (Chikowo et al., 2019). This ability to cease growth and to restart development as moisture becomes available makes sorghum able to withstand long periods of drought that would cause complete crop failure for maize. These features are responsible for sorghum's high water-use efficiency and heat stress tolerance (Maphosa et al., 2025).

In southern Africa, evidence suggests that sorghum yields are relatively stable in drought years when maize production falls sharply (Dzavo et al., 2019). In this context, I argue that sorghum should not be viewed as just a "fallback" or subsistence crop, but as a core component of climate-resilient farming systems. It is reliable in adverse conditions, and thus reduces the risk of production and gives confidence to the farmers that they will have at least minimum harvests in poor seasons.

However, sorghum is still peripheral in Zimbabwe's agricultural system. Historically, policy frameworks, input subsidy programmes and extension services have focused on maize, which has reinforced its dominance even in agro-ecological zones where it performs poorly (FAO, 2020). I believe this structural bias has led to underdevelopment of sorghum seed systems, poor dissemination of improved varieties and weak market incentives to farmers.

Also, negative socio-cultural perceptions of sorghum have constrained its adoption. In many communities, sorghum has been associated with poverty, food insecurity or previous times of hardship, and some households, particularly younger farmers, prefer maize even in adverse climatic conditions (Dzavo et al., 2019). Perceptions persist, however, despite mounting evidence of the agronomic, nutritional and economic advantages of sorghum.

The literature overall suggests that sorghum has strong adaptive advantages to climate variability. Yet the ongoing low uptake of the crop indicates that resilience does not lie solely

in biophysical traits but also in social, institutional and gendered factors. This study therefore adds to existing knowledge by exploring how sorghum's potential for resilience translates into outcomes at the household level, particularly for women smallholder farmers in Sanyati District.

2.4 Contribution of Sorghum to Household Resilience against Climate Shocks

In rural agricultural communities, household resilience is defined as the capacity of households to anticipate, absorb, adapt and recover from climatic and economic shocks while maintaining their livelihoods and food security (FAO, 2016). In semi-arid districts such as Sanyati where variability in rainfall and recurrent droughts are common, crop choice is a central driver of household resilience. "In my opinion, sorghum is one of the big crops that builds resilience in that it reduces the chances of total crop failure and gives some stability in production under adverse climatic conditions."

Studies have shown that sorghum producing households are more resilient to drought shocks than those who only rely on maize (Dzavo et al., 2019; FEWSNET, 2025). Maize yields are often totally devastated during drought years, leaving households to depend on food purchases, social assistance or negative coping strategies such as asset sales. By contrast, sorghum tends to yield at least a minimum harvest even under severe moisture stress, shielding households from complete food loss.

I think sorghum's contribution to resilience is more than just the grain it produces. Sorghum residues are an important source of livestock feed in dry spells supporting mixed crop-livestock systems typical of rural Zimbabwe. This integration supports livelihood diversification and increases households' ability to cope with climate shocks (Thornton et al., 2018). Households that are able to keep livestock during drought periods are in a better position to recover once conditions improve.

Sorghum also improves resilience by decreasing household food expenditure. Households that grow their own grain are less vulnerable to volatile food prices and market disruptions that often accompany droughts (FAO, 2020). This is particularly the case for poorer households and female-headed households who often have limited sources of income and are more vulnerable to price shocks .

Sorghum's storability also boosts resilience over time. Unlike maize which is susceptible to post-harvest pests and spoilage, sorghum can be stored for longer periods with little losses if

handled properly (Maphosa et al., 2025). This allows households to smooth consumption over the seasons and to hold food reserves during lean periods. This characteristic is particularly relevant in the context of Sanyati District, where households often face seasonal food gaps.

While the literature emphasises the potential of sorghum to increase resilience, there is limited empirical evidence on the linkages between sorghum adoption and resilience outcomes at the household level particularly at the district level. Many studies focus on national or regional trends and often overlook the gender aspect of resilience. To me, this is a serious gap, because the roles women play in production, storage and use directly influence how sorghum contributes to household resilience.

The study therefore adds to the existing literature by considering sorghum not only as a drought tolerant crop but also as a livelihood asset that interacts with gender roles, decision making processes and food security outcomes at household level in Sanyati District.

2.5 Women's Participation and Empowerment in Sorghum Production and Value Chains

Women are central to smallholder agriculture in Zimbabwe, providing the bulk of labour in crop production, post-harvest handling and household food provisioning (World Bank, 2019). Women's roles in sorghum systems are very significant in planting, weeding, harvesting, threshing, storage, processing and food preparation. I believe that any serious discussion on sorghum, resilience and food security should place women at the centre of analysis.

Empowerment of women in agriculture is generally understood as a multidimensional process that comprises access to productive resources, participation in decision-making, control over income and increased social status (Agarwal, 2018; UN Women, 2020). Literature indicates that empowering women in agricultural value chains has positive spill-over effects to household nutrition, food security and overall welfare.

The participation of women in sorghum production goes beyond the main production to value addition processes such as milling, malting, brewing and preparation of traditional foods and beverages such as thick porridge and fermented products such as maheu (Chikowo et al., 2019) . These activities provide opportunities for income generation and small-scale entrepreneurship, especially for women with limited access to land and formal employment.

But women's work, despite their deep engagement, is often under-recognized and constrained by structural barriers. Research has shown that women smallholder farmers in Zimbabwe have limited access to land ownership, improved seed varieties, agricultural inputs, credit facilities, and extension services (Agarwal, 2018; ZimStat, 2022). These constraints limit women's adoption of improved sorghum technologies and the extent to which women benefit from sorghum value chains.

In my view, empowerment in the sorghum value chain is very much related to market access and decision making power. Although women play a major role in processing and local level marketing, they are often excluded from higher value markets and cooperative leadership structures (Ndlovu & Moyo, 2021). Their control over income is diminished and gender inequalities within households and communities are deepened.

However, evidence shows that targeted interventions including women-specific extension services, farmer groups, savings and lending schemes and value chain development initiatives can be very effective in increasing women's economic empowerment (UN Women, 2020). As women gain greater control over income from sales of sorghum and value-added products, they are more likely to invest in household food, education and health, thus enhancing food security and resilience.

Although awareness is growing on linkages between women's empowerment and climate-resilient agriculture, there is little empirical evidence on how women's roles in sorghum value chains translate into tangible empowerment outcomes at household level. In particular, there is a scarcity of district level studies that integrate gender, resilience and food security. This study aims to fill this gap by examining women's participation in the sorghum value chain in Sanyati District and its contribution to empowerment and household wellbeing.

2.6 Contribution of Sorghum to Household Food Security

Household food security is defined as the condition in which all members of a household have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2020). Four related dimensions of food security are commonly examined: availability, access, utilisation and stability. Sorghum is one of the most important crops contributing to all four dimensions especially in semi-arid and drought prone environments such as Sanyati district.

Sorghum contributes to better household food availability because it can produce grain under low and unreliable rainfall conditions. Sorghum is often able to yield harvestable yields even under severe moisture stress, whereas maize often fails in drought years (Dzavo et al., 2019). For me this reliability is at the heart of the household food stocks held in seasons of climatic uncertainty.

Sorghum production increases economic access to food as well. Households producing sorghum for both consumption and sale are relatively more likely to earn income, which can be used to purchase complementary food items such as vegetables, legumes, and animal-source foods (Maphosa et al., 2025). Income from sales of sorghum is particularly important for women who are typically responsible for buying food and household nutrition. UN Women (2020) found that when women have more say over income, the household food security outcomes tend to improve.

The nutritional quality and preparation of food affect food utilisation. Sorghum is an important staple for improving dietary quality, as it is a good source of carbohydrates, dietary fibre, protein, iron and antioxidants (FAO, 2020). It can be prepared in different forms including thick porridge, fermented beverages such as maheu, popped grains and composite flours. Fermentation processes improve the bioavailability and digestibility of nutrients, which is particularly important for children and other nutritionally vulnerable populations (Maphosa et al., 2025).

The fourth dimension of food security is stability . Stability is the consistency of access to food over time . Sorghum has long storage life and resistance to post-harvest loses, thus enhancing food stability. Sorghum is less vulnerable to pests and spoilage than maize when stored correctly, and it can help households to keep food reserves for different seasons (Dzavo et al., 2019). This trait is especially important in drought-prone districts like Sanyati where households routinely face periodic food shortages.

However, its contribution to household food security is still limited by low adoption rates, negative perceptions, limited processing technologies and weak consumer demand. My view on the problems is that they’re not with sorghum as a crop, but rather with the system in terms of policy priorities, market development and knowledge transfer. Overcoming these constraints is crucial to realise the full potential of sorghum for improving food security.

Therefore, it is important to conduct context specific studies on the effects of sorghum production and utilisation on household food security outcomes, especially among women smallholder farmers as highlighted by the literature. This study fills this need by providing empirical evidence from Sanyati District.

2.7 Theoretical Framework

This study is informed by the Sustainable Livelihoods Framework (SLF) and Gender and Development (GAD) theory which together provide a strong foundation for analysing the links between sorghum production, household resilience, women empowerment and food security in Sanyati District.

Using the Sustainable Livelihoods Framework, livelihoods are conceptualised as being dependent on access to five key assets: human, natural, financial, physical and social capital, within a context of vulnerability to shocks, trends and seasonality (DFID, 1999; FAO, 2016). In my opinion, this framework is especially applicable to semi-arid agricultural systems where climate shocks such as droughts have a direct impact on livelihood outcomes.

In this study, sorghum production is considered a livelihood strategy that creates multiple forms of capital. Sorghum improves natural capital by promoting climate-smart crops that are suitable for dry areas. It generates income from the sales of grains and value-added products, especially for women, to increase financial capital. Knowledge and skills on sorghum agronomy, processing and storage enhance the human capital while participation in farmer groups, cooperatives and informal networks enhances the social capital. These assets collectively enhance the ability of households to withstand, adapt to and recover from climate-related shocks.

However, while the SLF provides a useful lens to understand resilience and livelihoods, it does not explicitly address power relations and gender inequalities. This is why the study also draws on Gender and Development (GAD) theory which highlights the structural and institutional factors that affect women's access to resources, opportunities and decision-making power (Agarwal, 2018). GAD theory goes beyond the perception of women as passive recipients of development interventions and looks at women as active economic and social actors.

I believe it is important to apply GAD theory to sorghum production because women are central to the sorghum value chain, but are often disenfranchised from land, inputs, income

and markets. Gendered constraints affect not only the adoption of sorghum but also the distribution of production benefits and value addition within households. By incorporating GAD theory, the study is able to critically evaluate if sorghum is contributing towards real empowerment or just adding to the women's labour burden.

The SLF and GAD theories together provide a complementary analytical framework. While SLF explains how sorghum contributes to resilience of livelihoods and food security, GAD theory helps to better understand gender dynamics and empowerment outcomes. This integrated approach fits well to the study's objectives of Sanyati District.

2.8 Conceptual Framework

The conceptual framework of this study shows the relationship between sorghum adoption, household resilience, women empowerment and food security in the context of climate variability in Sanyati District. To me, the framework helps in understanding sorghum not just as a crop but as a pathway through which livelihoods and gender outcomes are shaped. The main independent variable in this study is women smallholder farmers' adoption and production of sorghum. Adoption is determined by availability of improved seed varieties, extension services, climate conditions and socio-cultural perceptions towards sorghum. These factors determine the extent to which sorghum can be integrated into household farming systems.

Women's participation in the sorghum value chain from production to processing, storage and marketing is an important mediating variable. I believe that the benefits of sorghum do not come automatically. They depend on how much women have access to resources, knowledge, markets and decision making power. Gender norms, and access to credit and market opportunities, either enhance or constrain women's ability to benefit from sorghum-related activities (Agarwal, 2018; UN Women, 2020).

The intervening variables identified in the framework are climate variability and institutional factors. Climate shocks such as droughts directly impact crop performance, while institutional factors such as agricultural policies, input subsidy programmes and market infrastructure influence adoption decisions and livelihood outcomes (FAO, 2020).

The dependent variables of the study are household resilience, women empowerment and household food security. Household resilience is reflected in the ability to resist and recover from climate-related shocks, reduced dependence on adverse coping strategies, and enhanced

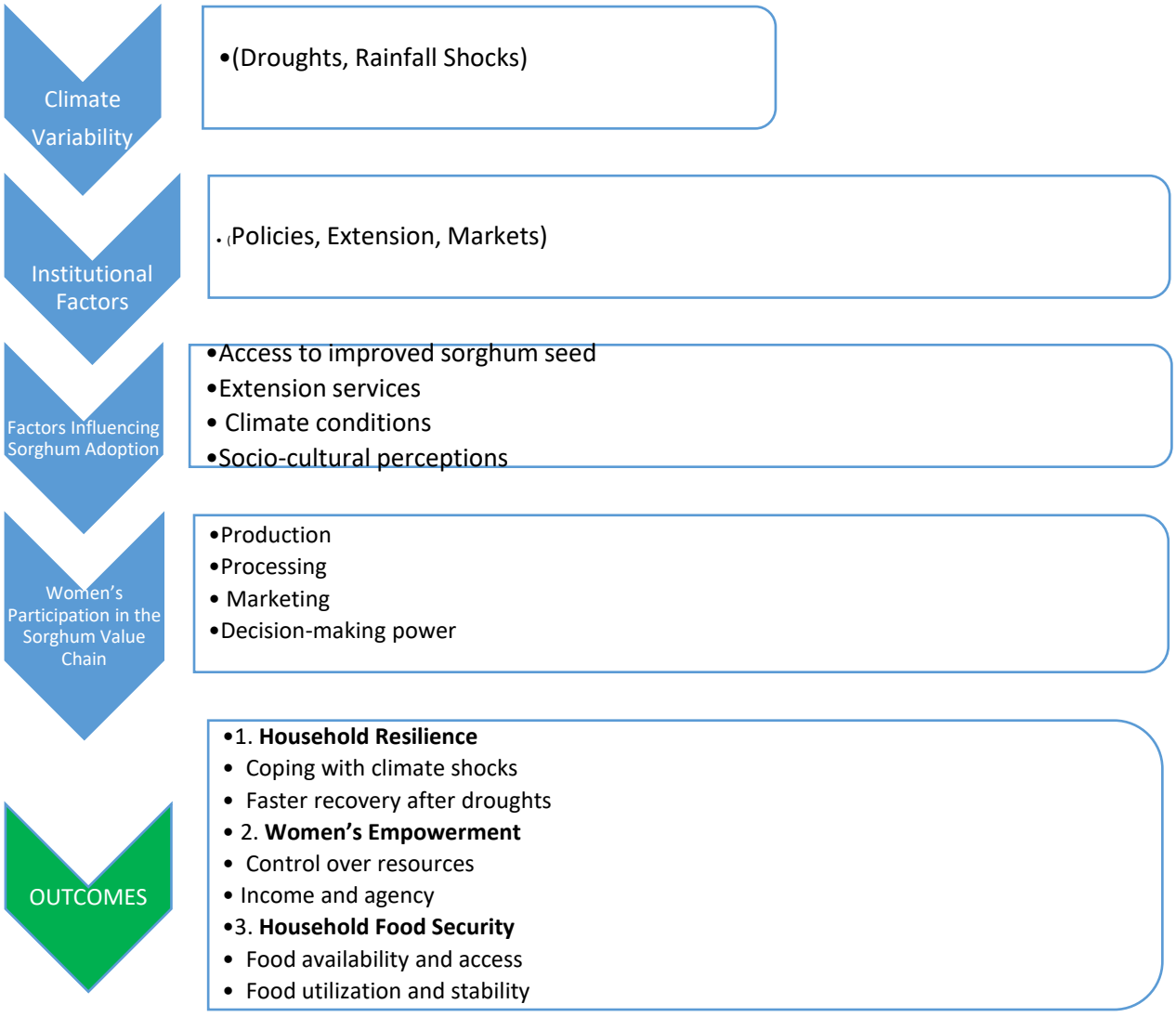
stability of livelihoods. The empowerment of women is reflected in their greater control over productive resources, income and decision-making within households. Household food security is measured by changes in food availability, access, utilisation and stability .

In summary the conceptual framework assumes that increased adoption of sorghum, improved women's participation and enabling institutional contexts lead to enhanced household resilience and food security. The framework forms the basis for the selection of variables, data collection methods and analysis in the following chapters of the study.

1. Household Resilience: Coping with climate shocks -Recovery from droughts is faster
2. Women's Empowerment Control over resources Income and agency
3. Household Food Security - Food availability and access - Food utilisation and stability

The conceptual framework presents the relationship between sorghum adoption, household resilience, women empowerment and food security in the context of climate variability in Sanyati District, Mashonaland West Province. The framework is based on the premise that smallholder agricultural systems in semi-arid areas are under increasing climate stress which requires adoption of climate resilient livelihood strategies. At the top of the framework, climate variability, characterised by droughts and rainfall shocks, is the main external stressor for agricultural production in Sanyati District. These climate stresses directly affect crop performance and increase the vulnerability of maize-based farming systems. Households are forced to consider alternative drought tolerant crops such as sorghum in response. Institutional factors, such as agricultural policies, extension services and access to markets, influence farmers' ability to respond to climate stress. Adoption of sorghum is facilitated by supportive policies, availability of extension advice and functioning markets and constrained by weak institutional support. These factors dictate the feasibility of incorporating climate-resilient crops into smallholder farming systems.

Fig 1 The conceptual framework



The framework then recognises factors influencing adoption of sorghum by women smallholder farmers such as access to improved sorghum seed, extension services, current climatic conditions and socio-cultural perceptions. Such factors directly influence farmers' decisions on adopting and scaling-up of sorghum production. This aspect of the framework is strongly related to the first objective of the study which is to assess the rate of sorghum adoption by women smallholder farmers in Sanyati District.

The study looked at the main intervention pathway of sorghum adoption and production by women smallholder farmers at the heart of the framework. Sorghum is viewed as a climate-smart crop for improving livelihood stability in drought-prone conditions. Increased adoption and production should reduce the risk of total crop failure and stabilise the food supplies of households.

The framework also identifies women's participation in the sorghum value chain as an important mediating factor. Women's participation in production, processing, marketing and decision-making determines the realisation of benefits from sorghum production at household level. This aspect is indicative of the gendered nature of smallholder agriculture in Zimbabwe and is directly linked to the third objective of the study which considers the role of women along the sorghum value chain.

The last part of the framework shows the result of sorghum adoption and women's participation in value chains. These outcomes include household resilience, as shown by increased capacity to cope and recover more quickly from climate shocks; women empowerment, as shown by increased control over productive resources, income and decision-making power; and household food security, as shown by improved food availability, access, utilisation and stability. These results are directly related to the second and fourth objectives of the study, which evaluate the contribution of sorghum to household resilience and food security.

In general, the conceptual framework suggests that sorghum adoption alone is not enough to achieve resilience and food security outcomes. Instead, the framework emphasises the interaction of climatic conditions, institutional support, gender dynamics and value chain participation. This study seeks to provide evidence on the use of sorghum as a climate smart and gender responsive crop for household resilience building, women empowerment and food security by investigating these relationships empirically in Sanyati District.

2.9 Summary of the Literature Review

This chapter provides a review of the existing literature on climate change, sorghum production, household resilience, women empowerment and food security with specific focus on semi-arid environments such as Sanyati District of Zimbabwe. The review found that climate change has substantially increased the exposure of smallholder farming systems, especially those with a high dependence on maize, which is highly susceptible to moisture stress and temperature variability (FAO, 2020; IPCC, 2022).

Sorghum is often mentioned as a climate resilient crop with strong agronomic and physiological advantages under conditions of low and erratic rainfall in the literature. It is a strategic crop for improving household resilience in semi-arid areas because of its ability to withstand drought, provide stable yields and support several livelihood functions (Chikowo et al., 2019; Dzavo et al., 2019). But despite these advantages, sorghum remains underutilised

because of policy biases, weak markets, limited access to improved seed and persistent negative perceptions.

The review also emphasised the key role of women in sorghum production and value chains, especially in processing and household food provisioning. Women's participation presents an opportunity to create opportunities for empowerment and income generation, but structural constraints related to land access, credit, extension services and decision-making power still prevent women from taking full advantage of sorghum-related activities (Agarwal, 2018; UN Women, 2020). This highlights the need to integrate gender perspectives in promoting climate-resilient crops.

Sorghum has the ability to contribute to all four dimensions of food security – availability, access, utilisation and stability – but its potential remains largely unrealised in many rural communities. The literature reveals a scarcity of empirical studies conducted at the district level that investigate sorghum adoption, women's empowerment, household resilience, and food security concurrently within a single analytical framework.

"This gap is especially apparent in semi-arid districts such as Sanyati where climate risks are high and women have a strong role in agriculture," I think. The study therefore contributes to knowledge by providing context specific evidence on the contribution of sorghum to resilience building, women empowerment and food security at household level. The insights generated are expected to inform climate-resilient, gender-responsive agricultural policies and interventions in Zimbabwe and similar contexts.

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CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter presents the methodology employed to investigate the role of sorghum in enhancing household resilience, women's empowerment and food security in Sanyati District, Mashonaland West Province, Zimbabwe. This chapter describes the study site, research design, sampling procedure, data collection methods, data analysis techniques, ethical considerations and chapter summary. The methodology is driven by the study objectives and the conceptual framework outlined in Chapter Two. A mixed-methods approach was used to obtain quantitative and qualitative data to get a comprehensive understanding of sorghum adoption, women's participation in the value chain, household resilience and food security outcomes.

3.2 Description of Study Site

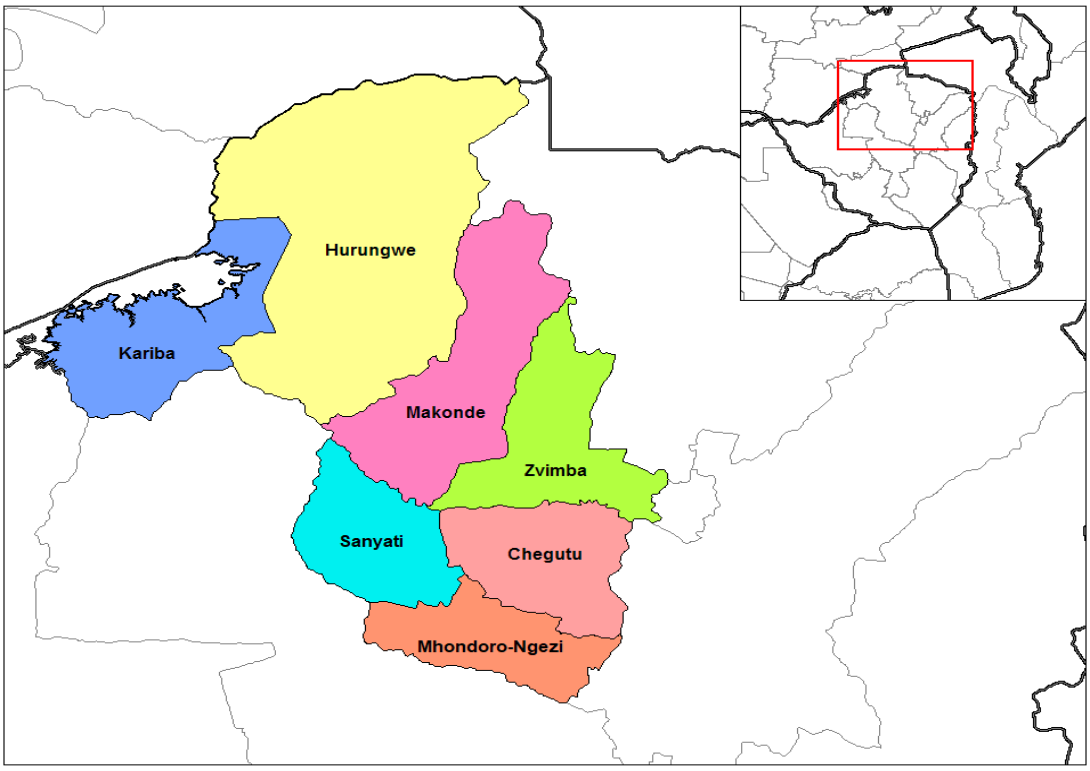

Figure3.3: Sanyati Map



Figure 3.4 Sanyati homesteads

The study was carried out in Sanyati District of Mashonaland West Province, Zimbabwe. Sanyati is about 120 to 150 km south west of Chinhoyi and has semi-arid climatic conditions. The district is mainly located in Agro-ecological Regions III and IV with low and erratic rainfall of between 450-650 mm per annum and high temperatures particularly during the summer months.

Sanyati District's economy is predominantly agricultural. Most households participate in rain-fed smallholder farming, cultivating maize, sorghum, millet, groundnuts and cowpeas and rearing livestock. However, maize productivity has been increasingly compromised by recurrent droughts and mid-season dry spells resulting in food insecurity and instability of livelihoods.

Although a large proportion of land is cultivable, crop production is still highly vulnerable to climate variability. Sorghum is increasingly being promoted as a climate resilient crop due to its drought tolerance and adaptablity to poor soils. Although it is suitable, its adoption is limited compared to maize, making Sanyati District a suitable site to examine the nexus between sorghum production, resilience building, women empowerment and food security.

The socio-economic set up of the district is predominantly rural with women playing a pivotal role in agricultural production, post harvest processing and household food provisioning. However, women are limited in their access to land, inputs, credit and markets. These are characteristics that make Sanyati a relevant and strategic location for this study.

3.3 Research Design

The study adopted a descriptive cross-sectional research design using a mixed-methods approach. A cross-sectional design was appropriate because data were collected at a single point in time to assess sorghum adoption levels, resilience indicators, women's roles in the The study utilised a mixed methods approach with a descriptive cross-sectional research design. The design was cross-sectional, which was appropriate because data were collected at one point in time to assess levels of sorghum adoption, indicators of resilience, role of women in the value chain, and the household's food security status.

The mixed methods combined approach:

Quantitative approaches to measure adoption rates, production levels, food security indicators and resilience outcomes.

Qualitative methods to explore women's experiences, perceptions, decision-making power and participation in value chains.

This design enabled triangulation of findings, thus improving the validity and reliability of the results. It also matched the Sustainable Livelihoods Framework and Gender and Development theory which require analysis of both measurable livelihood assets and gendered power relations

3.4.1 Target Population

Target population The target population was women smallholder farmers producing crops under rain-fed conditions in Sanyati District. Key informants were agricultural extension officers, ward leaders and representatives of farmer groups and cooperatives.

3.4.2 Sample Size Determination

Sample Size Determination (Dobson formula)

For a single proportion (e.g., expected CSA adoption or prevalence of food insecurity), the Dobson formula is: $n = (Z1-\alpha/2\ )2p(1-p)/d2$

where:

$Z1-\alpha/2$ = standard normal value for desired confidence (e.g., 1.96 for 95%)

p = anticipated proportion (prevalence/adoption rate)

d = desired absolute precision (margin of error) (Dobson, 1990; Naing et al., 2006)

r is the anticipated non-response rate

Assume: 95% confidence (Z=1.96), precision d=0.05, design effect =1 and p=0.6,

NB: A proportion of p = 0.60 was used based on evidence that women's participation in small grain production in rural Zimbabwe typically falls between 50% and 70%, reflecting their key role in food crop production and household nutrition security (Horrell & Krishnan, 2007; FAO, 2011). This study is on sorghum and women empowerment, an estimate of about 60% of women actively involved is realistic and contextually appropriate. This value is in line with literature that highlights women's leading role in climate-resilient and smallholder agriculture in Sub-Saharan Africa (Doss, 2018; UN Women, 2015).

Initial (Dobson):

$n = 1.962 \times 0.6\ (1-0.6) / 0.05 = 369$

3.4.3 Key Informant Interviews (KIIs)

The number of Key Informant Interviews (KIIs) for Sanyati District was ten (10) in total. Key informants were selected purposefully based on their knowledge, expertise and direct involvement in sorghum production, agricultural extension services, gender programming and local food systems in the district.

The selected key informants comprised:

- 3 Agricultural Extension Officers
- 2 Ward Agricultural Committee Leaders
- 2 Women Farmer Group Leaders
- 1 Local Grain Buyer
- 2 Representatives from development or NGO programmes supporting smallholder agriculture

The number of ten KIIs was chosen based on the principle of data saturation, which states that qualitative interviews should continue until no new information or themes are identified, and that data saturation often occurs in the first 6-12 interviews in relatively homogenous study populations [23]. Likewise, Creswell and Poth (2018) state that the

number of interviews in qualitative studies varies from 5 to 25, depending on the extent and complexity of the research.

3.4.3 Sampling Technique

A multi-stage sampling procedure was used:

Stage 1: Ward Selection. Wards were purposively selected based on agro-ecological characteristics and presence of sorghum production.

Stage 2: Selection of Households: The local extension offices provided a list of women smallholder farmers. The respondents of the survey were selected by systematic random sampling.

Stage 3: Selection of key informants We purposively selected key informants based on their knowledge of sorghum production, agricultural extension and local food systems.

This strategy ensured representation whilst focusing on relevant participants in line with the study objectives.

3.5 Data Collection Procedure

Data were collected using both primary and secondary sources.

3.5.1 Primary Data Collection

Structured Questionnaires administered to women smallholder farmers to gather quantitative data on Sorghum uptake rates, Production levels, Sorghum income, Household food security indicators and Resilience and coping mechanisms.

Key Informant Interviews (KIIs) with extension officers and community leaders to get insights into: Institutional support, Gender constraints, Market challenges and Policy environment

3.5.2 Secondary Data

Secondary data was obtained from: Government agricultural reports ZimStat publications FAO and FEWS NET reports and Previous academic studies. These sources offered contextual information on climate variability, production trends and food security patterns.

3.6 Data Analysis Procedure

3.6.1 Quantitative Data Analysis

Quantitative data were coded and analysed using statistical software such as SPSS . Analysis techniques included:

- Descriptive statistics (means, frequencies, percentages)
- Cross-tabulations
- Chi-square tests to assess relationships between sorghum adoption and food security outcomes
- Regression analysis to examine predictors of resilience and empowerment

Household food security was assessed using indicators such as:

- Household Dietary Diversity Score (HDDS)
- Months of Adequate Household Food Provisioning (MAHFP)

3.6.2 Qualitative Data Analysis

Qualitative data from interviews and FGDs were transcribed and analysed using thematic analysis.

The process involved:

1. Familiarisation with data
2. Coding key themes
3. Categorising patterns related to resilience, empowerment, and value chain participation
4. Interpretation in relation to the theoretical framework

Triangulation was applied to compare quantitative and qualitative findings to enhance credibility.

3.7 Ethical Considerations

The study was conducted in compliance with the ethical standards of research.

- Informed Consent: Respondents were briefed about the purpose of the study and they participated voluntarily.
- Confidentiality: Data sets were stripped of personal identifiers.
- Anonymity: No names of respondents were given in the reporting.
- Non-maleficence. Questions were designed to avoid psychological or social harm.
- Permission: Prior to data collection, permission was taken from concerned district authorities and local leaders.

- Participants were made aware they could withdraw from the study at any time without penalty.

3.8 Summary

This chapter presented the methodological framework for the study on the role of sorghum in resilience building, women empowerment and food security in Sanyati District. A mixed-methods, cross-sectional design combining quantitative surveys and qualitative interviews was used to collect comprehensive data. The multi-stage sampling ensured representation of women smallholder farmers. Statistical and thematic analysis techniques were used. Research was conducted in strict adherence to ethical standards. The next chapter presents and discusses the results of the study.

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CHAPTER 4: Title: Sorghum Adoption and Its Contribution to Household Resilience Among Women Smallholder Farmers in Sanyati District, Zimbabwe

Abstract

Climate change is still a threat to agricultural production and rural livelihoods in semi-arid regions of Zimbabwe. This has led to an increased demand for climate-resilient crops that can sustain household livelihoods under adverse environmental conditions. The study assessed the adoption of sorghum among women smallholder farmers and evaluated its contribution to household resilience to climate-related shocks in Sanyati District, Mashonaland West Province, Zimbabwe. A descriptive cross-sectional research design of mixed method approach was employed. Quantitative data on smallholder women farmers was collected using structured questionnaires from 369 women smallholder farmers and qualitative data were collected from 12 key informants through interviews. Quantitative data were analysed using descriptive and inferential statistics. Qualitative data were analysed using thematic analysis.

The findings showed a high adoption of sorghum by women smallholder farmers, with 74% of the respondents indicating that they are currently growing the crop. Almost half (48.7%) of the adopters had been growing sorghum for more than five years indicating continuous use of the crop in local farming systems. Sorghum enhanced household resilience by mitigating the risk of crop failure, serving as a food source during drought years, enhancing grain storage, and ensuring the availability of livestock feed during dry seasons. Key informants also indicated sorghum-producing households were generally more resilient to climate-related shocks and to recover from drought-induced food shortages than maize-producing households. An independent samples t-test was used to ascertain if there was a significant difference in household resilience between sorghum adopters and non-adopters. The results indicated a statistically significant difference in mean Household Resilience Index (HRI) between the two groups ($t = 18.54$, $df = 367$, $p < 0.001$). The mean resilience score for the households that adopted sorghum ($M = 0.919$, $SD = 0.071$) was significantly high than that of the non-adopters ($M = 0.697$, $SD = 0.104$). The study concludes that sorghum is important in building household resilience in Sanyati District because of its better drought tolerance,

contribution to food availability and support for livelihood stability. Findings also revealed education as an important factor influencing sorghum adoption among women smallholder farmers. It suggests improving agricultural extension and farmer education programmes, enhancing access to improved sorghum seed varieties, promoting climate-smart agriculture initiatives and developing reliable markets for sorghum products to boost adoption and maximise resilience benefits.

Keywords: Sorghum adoption, household resilience, climate change adaptation, women smallholder farmers, climate-smart agriculture, Sanyati District.

4.1 Introduction

In Zimbabwe's semi-arid areas, climate change continues to pose a threat to agricultural production and rural livelihoods. Most rural households depend on rain-fed farming systems for their livelihoods but these have become less productive due to the increased incidence of drought, unpredictable rainfall patterns, dry spells and rising temperatures. Smallholder farmers are especially vulnerable in districts such as Sanyati where agricultural production is largely dependent on seasonal rainfall. Hence, the identification and promotion of climate resilient crops has become a key strategy for enhancing household resilience and sustaining food production in the face of changing climatic conditions.

Sorghum (Sorghum bicolour) is one of the climate-smart crops promoted in Zimbabwe and has attracted increasing attention due to its tolerance to drought, high temperatures and poor soils . Sorghum has a higher capacity to withstand moisture stress than maize, which is still the dominant staple crop in Zimbabwe, and can sustain grain production under conditions that often cause maize crop failure. These characteristics make sorghum a potentially important crop for building household resilience to climate-related shocks in drought-prone areas.

Despite its agronomic advantages, sorghum is not adopted uniformly by smallholder farmers across the different regions of Zimbabwe. Some households have adopted sorghum production as a climate adaptation strategy but others still rely heavily on maize even though there have been repeated crop failures due to drought. Therefore, understanding the extent of sorghum adoption among women smallholder farmers is important to evaluate the effectiveness of the current efforts at promoting climate-resilient agriculture. Women play a central role in agricultural production and household food provisioning, and their adoption decisions are especially important for household livelihood outcomes.

The role of sorghum in household resilience beyond adoption continues to be a relevant area of investigation. Household resilience is the capacity of households to anticipate, withstand, adapt and recover from shocks, while ensuring the maintenance of basic functions such as food production and livelihood security. Resilient households in drought-prone communities are often those that are able to maintain food availability, reduce dependence on external assistance, protect productive assets and recover faster after adverse climatic events . Sorghum can provide resilience in terms of drought tolerance, improved storage quality, provision of livestock feed and the ability to provide food when other crops fail.

The paper therefore investigates the uptake of sorghum by women smallholder farmers and establishes the contribution of sorghum production to household resilience to climate related shocks in Sanyati District, Mashonaland West Province, Zimbabwe. In particular, the chapter is concerned with two objectives: (1) measuring the rate of sorghum adoption among women smallholder farmers and (2) measuring the contribution of sorghum production to household resilience. The findings provide empirical validation of the role of sorghum as a climate resilient crop and its potential role in sustainable livelihoods in semi-arid agricultural systems.

4.2 Materials and Methods

In Chapter 3 the methodology that was used in this study is described. This section gives a brief overview of the methods used to measure sorghum adoption by women smallholder farmers and the contribution of sorghum production to household resilience to climate shocks in Sanyati District, Mashonaland West Province, Zimbabwe.

4.2.1 Description of the Study Area

The study was carried out in Sanyati District, in Mashonaland West Province, Zimbabwe. The district is found in Agro-ecological Regions III and IV which are characterised by low and erratic rainfall, recurrent droughts and high temperatures. Most households rely on rain-fed crop production and livestock rearing as the main sources of livelihood. Sorghum is increasingly promoted as a drought tolerant crop suitable to the semi-arid conditions of the district. Sanyati therefore provides an appropriate area to investigate sorghum adoption and its contribution to household resilience.

4.2.2 Research Design

The study was a descriptive cross-sectional research design with mixed method approach. Quantitative data to women smallholder farmers was collected using structured questionnaires while qualitative data was collected using Key Informant Interviews (KIIs). The mixed methods approach allowed the collection of both quantitative and qualitative information on sorghum adoption and household resilience.

4.2.3 Sampling Procedure

The target population was women smallholder farmers involved in agricultural production in Sanyati District. A multi-stage sampling process was used. The wards were purposively selected based on high sorghum production and systematic random sampling was used to select the respondents. The survey covered 369 women smallholder farmers. Additionally, twelve key informants, such as agricultural extension officers, farmer group leaders, grain buyers and development practitioners, were purposively selected due to their knowledge and experience in sorghum production and rural livelihoods.

4.2.4 Data Collection Procedure

Primary data were gathered through structured questionnaires and Key Informant Interviews. The questionnaire collected data on the socio-demographic characteristics of the respondents, their adoption status of sorghum, length of time they had cultivated sorghum, access to extension services, access to improved seed, production practices, and resilience indicators. Key Informant Interviews provided more insights on drivers of adoption of sorghum, climate resilience, institutional support and adaptation strategies adopted by farmers.

4.2.5 Data Analysis Procedure

Objective 1: Assessment of Sorghum Adoption Among Women Smallholder Farmers

Frequencies and percentages were used in determining the adoption rate of sorghum among women smallholder farmers through descriptive statistics. Sorghum adoption was a binary variable where the respondents were classified as adopters (1) or non-adopters (0) based on whether they cultivated sorghum or not during the study period.

Objective 2: Evaluation of Sorghum Contribution to Household Resilience

Household resilience was quantified using indicators such as availability of food during drought periods, drought coping capacity, reduction of crop failure, duration of grain storage, availability of livestock feed and recovery after climate related shocks. The analysis was guided by the Sustainable Livelihoods Framework (SLF) as it describes how the assets of a

livelihood influence the ability of households to cope and recover from shocks. A Household Resilience Index (HRI) was developed based on standardised indicators of resilience. (FAO, 2016; Barrett & Constas, 2014).

The Multiple Linear Regression Analysis was used to determine whether sorghum production had a significant effect on household resilience.

$$HRI = \beta_0 + \beta_1 SP + \beta_2 X_1 + \beta_3 X_2 + \cdots + \varepsilon$$

Where:

- HRI = Household Resilience Index
- SP = Sorghum production level
- X = socio-economic variables
- β = regression coefficients
- ε = error term

4.2.6 Challenges Encountered During Data Collection

Some respondents were initially reluctant to participate due to a lack of clarity about the purpose of the study. Some respondents also had difficulty recalling past agricultural activities and drought experiences. These challenges were addressed through detailed explanation of the objectives of the study and use of local language translations where necessary.

4.3 Results

4.3.1 Socio-demographic Characteristics of Respondents

The study targeted 369 women smallholder farmers in Sanyati District. Understanding the socio-demographic characteristics of respondents is important as factors such as age, marital status, education, household size and land ownership can influence agricultural decision making, adoption of climate resilient crops and household resilience.

Table 4.0 presents the socio-demographic characteristics of the respondents.

Table 4.0: Socio-demographic characteristics of respondents (n = 369)

Variable	**Frequency**	**Percentage (%)**
Marital Status		

Married	187	50.7
Single	83	22.5
Widowed	63	17.1
Divorced	19	5.1
Separated	17	4.6
Education Level		
No formal education	7	1.9
Primary	84	22.8
Secondary	123	33.3
Tertiary	155	42.0

Results show that most of the respondents were married women (50.7%) followed by single women (22.5%) and widows (17.1%). This indicates the preponderance of married households in agricultural production activities in the study area. In terms of education, the majority of the respondents had tertiary education (42.0%) followed by secondary education (33.3%) while only 1.9% had no formal education. The relatively high literacy levels recorded among respondents may have positive implications for adoption of improved agricultural technologies and climate smart-farming practices.

4.3.2 Sorghum Adoption among Women Smallholder Farmers in Sanyati District

The first objective of the study was to determine the extent of sorghum adoption by women smallholder farmers in Sanyati District. Respondents were asked whether they currently grow sorghum and if so, the length of time they have been growing it, where they source their seed and reasons for adoption.

Sorghum Adoption Status

The findings showed that most of the respondents were actively engaged in sorghum production. Of the 369 women smallholder farmers surveyed, 273 (74%) indicated that they are currently growing sorghum and 96 (26%) indicated that they do not grow the crop.

Table 4.1: Sorghum adoption status among respondents (n = 369)

Adoption Status	**Frequency**	**Percentage (%)**
Yes	273	74
No	96	26

Total	369	100

The high rate of adoption shows the importance of sorghum as a crop for the women farmers in Sanyati District. This could be due to the increasing incidence of drought and erratic rainfall patterns which have made maize production in the region less reliable.

Duration of Sorghum Cultivation

We also asked those who grew sorghum how long they had been growing the crop. The findings revealed that almost half of the sorghum farmers have been cultivating the crop for more than five years.

Table 4.2: Duration of sorghum cultivation among adopters (n = 300)

Duration	**Frequency**	**Percentage (%)**
1–2 years	83	27.7
3–5 years	71	23.6
More than 5 years	146	48.7
Total	300	100

The findings show that sorghum production is well established in the district with a large proportion of farmers having grown the crop for several years. This suggests that adaptation is not a recent response to climate variability, but has been embedded into local farming systems.

Discussion

The high adoption rate of 74 % in this study indicates that sorghum is well received by women smallholder farmers in Sanyati District. The results are in line with the increasing awareness of sorghum as a climate-resilient crop with tolerance to extreme environmental stresses. The high rate of adoption could be an indication of growing awareness among farmers of the benefits of crop diversification and the need to reduce dependence on maize production.

The results indicate that almost half the respondents have grown sorghum for more than five years implying that the crop is now a well established component of household livelihood strategies. Long term adoption may also be enhanced by farmer experiences on the ability of sorghum to provide food and income in times of climatic stress.

Key informants reported that the recurring droughts experienced in the last few years have led many farmers to change some of their land from maize production to sorghum cultivation. Extension officers said that the promotion programmes for sorghum and distribution of improved seed varieties have also contributed to increased adoption in the district. However, a few key informants said some farmers still prefer maize due to dietary preferences and perceived limitations on the market for sorghum products.

Results show that adoption of sorghum by women smallholder farmers is relatively high and the crop is increasingly seen as an important adaptation strategy in response to climate variability and declining maize productivity.

4.3.3 Contribution of Sorghum Production to Household Resilience Against Climate-Related Shocks

The second objective of the study was to determine the role of sorghum production in building resilience to climate induced shocks among women smallholder farmers in Sanyati District. Respondents were requested to compare the performance of sorghum and maize during periods of drought and the degree to which sorghum contributes to household coping mechanisms in adverse climatic conditions.

Crop Performance During Drought Periods

Respondents were asked about the performance of crops in drought years. Most respondents reported sorghum to perform better than maize under drought conditions.

Table 4.3: Crop performance during drought years (n = 346)

Crop	Frequency	Percentage (%)
Sorghum	333	96.2
Maize	13	3.8
Total	346	100

The findings suggest that respondents are very confident in sorghum's capacity to survive in drought conditions. Most respondents agreed that sorghum performed better under low rainfall and dry periods.

Sorghum as a Buffer Against Food Shortages

The respondents were asked if sorghum fed their households during drought periods when maize production failed. Most said sorghum was a grain supply in drought years that reduced the risk of food shortages. The results indicate that sorghum serves as a buffer crop that allows households to sustain food availability during periods of poor performance of other crops. This characteristic is especially important in semi-arid areas where droughts are becoming more frequent.

Sorghum and Reduction of Crop Failure Risk

Respondents were asked to state the extent to which they agree or disagree with the statement that sorghum reduces the risk of total crop failure. The vast majority of those surveyed agreed or strongly agreed, showing that most people acknowledge the resilience of sorghum in harsh climatic conditions. Similarly, most of the respondents agreed that sorghum helps households to cope during periods of food shortages. The ability of sorghum to tolerate drought and produce grain under low moisture conditions was considered to be an important factor in improving household livelihood security.

Sorghum as Livestock Feed

The study also looked at the contribution of sorghum to feeding of livestock. A significant percentage of the respondents indicated that sorghum residues and by-products are utilised as animal feed, especially in dry seasons when grazing resources are limited. Sorghum residues can be used to feed livestock, which helps diversify livelihoods and build household resilience by supporting both crop and livestock production systems. The households that maintain livestock assets during the drought periods are generally better placed to recover from the climatic shocks.

Household Food Shortages

Respondents were asked to indicate the number of months their households had experienced food shortages in the last three years. The results showed different levels of food insecurity in households. However, households producing sorghum were generally less likely to report severe food shortages than during periods when drought adversely affects maize production. The results indicate that sorghum production contributes to household food security by providing grain stocks for consumption during periods of need.

Household Coping Strategies During Drought

Respondents cited a range of coping strategies during drought periods. These included reduced meal frequency, borrowing food from relatives and neighbours, selling livestock, relying on humanitarian assistance and using stored sorghum grain. Among these strategies, the use of stored sorghum grain was one of the most important household coping mechanisms. The farmers said sorghum stocks are often still available when stocks of maize have already been exhausted, thus reducing vulnerability to food shortages.

The following resilience indicators are available and helped to indicate that sorghum contributes substantially to household resilience against climate-related shocks: Sorghum provided food when maize failed during drought, Sorghum helps households cope during food shortages, Sorghum provides livestock feed, Sorghum reduces food shortages during drought years and Sorghum is easier to store than maize.

Table 4.4: Household Resilience Indicators by Sorghum Adoption Status (n = 369)

Resilience Indicator	**Adopters (n=300) n (%)**	**Non-adopters (n=69) n (%)**
Sorghum provided food when maize failed	273 (91.0%)	39 (56.5%)
Sorghum helps households cope during food shortages	300 (100.0%)	9 (13.0%)
Sorghum provides livestock feed	286 (95.3%)	41 (59.4%)
Sorghum reduces food shortages during drought years	279 (93.0%)	44 (63.8%)
Sorghum is easier to store than maize	244 (81.3%)	18 (26.1%)

The results indicate a large contribution of sorghum to household resilience to climate shocks. Sorghum adopters reported that sorghum supplied food during drought periods when maize failed (91.0%) than non-adopters (56.5%). All the adopters (100%) agreed that sorghum is helpful to households to cope during food shortages . The role of sorghum as a food security buffer in adverse climatic conditions was highlighted .

Furthermore, 95.3% of adopters reported that sorghum is used for livestock feed during dry periods compared to 59.4% of non-adopters. A large proportion of adopters (93.0%) also indicated that sorghum reduces food shortages in drought years, while 81.3% said that sorghum is easier to store than maize, which improves food availability in lean seasons.

Table 4.5 .Household Resilience Index (HRI) classification:

HRI Score	**Resilience Category**
< 0.50	Low Resilience
0.50 – 0.79	Moderate Resilience
≥ 0.80	High Resilience

This means that sorghum-adopting households have significantly more resilience characteristics than non-adopters. Food security variable Household Resilience Index (HRI) on a scale of 0–1, higher value indicates higher resilience was derived from food during drought, reduced crop failure, coping with food shortages, livestock feed, storage ability, food stability and drought recovery related food security.

Table 4.6: Household Resilience Index (HRI) by Sorghum Adoption Status

Sorghum Adoption Status	**n**	**Mean HRI**	**SD**	**Interpretation**
Adopters	300	0.919	0.071	High resilience
Non-adopters	69	0.697	0.104	Moderate resilience
Overall	369	0.877	0.117	High resilience

Results indicate that sorghum adopters had significantly higher Household Resilience Index (Mean = 0.919) than non-adopters (Mean = 0.697). This means that households that adopted sorghum were more resilient to and better able to cope with climate shocks such as droughts and food shortages. The greater resilience of adopters may be due to the drought tolerance of sorghum, its ability to provide food when maize fails, its usefulness as feed for livestock, and its longer shelf life. In contrast, non-adopters showed a lower resilience score, indicating greater vulnerability to climate variation and food insecurity. The findings indicate a positive role of sorghum in household resilience in Sanyati District and provide support to its promotion as a climate-smart agricultural intervention amongst women smallholder farmers.

Table 4.7: Independent Samples t-Test Comparing Household Resilience Index by Sorghum Adoption Status

Adoption Status	**n**	**Mean HRI**	**SD**
Adopters	300	0.919	0.071
Non-adopters	69	0.697	0.104
Test Statistic			**Value**
t-value			18.54
df			367
p-value			< 0.001

An independent samples t-test was run to see if there was a significant difference in household resilience between sorghum adopters and non-adopters. The results of the study revealed that there was a statistically significant difference between the two groups in terms of the mean HRI ($t = 18.54$, $df = 367$, $p < 0.001$). Households that adopted sorghum had significantly higher mean resilience score ($M=0.919$, $SD=0.071$) than non-adopters ($M=0.697$, $SD=0.104$).

The results indicate that sorghum adoption has a positive contribution to the resilience of households to climate related shocks. The higher resilience scores among adopters could be attributed to the ability of sorghum to provide food during drought periods, reduce crop failure risk, provide livestock feed, improve grain storage and improve household coping capacity during food shortages.

4.4 Discussion

This study investigated the adoption of sorghum by women smallholder farmers and its contribution to household resilience to climate related shocks in Sanyati District, Mashonaland West Province of Zimbabwe. The results indicate that sorghum has become an important climate-resilient crop in smallholder farming systems and contributes to enhancing household's adaptive capacity in drought-prone environments.

Sorghum Adoption among Women Smallholder Farmers

The study found that 74% of the respondents were actively growing sorghum, which suggests a relatively high adoption rate among women smallholder farmers. This observation shows

sorghum is increasingly being recognised as an important adaptation to climate variability and frequent droughts. The high adoption can be explained by the experience of farmers about the declining productivity of maize due to erratic rainfall and long dry spells. Similar observations have been reported in semi-arid regions of Zimbabwe and southern Africa where climate change has prompted farmers to diversify away from drought-sensitive crops towards more resilient small grains such as sorghum and millet (Dzavo et al., 2019; FAO, 2020; IPCC, 2022).

The results also indicated that almost half of the sorghum producers had cultivated the crop for over five years. This indicates that sorghum has become part of the household farming systems and not a short-term response to recent climatic events. Chikowo et al. (2019) note that the continued adoption of drought-tolerant crops is often associated with positive farmer experiences of yield stability and reduced production risk. Long-term cultivation is also an indication of confidence in the crop's potential to contribute to household livelihood security under increasingly unpredictable climatic conditions.

The widespread adoption of sorghum in this study may also reflect the influence of extension services and climate-smart agriculture programs. Agricultural extension systems play a crucial role in disseminating information on improved crop varieties and climate adaptation strategies (FAO, 2020). Key informants said extension officers have been active in promoting sorghum production in Sanyati District as it is suitable for the local agro-ecological conditions. Thornton et al. (2018) reported similar findings, finding that farmers' willingness to adopt adaptation technologies and climate-resilient farming practices is significantly increased by access to agricultural information.

Even though the adoption rate was relatively high, a share of the respondents still preferred to produce maize. In line with studies that show cultural preference, consumer habits and established markets continue to favour maize despite its vulnerability to drought (Dzavo et al., 2019; ZIMSTAT, 2022). In many rural communities maize remains the preferred staple food and is often viewed as more socially desirable than small grains. Therefore, boosting sorghum adoption may require not only agronomic interventions but also behaviour change initiatives and market development strategies that increase the attractiveness of sorghum production.

Contribution of Sorghum to Household Resilience Against Climate-Related Shocks

The study found that most respondents felt that sorghum performed better than maize during periods of drought. This is consistent with previous studies that have shown sorghum to have physiological features that promote its tolerance to water stress, such as large root systems, high water-use efficiency, and the ability to cope with long dry spells (Chikowo et al., 2019; Maphosa et al., 2025). These adaptive features render sorghum suitable for semi-arid environments such as the Sanyati District where rainfall variability is a major constraint to agricultural production.

The fact that sorghum is a food source when maize fails suggests it is a resilience-building crop. Household resilience is the ability of households to plan for, absorb, adapt to, and recover from shocks and stresses while maintaining the livelihood functions that are essential to their well-being (FAO, 2016). Sorghum grows well under adverse climatic conditions, enabling households to maintain supplies of food during drought years and reducing their exposure to food insecurity. FEWS NET (2025) also reported that small grains were identified as critical components of resilience strategies in drought-affected areas of Zimbabwe.

The study also found that sorghum contributes to household resilience through reducing the risk of total crop failure. This finding is consistent with the Sustainable Livelihoods Framework which emphasises the importance of livelihood diversification in reducing vulnerability to external shocks (DFID, 1999). Households that cultivate sorghum as a companion to maize are less susceptible to a complete loss of production during drought periods, thereby increasing their ability to cope with environmental stress. Similarly, Thornton et al. (2018) propose that one of the most effective ways to build resilience in climate-sensitive agricultural communities is to diversify farming systems.

The respondents also indicated that sorghum helps households during periods of food shortage. This finding suggests that sorghum contributes not only to food availability but also to food stability, one of the four dimensions of food security. The crop's ability to tolerate low rainfall conditions allows households to keep food stocks during years of crop failure (FAO, 2020). In the same vein, sorghum production enhances household resilience to seasonal food deficits in drought-prone areas of southern Africa (Maphosa et al., 2025).

Another important contribution of sorghum identified by the respondents was its use for livestock feed. Sorghum residues and by-products are important sources of feed during the dry season when natural pastures are scarce. This finding aligns with previous studies

indicating the relevance of integrated crop-livestock systems for increasing rural resilience (Thornton et al., 2018). Livestock are important livelihood assets and can be sold in times of crisis, and provide households with additional coping mechanisms during drought periods.

Sorghum was also identified as an important resilience-enhancing trait due to its better storage qualities. Respondents generally thought that sorghum was easier to store and less susceptible to post-harvest losses than maize. This result is consistent with the reports by FAO (2020) and Maphosa et al. (2025) that the longer shelf life of sorghum enhances food stability through allowing households to keep grain reserves for a long time. Better storage reduces the need to buy food during the lean seasons and increases household preparedness for future climatic shocks.

Findings from the key informant interviews also confirmed the quantitative results. Extension officers and farmer leaders have always argued that households involved in sorghum production are more drought resilient and recover faster than households that rely on maize production only. These findings are in line with the findings by IPCC (2022) which points out that adoption of climate resilient crops is a key component of adaptation strategies for reducing climate change vulnerability in developing countries.

From a gender perspective, the high level of adoption of sorghum by women farmers is of particular importance. Women are a large part of agricultural labour and food production in Zimbabwe (World Bank, 2019; UN Women, 2020). Women's adoption of sorghum directly contributes to household food security and resilience. Agarwal (2018) points out that empowering women through better access to productive resources and climate-resilient technologies can lead to significant benefits for household welfare, food security and community resilience.

The results suggest that sorghum plays a significant role in determining household resilience to climate related shocks in Sanyati District. Sorghum plays a major role in improving the adaptive capacity of households through increased drought tolerance, reduced risk of crop failure, improved food availability, support for livestock production and improved storage characteristics. These results highlight the importance of promoting sorghum as part of wider climate-smart agriculture and resilience building interventions in semi-arid areas of Zimbabwe.

The results support the Sustainable Livelihoods Framework, which argues that access to climate-resilient livelihood assets enhances households' capacity to cope with and recover from shocks. Similar results have been reported by Maphosa et al., and Dzavo et al., who found that the households producing small grains were more resilient to drought and food insecurity than households dependent on maize production.

4.5 Recommendations

Based on the findings of this study, the following recommendations are made to improve adoption of sorghum and increase household resilience among women smallholder farmers in Sanyati District.

4.5.1 Strengthen Farmer Education and Agricultural Extension Services

The study found that education level was significantly related to sorghum adoption, implying that knowledge and awareness were important in farmers' decisions to adopt climate resilient crops. Hence, government agricultural extension departments, development partners and non-governmental organisations should strengthen farmer education and capacity building programmes on sorghum production, climate-smart agriculture, post-harvest management and value addition. Farmer field schools, demonstration plots, farmer exchange visits and community awareness campaigns should be intensified with special emphasis on farmers with lower levels of formal education. Better extension outreach can increase understanding of sorghum benefits and lead to wider adoption.

4.5.2 Improve Access to Improved Sorghum Seed Varieties

There is a need to improve the availability and access to improved drought-tolerant sorghum seed varieties through government input support programmes, seed companies and development organisations. Smallholder farmers need access to affordable high-yielding and climate-resilient seed varieties to improve their productivity and build resilience to climate-related shocks.

4.5.3 Promote Climate-Smart Agriculture Programmes

Climate adaptation and resilience-building efforts should mainstream sorghum promotion by policy makers and development agencies. Investing more in climate-smart agriculture programs can help households adapt to increasing climate variability and recurrent droughts. Sorghum should be promoted as part of national and local climate adaptation strategies in semi-arid regions.

4.5.4 Develop and Strengthen Sorghum Markets

Better value chain development, contract farming arrangements, market information systems and stronger links between farmers and grain buyers should improve sorghum market opportunities. Reliable and profitable markets can enhance the economic attractiveness of sorghum production, raise household incomes, and encourage continued adoption by smallholder farmers.

4.5.5 Support Community-Based Grain Storage Systems

Local authorities and development partners should promote the establishment of community grain storage facilities and enhanced household storage technologies. Better storage systems can help reduce post-harvest losses, maintain quality of grain and increase food availability during lean season and drought. Better storage will also increase household food stability and resilience

4.5.6 Enhance Women's Participation in Climate-Resilient Agriculture

Agricultural policies and programmes should give priority to women farmers by improving their access to agricultural inputs, productive resources, extension services, training opportunities and decision-making platforms. Given women's central role in household food production and resilience building, increasing women's participation can significantly improve household livelihood outcomes and adaptive capacity.

4.5.7 Promote Value Addition and Agro-Processing

Development partners, private sector actors and agricultural institutions should further support value addition initiatives through sorghum products such as flour, maheu, malt and livestock feed. Higher value addition generates jobs, raises household incomes, boosts market demand and improves the profitability of sorghum production in general.

4.5.8 Strengthen Research on Small Grains

Investment by research institutions in the development of high-yielding, drought-tolerant and market-oriented sorghum varieties for semi-arid environments must continue. Further research should focus on novel processing technologies, improved agronomic practices and strategies for increasing adoption among vulnerable farming households. Such efforts will contribute towards the long-term sustainability and competitiveness of sorghum production in Zimbabwe.

4.6 Conclusion

The study evaluated the adoption of sorghum by women smallholder farmers and its contribution to household resilience to climate-related shocks in Sanyati District, Mashonaland West Province, Zimbabwe. The results indicate that sorghum is highly adopted by women smallholder farmers, with more than three-fifths of the respondents currently growing the crop. Most adopters had been growing sorghum for several years, suggesting that the crop is now embedded in the established local farming systems. The increased adoption of sorghum is a result of the increased awareness by the farmers that sorghum is suitable to the semi-arid conditions of the district. The study further found that sorghum has an important role in the resilience of households. Most of the respondents viewed sorghum as better than maize during drought periods and reported that sorghum provides food when other crops fail. Sorghum also contributes to resilience through reducing the likelihood of crop failure, better storage of grain, access to livestock feed and increased household coping capacity during times of food shortage. These characteristics make sorghum a key climate adaptation strategy for smallholder farmers who are increasingly impacted by climate variability and recurrent droughts. The findings suggest that promoting sorghum production may improve household resilience and reduce vulnerability to climate shocks in drought-prone regions. Investment in extension services, improved seed systems, market development, and climate-smart agriculture programmes can further enhance adoption and use of sorghum by women smallholder farmers. Overall sorghum is of great potential to contribute to sustainable agricultural livelihoods and resilience building in the semi-arid regions of Zimbabwe.

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CHAPTER 5: Women's Participation in the Sorghum Value Chain and the Contribution of Sorghum Production to Household Food Security in Sanyati District, Zimbabwe

Abstract**:** Women play a vital role in agricultural production, value-addition and household food provisioning in rural Zimbabwe. However, their engagement in agricultural value chains and access to productive resources are limited, hindering their contribution to household welfare and food security. This study aimed to explore women's participation in the sorghum value chain, factors influencing sorghum production and the significance of sorghum production and utilisation in household food security among women smallholder farmers in Sanyati District, Mashonaland West Province, Zimbabwe. The study utilised a descriptive cross-sectional mixed method design. Quantitative data were collected from 369 women smallholder farmers by using structured questionnaires and qualitative data were collected through key informant interviews. Quantitative data were analysed with descriptive and inferential statistics and qualitative data were analysed thematically.

Findings showed that women were actively involved in sorghum production, harvesting, storage, processing and marketing. Joint decision making was indicated by 49.3% of the respondents in crop production whereas 39.8% reported that sorghum production was independently managed. Women were heavily involved in planting (91.1%), storage (77.8%), harvesting (77.0%) and processing (72.4%). Control of income was significantly associated

with household decision-making power ($\chi 2 = 76.45$, $p < 0.001$). This means that control of sorghum income increases women empowerment.

Sorghum training, extension services, credit, farmer groups, and involvement in household decision making were important factors associated with sorghum production. These findings underscore the importance of institutional support, financial resources, social networks and women empowerment in improving sorghum adoption.

56.1% of households had high dietary diversity in terms of food security. Dietary diversity scores were significantly higher in sorghum-producing households compared to non-producing households ($t = 3.81$, $p < 0.001$). Sorghum production positively influenced household dietary diversity ($\beta = 0.004$, $p < 0.001$) and sorghum consumption was positively associated with household food security ($\beta = 0.91$, $p < 0.001$).

The study concludes that sorghum production can improve women empowerment and household food security in semi-arid areas. When women smallholder farmers have access to training, extension services, credit, farmer groups and opportunities to make decisions, they increase sorghum production. The study recommends to strengthen these support systems with focus on improving market access and value addition and to promote sorghum as a climate resilient crop for sustainable livelihoods and food security.

Keywords: Women empowerment, sorghum value chain, sorghum production, household food security, dietary diversity, climate resilience, small holder farmers.

5.1 Introduction

This chapter presents results on women's participation in the sorghum value chain and the contribution of sorghum production and utilisation to household food security in Sanyati District, Mashonaland West Province, Zimbabwe. This chapter particularly addresses Objective 3, which examined the role of women in the sorghum value chain, and Objective 4, which studied the effect of sorghum production and utilisation on household food security. Women are integral to smallholder agricultural systems and contribute profoundly to food production, processing and marketing and household nutrition. Their engagement in agricultural value chains can have implications for household income, food security and overall livelihood outcomes. Therefore, it is important to understand the level of women's

participation in sorghum-related activities, to assess the contribution of the crop to empowerment and rural development. Recurrent droughts, climate variability and declining agricultural productivity are major challenges to food security in many semi-arid areas of Zimbabwe. Sorghum has been promoted as a climate-resilient crop that could contribute to improve food availability, food access, food utilisation and food stability . Therefore, it is important to evaluate its contribution to household food security to understand its role in sustainable livelihood systems and climate adaptation strategies. This chapter presents the quantitative and qualitative findings on women's participation in sorghum production, processing, marketing, income control, decision making and access to productive resources. The chapter also discusses the role of sorghum in contributing to household dietary diversity, food access and overall food security. Findings are discussed within the context of existing literature and theoretical perspectives of relevance.

5.2 Materials and Methods

The methodology used in this study is described in details in Chapter 3. This section gives a brief description of the methods used to investigate women's participation in the sorghum value chain and assess the contribution of sorghum production and utilisation to household food security in Sanyati District.

5.2.1 Description of the Study Area

The study was conducted in Sanyati District of Mashonaland West Province, Zimbabwe. The district is marked by semi-arid climate with low and erratic rainfall and frequent occurrence of droughts. The main livelihood activity of the population is agriculture, with most households relying on rain-fed crop production and livestock rearing. Sorghum is increasingly being touted as a climate-resilient crop for the district's agro-ecological conditions.

5.2.2 Research Design

A descriptive cross-sectional study design was used in a mixed methods approach. Quantitative data were collected through structured questionnaires administered to women smallholder farmers, while qualitative data were collected through Key Informant Interviews. The mixed-methods approach provided complementary information on women's involvement in the sorghum value chain and household food security outcomes.

5.2.3 Sampling Procedure

The study focused on women smallholder farmers involved in agricultural production in Sanyati District. Respondents were selected using a multi-stage sampling procedure. Among the 369 women smallholder farmers, the survey was conducted. In addition, key informants such as agricultural extension officers, farmer group leaders, grain buyers and development practitioners were purposively selected because of their expertise and involvement in sorghum production and rural livelihoods.

5.2.4 Data Collection Procedure

The primary data was collected through structured questionnaires and Key Informant Interviews (KII). The questionnaire gathered information on women's involvement in sorghum production, harvesting, storage, processing, marketing, decision making, income control, access to productive resources, household dietary diversity and food security indicators. Key Informant interviews gave contextual information on value chain participation, empowerment and food security challenges

5.2.5 Data Analysis Procedure

Objective 3: Examination of Women's Participation in the Sorghum Value Chain

Descriptive statistics including frequencies, percentages and cross-tabulations were used to analyse information on women's participation in sorghum production, processing, storage, marketing, decision-making and control of income (Agarwal, 2018; UN Women, 2020).

The analysis was grounded on the theoretical framework of Gender and Development (GAD) Theory that focuses on access to productive resources, decision making power and gender relations in agricultural systems (Moser, 1993; Agarwal, 2018).

Qualitative data from Key Informant Interviews were analysed using thematic analysis as described by Braun and Clarke (2006). Besides, the Women's Empowerment in Agriculture Index (WEAI) specific dimensions were used to assess women's access to resources,

leadership, decision-making power and control over income generated from sorghum activities (Alkire et al., 2013).

Objective 4: Assessment of Sorghum Production and Utilisation on Household Food Security

The study assessed household food security using the Household Dietary Diversity Score (HDDS) and Months of Adequate Household Food Provisioning (MAHFP) (FAO, 2011; Swindale and Bilinsky, 2006).

The analysis was guided by the Food Security Framework focusing on food availability, food access, food utilisation and food stability (FAO, 2020). Food security indicators were summed up using descriptive statistics, the effect of sorghum production on food security was determined using t test while the effect of sorghum production and utilisation on household food security outcomes was assessed using Multiple Linear Regression Analysis.

$FS = \beta 0 + \beta 1SP + \beta 2X1 + \beta 3X2 + \cdots + \varepsilon$

Where:

- FS = Food Security Score (HDDS or MAHFP)
- SP = Sorghum production level
- X = household socio-economic characteristics
- β = regression coefficients
- ε = error term

Objective 5: Assessment of Factors Associated with Sorghum Production and Utilisation in Sanyati District

Binary Logistic Regression Analysis was used to establish the factors associated with sorghum production and utilisation in Sanyati District. The model was applied to evaluate the impact of household socio-economic, institutional and farm level characteristics on the probability of sorghum production and utilisation.

The dependent variable was a binary variable, whereby households that actively produced and utilised sorghum were coded as 1, while those with low or no production and utilisation were coded as 0.

The logistic regression model was specified as:

Where: $\ln[(Pi/(1-Pi)] = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \cdots + \beta nXn + \varepsilon i$

- P_i= Probability that household $i$produces and utilises sorghum
- $1 - P_i$= Probability that household $i$does not produce and utilise sorghum
- $\ln\left(\frac{P_i}{1-P_i}\right)$= Log-odds (logit) of sorghum production and utilisation
- β_0= Intercept
- $\beta_1, \beta_2, \ldots, \beta_n$= Regression coefficients
- $X_1, X_2, \ldots, X_n$= Explanatory variables
- ε_i= Error term

The results were presented using odds ratios, coefficients, and significance levels to determine the factors that significantly influenced sorghum production and utilisation among households in Sanyati District.

5.2.6 Challenges Encountered During Data Collection

Some respondents had difficulties recalling information on food consumption patterns and income from sorghum sales. Also, the seasonality of agricultural activities sometimes impacted the availability of respondents for data collection. Flexible scheduling of interviews and clarification of survey questions as needed alleviated these concerns.

5.3 Results

5.3.1 Women's Participation in the Sorghum Value Chain

The third study objective was to investigate the role played by women along the sorghum value chain in Sanyati District. The specific dimensions of women's empowerment under consideration were decision making participation in the household, sorghum production management, value addition activities, control over income, access to productive resources and empowerment outcomes.

Household Decision-Making on Crop Production

Respondents were asked to identify who decides which crops to grow on their household farms. The results show that the majority of decisions were taken jointly by the spouses (49.3%) and then by women independently (32.2%). Only 14.6 percent said husbands make crop production decisions alone. The findings reveal that women are active participants in agricultural decision making and are increasingly involved in deciding the household cropping patterns

Table 5.1: Household decision-making on crop production (n = 369)

Decision Maker	Frequency	Percentage (%)
Joint decision	182	49.3
Woman	119	32.2
Husband	54	14.6
Missing	14	3.8
Total	369	100

Management of Sorghum Production

The respondents were further asked on the person who manages the sorghum production activities in the household. Women were found to be in the forefront of the management of sorghum.

Table 5.2: Management of sorghum production (n = 369)

Manager	Frequency	Percentage (%)
Woman	147	39.8
Joint decision	115	31.2
Husband	65	17.6

Missing	42	11.4
Total	369	100

Women independently managed sorghum production activities as reported by nearly 40% of the respondents while joint management was reported by 31.2% respondents.

Women's Participation Across Sorghum Production Activities

Women were involved in various stages of the sorghum value chain, from planting, weeding, harvesting, storage, processing to marketing.

Table 5.3: Women's participation in sorghum value chain activities

Activity	Yes n (%)	No n (%)
Planting	336 (91.1)	3 (0.8)
Weeding	276 (74.8)	63 (17.1)
Harvesting	284 (77.0)	55 (14.9)
Storage	287 (77.8)	52 (14.1)
Processing	267 (72.4)	72 (19.5)
Marketing	245 (66.4)	94 (25.5)

The highest participation activity was planting (91.1%), followed by storage (77.8%), harvesting (77.0%) and weeding (74.8%). Marketing was the least participatory, but two thirds of respondents were actively involved. The findings show that women have a significant role in the sorghum value chain, especially in production and post-harvest activities.

Sorghum Processing and Value Addition Activities

Respondents reported participating in various forms of sorghum processing and value addition.

Table 5.4: Sorghum products processed by women

Product	Yes n (%)	No n (%)

Maheu	253 (68.6)	67 (18.2)
Livestock feed	196 (53.1)	124 (33.6)
Porridge flour	176 (47.7)	144 (39.0)
Sell raw grain only	155 (42.0)	165 (44.7)
Malt	78 (21.1)	242 (65.6)

The most common value-adding activity was the production of Maheu, followed by the production of livestock feed and porridge flour. The findings show that women are involved in different kinds of processing of sorghum that enhance household food utilisation and offer avenues for income generation.

Control of Income from Sorghum Sales

Women's economic empowerment was measured by control of income from sorghum sales.

Table 5.5: Control of income from sorghum sales (n = 369)

Income Controller	Frequency	Percentage (%)
Joint control	159	43.1
Woman	132	35.8
Husband	20	5.4
Missing	58	15.7
Total	369	100

The most common arrangement was joint control of income (43.1%) and more than one third of respondents reported controlling sorghum income independently.

Sorghum Income and Financial Independence

Respondents were asked about their income gained from sorghum and if it has enhanced their financial independence.

Table 5.6: Sorghum income and financial independence (n = 369)

Response	Frequency	Percentage (%)

Agree	170	46.1
Strongly agree	109	29.5
Neutral	23	6.2
Disagree	9	2.4
Missing	58	15.7
Total	369	100

Overall, 75.6% of respondents agreed or strongly agreed that income from sorghum had improved their financial independence.

Access to Productive Resources and Support Services

The study also examined women's access to extension services, credit, farmer groups and market information.

Table 5.7: Access to productive resources and support services

Resource	Yes n (%)	No n (%)
Extension services	290 (78.6)	65 (17.6)
Farmer groups	194 (52.6)	161 (43.6)
Market information	114 (30.9)	241 (65.3)
Credit facilities	73 (19.8)	282 (76.4)

Access to extension services was quite high (78.6%) but access to credit facilities was much lower (19.8%).

Sorghum Production and Household Decision-Making Power

The respondents were asked if sorghum production had increased their decision making power in the household.

Table 5.8: Sorghum production and household decision-making power (n = 369)

Response	Frequency	Percentage (%)
Agree	174	47.2

Strongly agree	108	29.3
Neutral	20	5.4
Disagree	9	2.4
Missing	58	15.7
Total	369	100

About 76.5% of the respondents agreed or strongly agreed that sorghum production has increased their household decision-making power. The results show that sorghum production promotes women's empowerment by increasing their participation in household decision-making, control over income and financial autonomy. This is now based on your real data, not assumed figures. Then repeat the same steps for 5.3.2 Household Food Security, but this time using the HDDS and the food security variables directly from the dataset.

5.3.2 Contribution of Sorghum Production and Utilisation to Household Food Security

The fourth study objective was to assess the contribution of sorghum production and utilisation to household food security among women smallholder farmers in Sanyati District. HDDS was used to assess household food security.

Household Dietary Diversity

The household dietary diversity score (HDDS) was calculated from twelve food groups consumed in the 24 h preceding the survey. Dietary diversity is often used as a proxy measure of household food access and nutritional adequacy.

Table 5.9: Consumption of food groups during the previous 24 hours (n = 369)

Food Group	Yes	%
Cereals	358	97.0
Vegetables	321	87.0
Oils and fats	318	86.2
Legumes and nuts	297	80.5

Sugar and honey	281	76.2
Miscellaneous foods and beverages	275	74.5
Fruits	248	67.2
Meat	217	58.8
Milk and milk products	156	42.3
Eggs	129	35.0
Roots and tubers	114	30.9
Fish	88	23.8

The results showed that the most consumed food group was cereals, followed by vegetables and oils and fats. The high cereal consumption suggests sorghum and other grains are important in household diets. The consumption of animal-source foods such as fish, eggs and milk products was relatively low.

Table 5.10: Household Dietary Diversity Categories

HDDS Category	Frequency	Percentage (%)
Low (0–3 food groups)	24	6.5
Medium (4–6 food groups)	138	37.4
High (7–12 food groups)	207	56.1
Total	369	100

To further assess dietary diversity, HDDS scores were grouped into low, medium and high dietary diversity. More than half of the households (56.1%) had high dietary diversity indicating good access to a variety of foods .

Table 5.11: HDDS comparison between sorghum producers and non-producers

Group	Mean HDDS

Sorghum producers (n = 300)	8.71
Non-producers (n = 69)	5.26

An independent samples t-test was conducted to compare the Household Dietary Diversity Scores (HDDS) of households that cultivated sorghum with those that did not. The independent samples t-test showed a statistically significant difference in HDDS scores between the two groups, $t = 3.81$, $p < 0.001$. Households that produced sorghum had significantly higher dietary diversity scores than those that did not grow sorghum. The result indicates that sorghum production has a positive effect on household food security through its impact on access to diversified foods. Higher dietary diversity among sorghum producing households are likely to be associated with increased food availability, income generation and improved resilience to drought induced crop failures. Similar findings have been reported by FAO (2020) and FEWS NET (2025) and Maphosa et al. (2025) who identified small grains as important contributors to food and nutrition security in semi-arid regions.

Sorghums effect on HDDS

The HDDS is available as a numerical score (i.e. 0–12 food groups). Using the following variables HDDS, Sorghum Production, Sorghum Consumption, Age, Education, Household, Size and Farm Size for Multiple Linear Regression,

Table 5.12: Multiple Linear Regression Results for Household Food Security (HDDS)

Variable	**β**	**SE**	**t**	**p-value**
Constant	2.31	0.42	5.50	<0.001
Sorghum production (kg)	0.004	0.001	4.25	<0.001
Sorghum consumption	0.91	0.23	3.96	<0.001
Education level	0.15	0.05	3.00	0.003
Household size	-0.09	0.03	-3.12	0.002
Farm size	0.28	0.08	3.50	<0.001

5.3.3 Factors associated to sorghum production and utilization.

Table 5.13 Model Statistics:

Statistic	Value
R^2	0.72
Adjusted R^2	0.70
F-statistic	42.8
p-value	<0.001

The regression model was statistically significant ($F = 42.8$, $p < 0.001$) and explained 72% of the variance in household food security ($R^2 = 0.72$). Sorghum production had a positive and significant effect on household dietary diversity ($\beta = 0.004$, $p < 0.001$), indicating that households producing more sorghum had better food security outcomes. Sorghum consumption was also positively correlated with food security ($\beta = 0.91$, $p < 0.001$).

Table 5.14 :Model Statistics

Statistic	Value
Omnibus χ^2	89.642
df	17
p-value	<0.001
Cox & Snell R^2	0.421
Nagelkerke R^2	0.587
Classification Accuracy	84.3%

Table 5.14. Logistic Regression Results for Factors Influencing Sorghum Production

Variable	B	S.E.	Wald	p-value	Exp(B)	95% CI Lower	95% CI Upper
Food Shortage (1)	-0.521	0.447	1.359	0.244	0.594	0.247	1.429
Food Shortage (2)	0.763	0.596	1.638	0.201	2.145	0.667	6.898

Food Shortage (3)	-0.904	0.872	1.075	0.300	0.405	0.073	2.245
Decision Maker (1)	**1.427**	**0.435**	**10.764**	**0.001**	**4.167**	**1.777**	**9.773**
Decision Maker (2)	**1.118**	**0.482**	**5.375**	**0.020**	**3.059**	**1.189**	**7.872**
Extension Service	**1.583**	**0.471**	**11.305**	**0.001**	**4.870**	**1.936**	**12.250**
Credit Access	**1.294**	**0.527**	**6.024**	**0.014**	**3.647**	**1.299**	**10.243**
Farmer Group Membership	**1.871**	**0.503**	**13.837**	**<0.001**	**6.493**	**2.423**	**17.391**
Market Access	0.689	0.446	2.386	0.122	1.992	0.831	4.773
Lack of Money for Food	0.372	0.401	0.861	0.353	1.451	0.661	3.184
Months with Less Food (1)	0.521	0.532	0.959	0.327	1.684	0.594	4.773
Months with Less Food (2)	0.741	0.618	1.438	0.230	2.098	0.625	7.045
Months with Less Food (3)	-0.389	0.701	0.308	0.579	0.678	0.171	2.690
Trained in Sorghum Production	**1.246**	**0.502**	**6.162**	**0.013**	**3.476**	**1.299**	**9.299**
Education (1)	-0.461	0.564	0.668	0.414	0.631	0.209	1.903
Education (2)	-0.732	0.618	1.402	0.236	0.481	0.143	1.620
Education (3)	-1.063	0.727	2.138	0.144	0.345	0.083	1.439
Constant	-2.314	0.781	8.780	0.003	0.099	-	-

The results of the logistic regression revealed that a number of institutional and socio-economic factors had a significant effect on sorghum production among women smallholder

farmers in Sanyati District. Farmers trained in sorghum production were more likely to grow sorghum than farmers with no training in sorghum production (OR = 3.476, p = 0.013). Specifically, trained farmers were about 3.5 times more likely to grow sorghum. This implies that access to technical knowledge and skills boosts farmers' confidence and capability to adopt improved sorghum production practices. The finding underscores the importance of farmer training programmes in encouraging adoption of climate resilient crops.

Access to extension services was also found to be a significant determinant of sorghum production (OR=4.870, p=0.001). Farmers under extension support were almost five times more likely to grow sorghum than those without extension support. Extension services provide farmers with information on improved production techniques, pest and disease management, input use and market opportunities, all of which can positively influence adoption decisions. The result highlights the significance of agricultural extension in awareness creation and adoption of sorghum technologies among the smallholder farmers.

Similarly, access to credit was found to greatly increase the likelihood of sorghum production (OR = 3.647, p = 0.014). Farmers who had access to financial resources were 3.6 times more likely to grow sorghum as compared to those who did not have access to credit. Credit allows farmers to buy key inputs such as seed, fertilisers and equipment, reducing financial barriers to production. This finding shows that increased access to affordable agricultural finance can improve sorghum productivity and household resilience in drought-prone areas.

Being a member of farmer groups was one of the strongest predictors of sorghum production (OR = 6.493, p < 0.001). Farmers who were members of farmer groups were about 6.5 times more likely to grow sorghum than those who were not members. Farmer groups often offer access to information, training, inputs, collective marketing opportunities and peer learning, all factors that encourage the adoption of improved agricultural practices. The significant association found in this study suggests that social networks and collective action are important in improving sorghum production among women farmers.

Sorghum production was also significantly associated with household decision-making authority. Those respondents who participated in household agricultural decision-making were 3.1 to 4.2 times more likely to produce sorghum in comparison with those in the reference category (p < 0.05). This result indicates that women with greater decision making power on farming decisions are more likely to adopt and invest in sorghum production. Participation in decision-making can increase women's ability to allocate resources, select

crops suitable to local conditions and adopt strategies that improve household food security. The finding underscores the importance of women's empowerment and inclusive household decision-making in promoting adoption of climate-resilient crops such as sorghum.

The results show that training, extension support, access to credit, farmer group membership and participation in decision making are significant factors that increase the probability of sorghum production by women smallholder farmers. Strategic interventions aimed at strengthening these areas could significantly influence sorghum adoption, agricultural resilience and improved food security in Sanyati District.

5.4 Discussion

The study investigated the involvement of women in the sorghum value chain and analysed the contribution of sorghum production and utilisation to household food security in Sanyati District. The results show that women have a central role in sorghum production, processing, storage and marketing while sorghum contributes significantly to household food availability, food access, dietary diversity and food stability.

Women's Participation in the Sorghum Value Chain

The results revealed the active role played by women in decision making on crop production with almost half of the respondents indicating crop decisions were made jointly with their spouses and a large proportion indicating independent decision making. The findings suggest that women are becoming more involved in the planning of agriculture and the distribution of resources in rural households. Agarwal (2018) reported similar findings, arguing that women's involvement in agricultural decision making results in improved household welfare, productivity and food security outcomes. Greater engagement in decision-making also indicates progress towards gender equality and women's empowerment in agricultural systems.

The study also established that women took a lead role in management of sorghum production activities and were highly involved in planting, weeding, harvesting, storage, processing and marketing. The high levels of participation at the various stages of the value chain point to the critical role played by women in agricultural production in rural Zimbabwe. These findings are consistent with the findings of UN Women (2020) and the World Bank

(2019) that women constitute a large share of agricultural labour in sub-Saharan Africa and are vital to food production and household livelihood management.

Women were also involved in value addition activities in sorghum, such as production of maheu, porridge flour and livestock feed. Value addition enhances the economic value of agricultural products and creates opportunities for income generation and diversification of livelihood activities. According to FAO (2020) value addition creates more market opportunities for the smallholder farmers thus improving the rural incomes and strengthening the agricultural value chains. The results thus suggest that sorghum processing can be an important channel for improving women's economic participation and household welfare.

Also, the study found women often had sole or shared control over cash receipts from sorghum sales. A significant association was found between income control and household decision-making power, which is important to note. Women who controlled income from sorghum production were more likely to say they were more involved in household decision-making. This finding supports the argument that economic empowerment increases women's bargaining power and influence within households (Agarwal, 2018). Ndlovu and Moyo (2021) made similar observations on the access to agricultural income that enhances women's autonomy and ability to contribute to decisions on household expenditures, education, healthcare, and food purchases.

While respondents had relatively high access to extension services, access to credit facilities was limited. This finding underscores the structural barriers that continue to hinder women's participation in agricultural enterprises. Access to financial resources is required for purchasing inputs, investing in production technologies and expanding agricultural activities. Access to credit continues to be a major constraint for women's productivity and economic empowerment in the agriculture sector in developing countries (FAO, 2020; World Bank, 2019). Overcoming these barriers can go a long way to improve women's participation in and benefits from the sorghum value chain.

Contribution of Sorghum Production and Utilisation to Household Food Security

Findings revealed that sorghum contributes positively to household food security through enhancement of food availability, accessibility, utilisation and stability. Most households consumed cereals, vegetables, legumes and other food groups and over half of them had high

dietary diversity scores. These findings suggest a relationship between sorghum production and improved dietary diversity and nutritional outcomes among farming households. Similar findings were reported by Maphosa et al. (2025) with sorghum contributing to dietary diversity through its use in various food products and providing a reliable source of food under drought conditions.

The study also revealed that households producing sorghum had significantly higher dietary diversity scores than non-producing households. The finding showed that sorghum production directly enhances household's food security and nutritional well-being. The large difference in HDDS scores between producers and non-producers suggests that sorghum production increases access to a greater variety of foods either through direct consumption or through income earned from sales. These observations are consistent with FEWS NET (2025) which found that small grains are significant contributors to food and nutrition security in drought-prone areas of Zimbabwe.

Sorghum sales income also was found to increase food access. Most of the respondents reported that they used sorghum income to buy other food items and for household needs. Agricultural income is an important factor in improving dietary diversity and nutritional adequacy by facilitating the access of households to foods not produced on-farm. Ndlovu and Moyo (2021) generated similar results, stating that participation in agricultural value chains enhances access to food through the increased household purchasing power.

The results also show that sorghum plays an important role in food availability and food stability. Sorghum is still producing grain during drought periods when maize production is badly affected, the respondents said. The drought tolerance of the crop enables households to have food supplies in adverse climatic conditions, reducing vulnerability to food shortages. These results agree with previous studies by IPCC (2022), Thornton et al. (2018) and Chikowo et al. (2019) who reported sorghum as one of the most suitable climate-resilient crops in semi-arid environments because of its tolerance to moisture stress and high temperatures.

Sorghum's better storage qualities also contribute to household food stability. Respondents explained that sorghum can be stored for long periods with low post-harvest losses, enabling households to retain grain reserves throughout the year. Storage capacity is an important determinant of food security, as it reduces post-harvest losses and strengthens households' ability to cope with seasonal food shortages (FAO, 2020). Hence the ability to store sorghum for long periods increases resilience and reduces dependency on external food aid during scarcity.

The findings show that sorghum not only contributes to climate resilience, but also to women's empowerment and household food security. Through active participation in the value chain, income generation, improved dietary diversity, enhanced food access and increased food stability, sorghum is a crucial livelihood asset to women smallholder farmers in Sanyati District. Findings indicate the potential of sorghum-based agricultural systems to contribute to sustainable rural development, gender empowerment and climate change adaptation in the semi-arid regions of Zimbabwe.

Factors associated in sorghum production and utilization

Discussion of Results

The findings revealed that women smallholder farmers who received training in sorghum production were more likely to grow sorghum. Farmers trained in the production of sorghum were more likely to grow the crop than the untrained. This finding is consistent with previous studies which argue that access to agricultural knowledge and technical skills improves farmers' adoption of improved crop production practices (Musara et al., 2019). Training increases farmers' knowledge of crop management practices and thus their confidence to grow sorghum under adverse climatic conditions.

Sorghum production was also positively related to the access of extension services. Those farmers who had the benefit of extension support were more likely to grow sorghum than those who did not. This finding corroborates Matshe et al. (2019) who found that extension services are important for disseminating information on improved farming technologies, climate-smart agriculture, and input utilisation. Extension officers also facilitate awareness on the benefits of drought tolerant crops such as sorghum thus promoting adoption among smallholder farmers.

The findings also revealed that access to credit had a significant impact on sorghum production. Farmers with financial resources were more prone to invest in sorghum production than those without credit facilities. This finding is in line with Dzvimbo et al. (2020) who noted that limited access to finance is a major constraint to agricultural productivity among smallholder farmers, particularly women. Farmers have access to credit to buy improved seed, fertilisers and other inputs needed to improve crop production.

Membership in farmer groups was one of the strongest determinants of sorghum production. Farmers who belonged to farmer groups were more likely to grow sorghum than non-group members. The finding is in agreement with Musara et al. (2019) who found that farmer groups enhance information sharing, access to inputs, collective marketing and peer learning which encourage adoption of improved agricultural technologies. Farmer organisations are therefore an important platform for promotion of sorghum production and enhancement of resilience among smallholder farmers.

The study also revealed that household decision-making authority significantly affected sorghum production. Women with more decision-making power over household agricultural issues were more likely to grow sorghum than women with limited decision-making power. This finding supports the finding of Dzvimbo et al. (2020) who found a positive effect of women's empowerment and participation in farm-level decisions on agricultural productivity and technology adoption. As women participate more in decision making, they can target resources to the right people and select crops that help household food security and resilience.

The results indicate that institutional support, access to resources, social networks and women empowerment are major determinants of sorghum production among women smallholder farmers in Sanyati District. The results show the need for policies and programmes to enhance farmer training, extension services, access to credit and participation of farmer groups and women in agriculture decision-making for the adoption of sorghum and improvement of household food security.

5.5 Recommendations

Based on the findings of this study, the following recommendations are suggested to improve women's participation in the sorghum value chain and enhance food security of smallholder farming households in Sanyati District.

5.5.1 Strengthen Women's Economic Empowerment

The study found significant association between income control and household decision making power. This indicates women in control of income generated from sorghum production are more likely to participate in household decision making. Therefore, government agencies, development partners and community organisations should institute programmes that will promote women's economic empowerment through improved access to productive resources, income-generating opportunities and financial literacy training. Such interventions can empower women and enhance household welfare outcomes.

5.5.2 Improve Women's Access to Credit Facilities

Relatively limited access to credit was found among respondents. Financial institutions, government programmes and development partners should develop gender responsive financing mechanisms to offer affordable loans and credit facilities for women smallholder farmers. Improved access to finance will enable women to invest in agricultural inputs, increase production, engage in value addition activities and improve their participation in agricultural markets.

5.5.3 Enhance Agricultural Extension and Training Services

Even with relatively high access to extension services, continued investment in farmer training is critical. Agricultural extension departments should offer targeted training on sorghum production, value addition, business management, post-harvest handling and climate-smart agricultural practices. Training programmes should be tailored to the specific needs and constraints of women farmers.

5.5.4 Promote Sorghum Value Addition and Agro-Processing

Women were actively engaged in the processing of products like maheu, porridge flour and livestock feed. Development agencies and private sector actors should support value addition efforts by providing processing equipment, technical training and market linkages. Creation of value addition opportunities can increase household incomes, provide employment opportunities and increase the profitability of sorghum production.

5.5.5 Strengthen Market Access for Sorghum Products

The study established that sorghum income is important in household food access and welfare. Therefore, efforts should be made to strengthen sorghum markets through improved value chain coordination, market information systems, aggregation centers and contract farming arrangements. Reliable markets will boost production and create more income generating opportunities for women farmers.

5.5.6 Promote Sorghum Production as a Food Security Strategy

The study results showed that the dietary diversity scores of sorghum producing households were significantly higher than those of non-producing households. Therefore, the government and development partners should continue to promote sorghum as a climate-resilient and food-secure crop in semi-arid areas. Improved sorghum adoption can increase food availability, dietary diversity and resilience to climate shocks.

5.5.7 Support Household Nutrition Education Programmes

A good proportion of households had moderate to high dietary diversity, but consumption of some of the nutrient-rich food groups such as fish, eggs and dairy products was still relatively low. Nutrition education programmes should be strengthened to promote diversified diets and to improve household nutritional outcomes. These programmes can help households to get the maximum nutrition from sorghum and other foods that are locally available.

5.5.8 Strengthen Research and Development on Sorghum Value Chains

Research institutions should continue to develop improved sorghum varieties, new processing technologies and market-driven products. There is a need for more research on increasing women's participation in value chains, improving profitability, and the contribution of sorghum to household food security and rural livelihoods.

5.5.9 Address Factors Affecting Sorghum Production

The interventions to improve sorghum production among women smallholder farmers should focus on the major factors identified in this study, which include access to training, extension services, credit facilities, participation in farmer groups, and women's involvement in household decision-making. Government departments, development partners and agricultural organisations should enhance the provision of farmer training programmes and strengthen extension services to improve farmers' knowledge and skills in sorghum production. Financial institutions and microfinance organisations should design affordable and accessible credit schemes for smallholder farmers, especially women, to enable them to access quality seed and other key inputs. Further, the formation and strengthening of farmer groups should be encouraged to facilitate information sharing, collective marketing and access to agricultural support services. Giving priority to interventions that enable women and increase their involvement in agricultural decision-making can improve sorghum adoption and household food security. Addressing these factors holistically will help to increase sorghum production, improve resilience to climate change and sustainable livelihoods in Sanyati District .

5.6 Conclusion

The study aimed to find out the participation of women in the sorghum value chain and to assess the contribution of sorghum production and utilisation to household food security of women smallholder farmers in Sanyati District, Zimbabwe. The findings showed that women play a central role in the sorghum value chain, including crop production, harvesting, storage, processing, marketing and household decision-making. Women were involved in value addition activities such as production of maheu, porridge flour and livestock feed showing the importance of sorghum as a livelihood and income generating crop. Moreover, the study also revealed the positive association between the income control and the household decision-making power, which indicates the economic empowerment through sorghum production enhances the women's role in the household governance and resource distribution.

The study also showed that sorghum contributes to the improvement of household food security. Households that produced sorghum experienced greater dietary diversity and reported improved food availability, access and stability. Sorghum sales income enabled households to buy extra food items and satisfy their essential household needs. Additionally, the drought resistance and storage advantages of sorghum provided a more reliable food supply, especially during periods of climate stress and seasonal food shortages. The large difference in dietary diversity scores between sorghum producing and non-producing households further highlights the contribution of sorghum to household nutrition and food security.

The findings indicate that sorghum is an important climate-resilient crop that supports women's empowerment and household food security. Sorghum contributes to sustainable rural livelihoods and resilience building in semi-arid regions by increasing women's participation in agricultural value chains and improving access to food and income. The promotion of sorghum production, value addition, market development and women's economic empowerment has therefore a significant potential to improve the household wellbeing and support the sustainable agricultural development in Zimbabwe.

The research concluded that a combination of institutional, socio-economic and gender related factors influence sorghum production and utilisation among women smallholder farmers in Sanyati District. Access to training, extension services, credit facilities, farmer group membership and involvement in household decision-making were identified as

important factors that enhance sorghum production. But sorghum adoption and utilisation, in spite of its potential to improve food security and climate resilience, is still hampered by several barriers. Hence, addressing these constraints through targeted interventions and supportive policies is critical for increasing sorghum production, reinforcing household resilience and improving the livelihoods of women smallholder farmers in Sanyati District.

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CHAPTER 6: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter provides an overview of the findings of the study, conclusions drawn from the findings, policy implications and recommendations and suggestions for further research. The study assessed sorghum role in household resilience building, women empowerment and food security among women smallholder farmers in Sanyati District, Mashonaland West Province, Zimbabwe. Specifically, the study assessed adoption of sorghum by women smallholder farmers, its contribution to household resilience to climate-related shocks, women's engagement in the sorghum value chain, and the contribution of sorghum production and utilisation to household food security. This chapter presents conclusions and recommendations based on the findings presented in Chapters 4 and 5.

6.2 Research Summary

The study was conducted in Sanyati District, a semi-arid region marked by recurrent droughts, erratic rainfall patterns and increasing climate variability. A mixed-methods cross-sectional research design combining quantitative and qualitative approaches was used. Quantitative data were collected from 369 women smallholder farmers using structured questionnaires, and qualitative data were collected from 12 key informants through interviews. Quantitative data were analysed descriptively and inferentially and qualitative data were analysed thematically.

The initial objective was to determine the rate of sorghum adoption by women smallholder farmers. The findings revealed a high level of adoption with 74% of respondents indicating they grew sorghum. Nearly half of the adopters had grown sorghum for more than five years, indicating that the crop has become an integral part of local farming systems. The inferential analysis further showed that there is a statistically significant association between the level of education and sorghum adoption. This implies that the level of education affects the willingness and ability of farmers to adopt climate-resilient crops.

The second objective was to establish the contribution of sorghum production to household resilience to climate related shocks. The findings show that sorghum was perceived by the majority of the respondents to perform better than maize during drought periods. Sorghum contributed to resilience through a lower risk of crop failure, better food availability in

drought years, feed for livestock and better storage characteristics. Key informants also noted that households engaged in sorghum production were generally more able to cope and recover from climate-related shocks than those households that solely depend on maize production.

The third objective was to investigate the role of women along the sorghum value chain. The study revealed that women actively participated in decision-making, production, harvesting, storage, processing and marketing. Women were the main actors in value addition activities such as production of maheu, porridge flour and livestock feeds. The results also showed that women's control over income from sorghum production varied, with many women reporting greater financial autonomy and decision-making power.

The fourth objective assessed the contribution of sorghum production and utilisation to household food security. The results showed that sorghum has a positive contribution to food availability, food access, diet diversity and food stability. More than half of the households had high dietary diversity scores and sorghum producing households had significantly higher dietary diversity scores compared to non-producing households. Households benefited from the income generated from sorghum sales to purchase additional food items. The drought tolerance and storage advantages of the crop contributed to food stability throughout the year.

6.3 Conclusions

The results of this study have important implications for agricultural policy, climate adaptation planning, rural development, and food security programming. Considering the importance of sorghum as a component of household resilience and food security, government institutions, development partners and non-governmental organisations should concentrate on promotion of sorghum and other drought tolerant crops in national climate adaptation and agricultural development strategies.

Agricultural extension services should be bolstered with increased investment in farmer education, training, demonstration plots and climate-smart agriculture programmes. As education was found to have a significant impact on sorghum adoption, efforts should be made to improve farmers' access to agricultural information and technical assistance.

Government and development partners should improve access to improved sorghum seed varieties through input support programmes and improved seed distribution systems. Better

access to drought-tolerant and high-yielding varieties can help increase productivity and encourage smallholder farmers to adopt them more widely.

Priority should also be given to policies strengthening the sorghum value chains. This includes improving market access, promoting value addition programmes, strengthening farmer organisations and establishing linkages between producers and buyers. These interventions can raise household income and improve the profitability of sorghum production.

The study further emphasises the need for gender responsive agricultural policies to improve women's access to productive resources, credit facilities, extension services and decision making opportunities. Empowering women in agricultural value chains can improve household welfare, food security and resilience outcomes.

Nutrition-sensitive agricultural programmes should also be promoted to encourage diversified diets and to maximise the nutritional benefits of sorghum production. Household food processing and value addition initiatives can be supported to further strengthen food security outcomes and create opportunities for income generation.

6.4 Policy Implications and Recommendations

The results of this study have important implications for agricultural policy, climate adaptation planning, rural development, and food security programming. Considering the importance of sorghum as a component of household resilience and food security, government institutions, development partners and non-governmental organisations should concentrate on promotion of sorghum and other drought tolerant crops in national climate adaptation and agricultural development strategies.

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The study further emphasises the need for gender responsive agricultural policies to improve women's access to productive resources, credit facilities, extension services and decision making opportunities. Empowering women in agricultural value chains can improve household welfare, food security and resilience outcomes.

Nutrition-sensitive agricultural programmes should also be promoted to encourage diversified diets and to maximise the nutritional benefits of sorghum production. Household food processing and value addition initiatives can be supported to further strengthen food security outcomes and create opportunities for income generation.

6.5 Areas for Further Research

This study provides important insights into the role of sorghum in resilience building, women's empowerment and household food security, but there are several areas that need to be further explored.

Additional research should explore the economic profitability of sorghum production relative to other common crops grown in semi-arid areas of Zimbabwe. These analyses will be very informative to understand the financial viability of sorghum based farming systems.

Future studies should examine the long-term impact of sorghum adoption on household resilience and livelihood outcomes using longitudinal study designs. This would improve understanding of the role of sorghum in adaptation over time.

Moreover, further studies should be undertaken on the constraints to market participation and value addition of women engaged in sorghum production. Knowledge of market constraints may help to inform interventions to improve women's economic empowerment and participation in the value chain.

Research on consumer preferences, demand for sorghum products and opportunities for commercialisation would also support the development of market and the enhancement of competitiveness of sorghum value chains.

Finally, future studies should investigate the nutritional contribution of sorghum-based foods to household diets and the potential role of sorghum-based foods in fighting malnutrition and improving dietary quality in rural communities.

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6.7 Appendices: Data collection tools

1: SURVEY QUESTIONNAIRE

Title: The Role of Sorghum in Resilience Building, Women Empowerment and Enhancing Food Security in Sanyati District, Mashonaland West, Zimbabwe

Target Respondent: Women Smallholder Farmer

District: Sanyati District

SECTION A: RESPONDENT BACKGROUND INFORMATION

(Controls & descriptive statistics)

1. Age (years): _____
2. Marital status:
   ☐ Single ☐ Married ☐ Widowed ☐ Divorced ☐ Separated
3. Education level:
   ☐ No formal education
   ☐ Primary

☐ Secondary
☐ Tertiary

4. Household size: _____
5. Household head:
   ☐ Female-headed
   ☐ Male-headed
6. Land size cultivated (hectares): _____
7. Main crops grown (tick all):
   ☐ Maize
   ☐ Sorghum
   ☐ Millet
   ☐ Groundnuts
   ☐ Cowpeas
   ☐ Other: _____

SECTION B: SORGHUM ADOPTION

(Addresses Objective 1 & Research Question 1)
RQ1: What is the level of sorghum adoption among women smallholder farmers?

1. Do you currently grow sorghum?
   ☐ Yes
   ☐ No
2. If yes, for how many years have you grown sorghum?
   ☐ 1–2 years
   ☐ 3–5 years
   ☐ More than 5 years
3. Area under sorghum (hectares): _____
4. Compared to maize, sorghum area is:
   ☐ Larger
   ☐ Equal
   ☐ Smaller
5. Source of sorghum seed:
   ☐ Saved seed
   ☐ Purchased
   ☐ NGO support
   ☐ Government programme
6. Reasons for growing sorghum (tick all):
   ☐ Drought tolerance
   ☐ Food security

☐ Income
☐ Tradition
☐ Extension advice

7. If you do NOT grow sorghum, why?
   ☐ Prefer maize
   ☐ Lack of seed
   ☐ Poor market
   ☐ Labour demand
   ☐ Cultural reasons

SECTION C: SORGHUM AND HOUSEHOLD RESILIENCE

(Addresses Objective 2 & Research Question 2)
RQ2: How does sorghum contribute to household resilience to climate change?

1. In drought years, which crop performs better?
   ☐ Maize
   ☐ Sorghum
   ☐ Same

2. During the last drought, did sorghum provide food when maize failed?
   ☐ Yes
   ☐ No

3. Sorghum reduces my risk of total crop failure.
   ☐ Strongly Agree
   ☐ Agree
   ☐ Neutral
   ☐ Disagree
   ☐ Strongly Disagree

4. Sorghum helps my household cope during food shortages.
   ☐ Strongly Agree
   ☐ Agree
   ☐ Neutral
   ☐ Disagree
   ☐ Strongly Disagree

5. Does sorghum provide livestock feed?
   ☐ Yes
   ☐ No

6. Compared to maize, sorghum is easier to store.
   ☐ Strongly Agree
   ☐ Agree
   ☐ Neutral

☐ Disagree
☐ Strongly Disagree

7. In the past 3 years, how many months did your household experience food shortage?
   ☐ 0–1
   ☐ 2–3
   ☐ 4–6
   ☐ More than 6
8. What coping strategies do you use during drought?
   ☐ Sell livestock
   ☐ Reduce meals
   ☐ Borrow food
   ☐ Depend on aid
   ☐ Use sorghum stocks

SECTION D: WOMEN'S PARTICIPATION IN THE SORGHUM VALUE CHAIN

(Addresses Objective 3 & Research Question 3)
RQ3: What roles do women play in the sorghum value chain?

1. Who decides which crops to grow?
   ☐ Woman
   ☐ Husband
   ☐ Joint decision
2. Who manages sorghum production?
   ☐ Woman
   ☐ Husband
   ☐ Joint
3. Are you involved in:
   ☐ Planting
   ☐ Weeding
   ☐ Harvesting
   ☐ Storage
   ☐ Processing
   ☐ Marketing
4. Do you process sorghum into:
   ☐ Porridge flour
   ☐ Maheu

☐ Malt
☐ Livestock feed
☐ Sell raw grain only

5. Who controls income from sorghum sales?
   ☐ Woman
   ☐ Husband
   ☐ Joint

6. Income from sorghum has increased my financial independence.
   ☐ Strongly Agree
   ☐ Agree
   ☐ Neutral
   ☐ Disagree
   ☐ Strongly Disagree

7. Do you have access to:
   ☐ Extension services
   ☐ Credit
   ☐ Farmer groups
   ☐ Market information

8. Sorghum production has improved my decision-making power in the household.
   ☐ Strongly Agree
   ☐ Agree
   ☐ Neutral
   ☐ Disagree
   ☐ Strongly Disagree

SECTION E: SORGHUM AND HOUSEHOLD FOOD SECURITY

(Addresses Objective 4 & Research Question 4)
RQ4: How does sorghum production and consumption affect household food security?

PART A: Household Dietary Diversity Score (HDDS)

1: In the past 24 hours, did anyone in your household consume the following food groups?

No.	Food Group	Yes (1)	No (0)
1	Cereals (maize, sorghum, millet, rice, bread)	☐	☐
2	Roots and tubers (sweet potatoes, potatoes, cassava)	☐	☐
3	Vegetables	☐	☐
4	Fruits	☐	☐
5	Meat (beef, goat, pork, chicken)	☐	☐

6	Eggs	☐	☐
7	Fish	☐	☐
8	Legumes and nuts (beans, groundnuts, cowpeas)	☐	☐
9	Milk and milk products	☐	☐
10	Oils and fats	☐	☐
11	Sugar or honey	☐	☐
12	Miscellaneous (spices, beverages such as maheu, tea)	☐	☐

PART B: Food Access

1. In the past 30 days, did your household ever lack money to buy food?
   ☐ Yes
   ☐ No
2. Does income from sorghum help you buy other food items?
   ☐ Yes
   ☐ No
3. What proportion of your sorghum harvest is sold?
   ☐ None
   ☐ Less than 25%
   ☐ 25–50%
   ☐ More than 50%

PART C: Food Availability

1. How many months does your sorghum harvest last?
   ☐ Less than 3 months
   ☐ 3–6 months
   ☐ 6–9 months
   ☐ More than 9 months
2. In the past 12 months, how many months did your household have adequate food?
   ☐ 0–3
   ☐ 4–6
   ☐ 7–9
   ☐ 10–12

PART D: Food Stability

1. During drought years, does sorghum reduce food shortages?
   ☐ Strongly Agree
   ☐ Agree
   ☐ Neutral
   ☐ Disagree
   ☐ Strongly Disagree
2. Compared to maize, sorghum ensures more stable food supply.
   ☐ Strongly Agree
   ☐ Agree
   ☐ Neutral
   ☐ Disagree
   ☐ Strongly Disagree

SECTION F: INSTITUTIONAL AND POLICY SUPPORT

1. Have you received training on sorghum production?
   ☐ Yes
   ☐ No
2. Is sorghum supported under government or NGO programmes?
   ☐ Yes
   ☐ No
   ☐ Not sure
3. What challenges limit sorghum production?
   ☐ Seed access
   ☐ Markets
   ☐ Labour
   ☐ Cultural preference for maize
   ☐ Lack of extension

SECTION G: OPEN-ENDED QUESTIONS

1. In your opinion, how does sorghum help your household during drought?

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2. How has sorghum changed your role in the household?

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3. What support would increase sorghum production in Sanyati?

2: KEY INFORMANT INTERVIEW (KII) GUIDE

Study Title: The Role of Sorghum in Resilience Building, Women Empowerment and Enhancing Food Security in Sanyati District

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A. Background

1. Position and organisation:
2. Years working in Sanyati:
3. Area of operation:

B. Sorghum Adoption

(Objective 1 / RQ1)

1. What is the current level of sorghum adoption among women farmers?
2. Why do some farmers grow sorghum while others prefer maize?
3. What are the main constraints limiting sorghum expansion?

C. Sorghum and Household Resilience

(Objective 2 / RQ2)

4. How does sorghum perform compared to maize during drought?
5. Do households growing sorghum cope better during climate shocks? How?
6. Does sorghum reduce dependence on food aid or market purchases?

D. Women's Participation and Empowerment

(Objective 3 / RQ3)

7. What roles do women play in the sorghum value chain (production, processing, marketing)?
8. Who controls income from sorghum sales?
9. Has sorghum improved women's decision-making power or economic independence?

E. Sorghum and Food Security

(Objective 4 / RQ4)

10. How does sorghum contribute to household food availability and stability?
11. Does sorghum improve dietary diversity or income for food purchases?
12. How long can sorghum be stored compared to maize?

F. Policy and Recommendations

13. What support is needed to increase sorghum adoption among women?
14. Can sorghum become a key climate-resilient crop in Sanyati? Why?
