

An assessment of the effectiveness of smallholder irrigation schemes in enhancing agricultural productivity and food security of rural farmers in semiarid regions of Zimbabwe

A dissertation submitted in partial fulfilment of the requirements for the Master of Science Degree in Food Security and Sustainable Agricultural Production

Bindura University of Science Education



**Faculty of Agriculture and Environmental Science
Department of Agricultural Economics, Education and Extension**

**Naume Sihlola
B223113B**

May 2024

RELEASE FORM

Name of Candidate: Naume Sihlola

Reg Number: B223113B

Degree: Master of Science Degree in Food Security and Sustainable Agriculture

Project Title: An Assessment of the Effectiveness of Smallholder Irrigation Schemes in Enhancing Agricultural Productivity and Food Security of Rural Farmers in Semi-Arid Regions of Zimbabwe

Permission is hereby granted to **Bindura University of Science Education Library** to produce a single copy of this dissertation and lend such copy for private, scholarly or scientific research only.

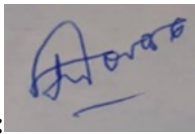
Signed *naumesihlola*

Permanent Address: 22 Bluebell Road, Trenance, Bulawayo, Zimbabwe

APPROVAL FORM

The undersigned certified that they have supervised and recommended to Bindura University of Science Education for acceptance of dissertation entitled '**An Assessment of the Effectiveness of Smallholder Irrigation Schemes in Enhancing Agricultural Productivity and Food Security of Rural Farmers in Semi-arid Regions of Zimbabwe**' submitted in partial fulfilment of a Master of Science Degree in Food Security and Sustainable Agriculture.

Name of supervisor: Mr I Govere



Signature:

Date: 12 November 2024

Name of Chairperson: Dr N Mafuse



Signature:

Date: 15 November 2024

DECLARATION

I hereby declare that the research project entitled “**AN ASSESSMENT OF THE EFFECTIVENESS OF SMALLHOLDER IRRIGATION SCHEMES IN ENHANCING AGRICULTURAL PRODUCTIVITY AND FOOD SECURITY OF RURAL FARMERS IN SEMI-ARID REGIONS OF 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 MR I GOVERE 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 or diploma.

Author: Naume Sihlola

Reg Number: B223113B

Signature:

Date:

DEDICATION

This research is dedicated to my family for their unwavering support and encouragement during my studies.

ACKNOWLEDGEMENTS

The author acknowledges Bindura University of Science Education Faculty of Agriculture and Environmental Science Department of Agricultural Economics, Education and Extension for making it possible to do this research and Mr I Govere for supervision of the research project.

ABSTRACT

Agro ecological regions III, IV and V are characterized by aridity, low erratic rainfall, low rain fed farming yields, high poverty prevalence and dependence on subsistence agriculture for livelihoods making it prone to food insecurity. Smallholder irrigation schemes play a significant role in improving food security in these regions. The study assessed the effectiveness of smallholder irrigation schemes in enhancing agricultural productivity and food security in semiarid regions of Zimbabwe. In depth analyses on adoption of climate resilient technologies by farmers, food access and dietary diversity of households were carried out to determine contribution of smallholder irrigation programs to food security. A survey was carried out covering a total of 300 beneficiaries and non-beneficiaries of smallholder irrigation programs randomly selected from lists provided by extension workers for six irrigation schemes. The irrigation schemes were purposively selected from three provinces of Zimbabwe namely Masvingo Province, Matabeleland Province and Midlands Province. Qualitative data was analysed using thematic analysis. The study revealed that the majority (54%) of households adopted new agricultural technologies promoted by the program, indicating a positive response to the initiative. Beneficiaries have a higher average Household Dietary Diversity Score (HDDS) (4.3628) compared to non-beneficiaries (3.7523), indicating better dietary diversity among beneficiaries. Beneficiaries report much better access to nutritious food compared to non-beneficiaries. There is a significant improvement in food access and dietary diversity of households that are beneficiaries of smallholder irrigation programs. Programs in the areas studied in this research have been effective in improving environmental sustainability, climate resilience, food access, and dietary diversity especially for beneficiaries.

Keywords: Food Security, Smallholder Irrigation, Climate Resilience, Semiarid regions

LIST OF ACRONYMS AND ABBREVIATIONS

FAO	Food and Agricultural Organisation
USAID	United States Agency for International Development
HDDS	Household Dietary Diversity Score
FCS	Food Consumption Score
ZimVac	Zimbabwe Vulnerability Assessment Committee
NDS	National Development Strategy
HH	Household Head
HHM	Household Member
SHIP	Smallholder Irrigation Program
PHHS	Post-Harvesting and Storage
ToC	Theory of Change

TABLE OF CONTENTS

RELEASE FORM.....	I
APPROVAL FORM	II
DECLARATION	III
DEDICATION.....	V
ACKNOWLEDGEMENTS.....	VI
ABSTRACT.....	VII
LIST OF ACRONYMS AND ABBREVIATIONS.....	VIII
LIST OF TABLES.....	IX
LIST OF FIGURES.....	Xi
LIST OF APPENDICES.....	Xli
CHAPTER 1	
INTRODUCTION.....	1
1.1 Background to the Study.....	1
1.2 Problem Statement.....	2
1.3 Objectives	
1.3.1 Main Objective.....	3
1.3.2 Precise Objectives.....	3
1.4 Research Questions.....	3
1.5 Hypothesis.....	4
1.6 Justification.....	4
1.7 Scope/delimitations and Limitations of the study.....	4
1.8 Outline of Thesis.....	4
1.9 References.....	5
CHAPTER 2	
LITERATURE REVIEW.....	6
2.1 Introduction.....	6

2.1.2 Conceptual Framework	6
2.2 Contribution of Smallholder Irrigation Schemes to Food Security.....	7
2.2.1 Prevalence of food security in irrigation schemes.....	8
2.2.2 Adoption of climate resilient technologies.....	9
2.2.3 Impact of smallholder irrigation activities on crop yields.....	9
2.2.4 Contribution of smallholder irrigation programs to food access and dietary diversity.....	10
2.2.5 Factors influencing the Household Dietary Diversity and Food Consumption Score of beneficiaries of irrigation schemes.....	10
2.3 Theoretical Framework.....	11
2.3.1 Theory of Change.....	11
2.3.2. Reasons to develop a theory change.....	11
2.4 Summary of Literature Review.....	12
2.5 References.....	13
CHAPTER 3	
METHODOLOGY.....	15
3.1 Introduction.....	15
3.1.2 Research Methodology	15
3.2 Description of Study Area.....	16
3.3 Research Design.....	16
3.4 Sampling Procedure.....	17
3.5 Data Collection Procedure.....	18
3.6. Data Analysis Procedure.....	19
3.6.1. To establish the prevalence of food security in the irrigation schemes.....	19
3.6.2.To analyse the extent of adoption of climate resilient technologies among smallholder farmers in irrigation schemes.....	19
3.6.3.To assess the impact of smallholder irrigation activities on crop yields.....	19
3.6.4.To determine the contribution of smallholder irrigation programs to food access and dietary diversity.....	19

3.6.5. To analyse the factors influencing Household Dietary Diversity Score and Food Consumption Score of beneficiaries of smallholder irrigation schemes.....	19
3.7 Ethical Considerations.....	19
3.8 Summary.....	20
3.9 References.....	21
CHAPTER 4	
RESULTS AND DISCUSSION.....	22
Abstract.....	22
4.1 Introduction.....	22
4.2 Materials and Methods.....	22
4.3 Results and Discussion.....	23
4.3.1. Demographics.....	23
4.2. To establish the prevalence of food security in the irrigation schemes.....	26
4.3. To assess the impact of smallholder irrigation activities on crop yields.....	28
4.4. To determine the influence of smallholder Irrigation programs to food access and dietary diversity.....	30
4.6 Recommendations.....	37
4.7 Conclusion.....	37
4.8 References.....	38
CHAPTER5	
SUMMARY, CONCLUSION AND RECOMMENDATIONS.....	40
5.1 Introduction.....	40
5.2 Research Summary.....	40
5.3 Conclusions.....	42
5.4 Policy implications and Recommendations.....	43
5.5 Suggestion for Further Study	45
5.5 References.....	46
5.6 Appendices.....	47

LIST OF TABLES

Table 4.1 Socio demographics

Table 4.2 Beneficiary by province

Table 4.3 Beneficiary by irrigation scheme

Table 4.4 Descriptive Statistics

Table 4.5 Irrigation

Table 4.6 New agriculture technology

Table 4.7: Adoptions to climate resilience practices

Table 4.8 Mean difference

Table 4.9 Independent t test

Table 4.10 Mean differences on beneficiary type and dietary diversity

Table 4.11 Independent test on beneficiary type and dietary diversity

Table 4.12 Association test of beneficiary type and access to nutritious food

Table 4.13 Logistic model

Table 4.14 Linear regression model

Table 4.15 Logistic model

Table 4.16: Linear regression model

LIST OF FIGURES

Fig 2.1 Theory of Change for Transforming Smallholder Irrigation Schemes

Fig 3.1 Map showing location of study sites

Fig 4.1 Prevalence of food security in irrigation schemes

LIST OF APPENDICES

- i. Household Questionnaire
- ii. Focus Group Discussion Guide
- iii. Key Informant Guide

CHAPTER 1

INTRODUCTION

The purpose of this study is to evaluate the impact and effectiveness of smallholder irrigation systems in addressing the challenges of agricultural productivity and food security in arid regions. Smallholder irrigation schemes situated in region 4 and 5 of Zimbabwe are the focus of this research. Smallholder irrigation schemes have been implemented as a potential solution to the challenges faced by rural farmers in semi-arid regions of Zimbabwe. The challenges include limited water sources, erratic rainfall patterns and adverse climatic conditions. There is however a need to assess the effectiveness of these irrigation schemes in achieving their intended goals.

This introductory chapter covers the background of the study, the statement of the problem, the conceptual framework, the purpose of the study, and the objectives of the study. It further raises the research questions, the significance of the study, delimitations of the study and assumptions of the study.

1.1 Background of the study

According to the State of Food Security and Nutrition in the World Report, 2023, about 29.6 percent of the global population (2.4 billion people) were moderately or severely food insecure in 2022. Worldwide food insecurity disproportionately affects women and people living in rural areas. According to the Zimbabwe Livelihoods assessment Committee Report for 2023, 2.7 million people are expected to be food insecure from April 2023 until end of March 2025.

The Food and Agricultural Organisation (FAO) definition of food insecurity is a, “situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life”. It is important to promote initiatives that can deal with food insecurity as it can damage the health of generations. Agriculture is one such initiative that can address food insecurity but it cannot sustain the livelihoods of rural farmers situated in semi-arid regions due to the unfavourable climatic conditions.

Semi-arid regions of Zimbabwe found in agroecological regions III, IV and V are characterized by aridity, low erratic rainfall, and low rain fed farming yields, high poverty prevalence,

dependence on subsistence agriculture for livelihoods. These characteristics make it prone to food insecurity and it calls for interventions that may be put in place to address it.

The International Federation of Red Cross and Red Crescent Societies (2006) refers to some of the possible interventions to reduce food insecurity which include, “food aid in the form of distributions of food rations to give immediate relief to a household, to save lives or to increase household’s assets (general food distribution, targeted food distribution, home-based care food ration distribution)”. Households that suffer food insecurity can work for the community and get paid. Seeds and fertilizer are distributed in some communities to encourage production of agricultural commodities. Training is offered to community members to allow them to grow diverse crops as another intervention. Livestock restocking and distribution of fodder are also common ways used in many areas in times of droughts. Most of these interventions provide short term relief to the food insecurity but are not sustainable.

Smallholder irrigation schemes provide a solution to food security challenges faced by the majority of the population in Zimbabwe. According to findings from Mhembwe et al, (2019), “small scale rural irrigation schemes have the capacity to significantly transform the lives of rural farmers through earning increased reliable income from farming”. This works well if institutional issues of the farmers are addressed (Masasi & Ng’mbwe, 2019). ZimVac (2022) further states that there are 450 smallholder irrigation schemes of which 50% need rehabilitation.

This study therefore focuses on the role played by smallholder irrigation schemes as a way of improving agricultural efficiency and enhancing food security among farmers in semi-arid regions of Zimbabwe.

1.2 Problem Statement

According to Chazovachii (2012) the goal of Zimbabwe’s irrigation development programme is to ensure food security through higher crop production. By taking part in irrigation schemes, smallholder farmers may be less vulnerable to economic shocks, the effects of climate change and food and nutrition insecurity. It has often been demonstrated that smallholder irrigation systems outperform rain fed agriculture in terms of crop yields. In addition smallholder

irrigation has been found to increase productivity, household incomes and employment (Mupaso, 2023).

Data on the frequency of Integrated Food Security Phase Classification (IPC) Stressed and Crisis levels throughout Zimbabwe from 2008 - 2012 demonstrate that the most food insecure areas nationally are in the southern and western parts of the country (the drier parts of Matabeleland North and South, Midlands, and Masvingo provinces). Although smallholder irrigation schemes have been implemented in these semi dry regions of Zimbabwe, food insecurity continues to persist. Under performance of some irrigation schemes to the effect that low yields continue to be recorded is also a cause for concern. This underscores the benefits that come with implementation of irrigation schemes especially in the dry regions. Failure to address the problem may lead to chronic food shortages resulting in malnutrition and poor health of the rural population. It can also contribute to increased poverty and economic hardship resulting in social unrest. Loss of biodiversity and over exploitation of water resources may also further exacerbate the effects of climate change. This necessitates an assessment of the effectiveness of irrigation schemes in semi-arid regions of Zimbabwe. To effectively benefit from the contribution of smallholder irrigation schemes, this study is essential. Therefore, the purpose of this study is to evaluate how effective smallholder irrigation schemes are in enhancing agricultural productivity and food security for farmers in semiarid regions. The study will focus on irrigation schemes located in Masvingo, Midlands and Matabeleland South.

1.2 Objective

1.2.1 Main objective

To assess the effectiveness of climate resilient technologies in smallholder irrigation schemes to enhance agricultural productivity and household food security of rural farmers in semi-dry regions of Zimbabwe.

1.2.2 Specific Objectives

1. To establish the prevalence of food security in the irrigation schemes
2. To analyse the extent of adoption of climate resilient technologies among smallholder farmers in irrigation schemes
3. To assess the impact of integrated crop management techniques on maize, beans and tomato yields in smallholder irrigation schemes.
4. To determine the contribution of smallholder irrigation programs to food access.

5. To analyse the factors influencing household dietary diversity score and food consumption score of smallholder irrigation schemes beneficiaries.

1.3. Research questions

1. What is the level of food security amongst households within irrigation schemes?
2. How does the adoption of climate resilient technologies impact on the productivity and resilience of smallholder farming systems in irrigation schemes?
3. What is the difference in crop yields (maize, beans and tomatoes) between beneficiaries of smallholder irrigation schemes and non-beneficiaries?
4. How does participation in smallholder irrigation programs influence food access of beneficiary households?
5. What factors influence the household dietary diversity score and food consumption score of smallholder irrigation schemes beneficiaries?

1.5. Hypothesis

Smallholder irrigation systems lead to higher yields and intensified cropping practices, thereby enhancing agricultural productivity in arid regions.

1.6. Justification

An understanding of factors that contribute to the effectiveness of smallholder irrigation schemes in improving agricultural productivity and food security will help in policy formulation and direct development agencies in decision making so that they channel resources where they make the most impact. This study is needful because it will contribute to such.

1.7. Scope of study

Geographic Scope – the study focuses on smallholder irrigation schemes located in Masvingo, Midlands and Matabeleland South provinces, which constitute the semi-arid regions of Zimbabwe and findings, may not apply directly to other regions.

1.8. Limitations of the study

Time Constraints – Due to limited time the study only focused on six irrigation schemes, two from each of the three provinces namely Masvingo, Midlands and Matabeleland South.

1.9. Outline of Thesis

The study is organised into five chapters. The first chapter is an introduction to the study. The literature review is the second chapter and it gives a brief overview of what other studies have gathered. The methodology the study makes chapter 3 and it outlines the process of data collection and methods used. The fourth chapter analyses data and discusses findings and finally the fifth chapter gives conclusions and states recommendations.

1.9. References

- Chazovachii, B. (2012). The impact of small scale irrigation schemes on rural livelihoods: the case of Panganai irrigation scheme Bikita District Zimbabwe. *Journal of sustainable development in Africa*, 14(4), 217-231
- International Federation of Red Cross and Red Crescent Societies (2006). *How to conduct a food security assessment: A step by step guide for national societies in Africa*. Second edition.
- Masaki, B., & N., N., Ng'ombe.(2019). Does a market systems approach revitalise smallholder irrigation schemes? Evidence from Zimbabwe: *Sustainable Agriculture Research – pub7promo.com*
- Mhembwe, S., Chiunya, N., & Dube, E. (2019). The contribution of small-scale rural irrigation schemes towards food security of smallholder farmers in Zimbabwe. *Jàmbá: Journal of Disaster Risk Studies*, 11(1), 1-11.
- Mkodzongi, G. (Ed.). (2022). *The Future of Zimbabwe's Agrarian Sector: Land Issues in a Time of Political Transition*. Routledge.
- Mupaso, N., Makombe, G., Mugandani, R., & Mafongoya, P. L. (2024). Assessing the Contribution of Smallholder Irrigation to Household Food Security in Zimbabwe. *Agriculture*, 14(4), 617.
- Nhundu, K., & Mushunje, A. (2012). Irrigation development: A food security and household income perspective. *Problems, perspectives and challenges of agricultural water management*.
- World Health Organization. (2022). *The state of food security and nutrition in the world 2022: Repurposing food and agricultural policies to make healthy diets more affordable* (Vol. 2022). Food & Agriculture Org..
- Zimbabwe Vulnerability Assessment Committee. (2010). Zimbabwe Vulnerability Assessment Committee (ZimVac) Rural Livelihoods Assessment. *In presentation to the RVAC Dissemination Meeting*, July (Vol. 15).

CHAPTER 2

LITERATURE REVIEW

2.1. Introduction

This chapter aims to critically analyse the literature done by different scholars on the effectiveness of smallholder irrigation schemes in enhancing agricultural productivity and food security of arid regions. For purposes of conceptual clarity, key concepts used in this study and their relevance are also discussed in this section. Important concepts in this study include, resilience, food security, food insecurity, household food security and climate resilient technologies.

2.1.1 Contribution of Smallholder Irrigation Schemes to Food security

Smallholder irrigation schemes play an important role in improving food security especially in regions where the majority of people rely on rain fed subsistence agriculture. The Food and Agricultural Organisation (FAO) defines food security as “a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.” According to International Federation of Red Cross and Red Crescent Societies (2006) “a person, household or community, region or nation is food secure when all members at all times have physical and economic access to buy, produce, obtain or consume sufficient, safe and nutritious food to meet their dietary needs and food preferences for a healthy and active life”. The 1996 World Food Summit defined food security as:

“... a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (FAO, 2002 cited in Clay, 2002).

Such definitions denote that a food-enabling environment that hinges on social, economic, political, environmental factors is critical for food security. However, the environment is an important determinant of agriculture and any paralysis of the agricultural ecosystem has negative effects on food production thereby increasing the incidence and impacts of food security. Household Food Security is the capacity of a household to procure a stable and sustainable basket of adequate food (IFAD, 1992) and is determined by a household’s current food supplies, past food supply and potential future supply (Gittelsohn et. al., 1998). Potential

future food supply is a function of the household's available resources, such as capital (e.g., land), labour, and time (Gittelsohn et. al., 1998 cited in Msaki, 2010). This implies that HFS is not simply a function of household food production, but is linked, often in complex ways, to the overall livelihood strategies of households (Frankenberger, 1992; Sen, 1981). Strategies include a household's ability to convert endowments into food entitlements, and even to go hungry, up to a point, to meet another objective, such as asset preservation (de Waal, 1989).

Nyssen (2015) suggests that smallholder irrigation schemes could meaningfully improve the agricultural production and status of food security in rural communities. The conclusions drawn by ZimVac (2022) suggest that governments should spend more in the establishment of irrigation systems to guarantee access to dependable supplies of water for agricultural output. According to Mupaso et al. (2023), smallholder irrigation investments continue to be a crucial tactics for boosting livelihoods, food security, and agricultural output while lowering poverty in rural areas.

Farmers in underdeveloped areas continue to experience acute food insecurity and chronic poverty as a result of their increased reliance on erratic rainfall and susceptibility to climate change (Mhembwe, 2019). Furthermore Ndiweni (2019) posit that farming communities face dangers from unfavourable seasonal conditions like drought, waterlogging, and protracted dry spells, which makes an excessive dependence on rain-fed farming problematic. This is evident in high temperatures regions where surface water and soil moisture evaporate leading to the depletion of water sources, a situation which further worsen farming experiences of semi-arid region communities.

In the hopes that this will boost food security and lessen poverty for smallholder farmers, governments and donors from all over Africa are heavily investing in the growth of irrigated agriculture (Sullivan & Pittock, 2014). Yet, there are a number of issues with irrigation in Sub-Saharan Africa. These include the inability of irrigation to yield a sufficient return on investment, the lack of market assimilation and water governance institutions, and the notable decline and neglect of irrigated land (Bjornlund et al., 2017). It is also argued that for Zimbabwe, the majority of small-scale irrigation schemes have faced difficulties including inadequate marketing plans, restricted access to water, a lack of land rights, financial viability,

and poor governance, all of which have led to equipment deterioration and vandalism (Rukuni et al. 1990).

2.1.2 Prevalence of food security in irrigation schemes

Irrigation schemes activities have the potential to contribute to the four pillars of food security. Irrigation schemes contribute to food availability by increasing availability of food. With a steady access to water resources farmers are able to intensify crop production and also obtain high yields, making food accessible to many households. Diversity of crops grown also leads to more diverse and nutritious diet. By reducing risks of crop failure, irrigation schemes contribute to more stable and reliable food supplies, enhancing food security.

Food and nutrition insecurity remains a global concern and is more prevalent among Sub Saharan African countries, including Zimbabwe. The Zimbabwean government has prioritized the development of smallholder irrigation and the restoration of decrepit irrigation infrastructure as part of its initiatives to improve food and nutrition security, as stated in NDS 1. By 2025, the NDS 1 aims to increase food self-sufficiency from 45% to 100% (between 2019 and 2025), decrease food insecurity to less than 10%, and put the nation back in the position of a breadbasket (Mkodzongi, 2022).

2.1.3 Adoption of climate resilient technologies

Resilience is defined as a set of capabilities possessed by each household that make them able to anticipate (prevent impacts) absorb (recover and withstand) and adapt (build back better) to stress and shocks which they are likely to be exposed to (Patel et al, 2017). This is a call for smallholder farmers to implement sustainable agricultural practices so as to improve crop yield at the same time safeguarding inventive use of resources (FAO, 2014). This implies that smallholder farmers should practise climate-smart agriculture which aims to improve food security; rural livelihoods; facilitate climate change adaptation and provide mitigation benefits (Scherr, Shames and Friedman, 2012). Most farmers now feel more confident and have shifted from subsistence to commercial farming as a result of social learning. Their methods have evolved to choose valuable crops and higher-yielding varieties, thereby negotiate advantageous deals along the value chain, and employ agricultural resource effectively. The farmers now know how to recognise issues, rank them, and put solutions into action. As such increasing profitability will stimulate more innovation and adoption, even in the absence of government interventions (Pittock et al 2020).

Climate resilience is the ability to recover from or reduce vulnerability to climate related events, such as drought and flood (IPCC,2023). Climate resilient practices commonly adopted by farmers in smallholder irrigation schemes include drip irrigation, conservation farming, integrated soil fertility management, integrated pest and disease management, planting heat tolerant crops and varieties, planting a diversity of crops and agroforestry among others.

2.1.4 Impact of smallholder irrigation activities on crop yields

Support of irrigation is paramount in areas of low areas in order to increase productivity. Hussian and Smith in the contemporary literature argued that irrigated farming is recognized as central in increasing land productivity, enhancing food security, earning higher and more stable incomes and increasing prospects for multiple cropping and crop diversification. Irrigation acts as a mitigation measure against droughts and mid-season dry spells. This enables farmers to grow crops throughout the year and intensify crop production which then guarantee food and nutrition security in arid regions.

By providing more consistent crop production in the face of climatic uncertainty and change, irrigated agriculture has the potential to overcome numerous obstacles to food security in Africa. The Transforming Irrigation in Southern Africa (TISA) project proposes the adoption of a profit based irrigation initiative which adeptly will enable smallholder farmers to maintain the enormous water infrastructure sustainably and break the cycle of degradation; refurbishment, and decay (Stirzaker & Pittock, 2014). According to van Rooyen et al. (2017), there is a need for smallholder farmers to have improved market access in order to gain autonomy from governments, as well as to give them the motivation and assurance to innovate and increase the advantages of agriculture.

2.1.5 Contribution of smallholder irrigation programs to food access and dietary diversity

Dietary diversity is usually measured by summing the number of food groups consumed over a reference period (Steyn et al., 2006). Access to food refers to how various people can get hold of the food that is available. Usually, we obtain food by a combination of borrowing, selling, bartering, buying, stockpiling, home production, and food assistance. When households, communities, and all of the people living there have enough money and other resources to buy the right foods for a healthy diet, then food availability is guaranteed. Access is influenced by the household's income, how that income is divided up within the household, and the cost of

food. It also depends on the entitlements and privileges that people have access to in the market, society, and institutions (Red Cross and Red Crescent Societies International Federation, 2006). Food access consists of three elements, which are physical, economic/financial and socio-cultural (Napoli et al, 2011).

2.1.6 Factors influencing Household Dietary Diversity Score and Food Consumption Score of smallholder irrigation schemes beneficiaries

Food Consumption Score is a composite score based on dietary diversity, food frequency and relative nutrition importance of different food groups. Food Consumption Score (FCS) is a weighted sum of food groups. Household Dietary Diversity Score (HDDS) is a qualitative measure of food consumption that reflects household access to a variety of foods (FAO, 2011). It consists of a simple count of food groups that a household has consumed over the preceding 24 hours. It reflects the economic ability of a household to access a variety of foods.

There are studies that indicate a relationship between household size and HDDS. This variable in most times increase food demand for adults in the household and in some cases can increase dietary diversity (Christian; 2019). The results also show that the level of education of the household head contribute to the improvement of the HDDS (Torheim; 2004). This suggests that education is has an impact on household nutritional knowledge and understating of messages promoting nutrition which then lead to dietary diversity (Lukumay; 2017). The conclusion drawn points to the importance of support for educational trainings conducted on nutrition whose uptake depends on the level of reception by the local community (Chegere; 2020). Another factor raised is that market limitations reduce the ability of rural farmers to produce food for self-consumption and earn a living a meaningful from crop sales. The area of land cultivated is another factor which contributes to the dietary diversity of households, it is important in terms of food production and food diversity. Largely households with access to land increase the capacity to produce greater variety of crops (Afari-Sefa et al, 2017).

2.3 Theoretical Framework

2.3.1 Theory of Change

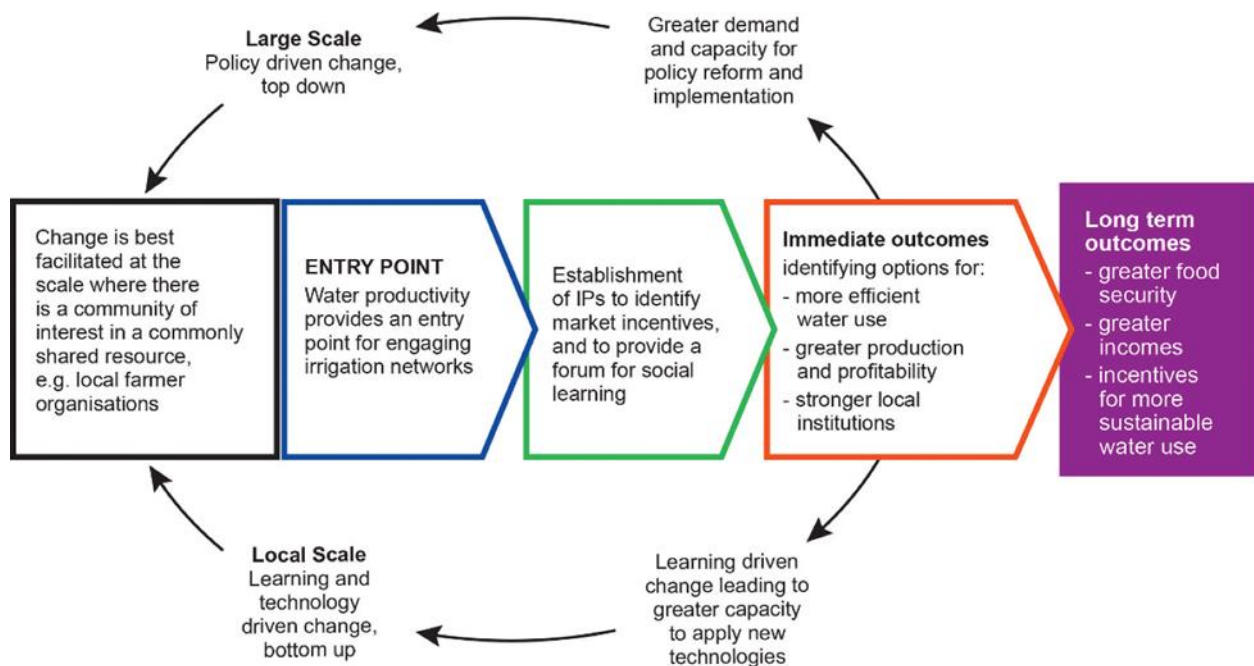


Figure 2.1 Theory of Change

The 2013 theory of change for transforming smallholder irrigation schemes by setting them on a path of constant development in viability and sustainability (Stirzaker & Pittock, 2014). ToC is described by Vogel (2012) as a rational series of modifications that are expected to produce a specific result and create a path towards effect. A textual or graphic representation of the methods, procedures, environments, and materials needed to bring about change and produce results is called a theory of change (Vogel, 2012). According to Reinholz & Andrews (2020), theory of change possesses "explanatory power" since it should clarify your belief that specific behaviours or actions would result in specific results. Positive results prompt farmers to become more interested, which in turn boosts involvement and results in higher productivity, higher profitability, and more economical use of water resources.

2.3.2. Reasons to develop a theory of change

Omore (2017) is of the view that, a strong theory of change can clarify any presumptions made about success and give you a program justification based on the greatest research and practice data currently available. This can assist in evaluating a program's merits and potential to provide the desired results, as well as in delivering programs more successfully (Kilelu et al. 2017). It can also assist you in informing your community about your aims and providing justification for government or charitable expenditures. The theory of change can be applied to

ensure that the individuals providing or receiving an intervention or program understand their goals and the purpose of their participation. Key long term outcomes expected from programs are sustainable water use, greater food security and higher farm incomes.

2.4 Summary of Literature Review

The review of literature alludes to the fact that smallholder irrigation schemes have a positive contribution to improving agricultural productivity and food security of rural farmers in arid regions. It is however important to note that the smooth running of these irrigation schemes is marred by challenges and setbacks which if properly addressed would result in their set goal of achieving food security being realised. The next chapter presents the methodology of the study.

2.5 References

Bonti-Ankomah, S. 2001. Addressing food insecurity in South Africa, The National Institute for Economic Policy, Paper presented at the SARPN conference on Land Reform and Poverty Alleviation in Southern Africa. Pretoria.

Christian, A.K.; Marquis, G.S.; Colecraft, E.K.; Lartey, A.; Soueida, R. Household food insecurity but not dietary diversity is associated with Children' mean micronutrient density adequacy in rural communities across Ghana. *Nutrition* 2019, 65, 97 – 102.

De Waal, A. 1989. *Famine That Kills: Darfur, Sudan, 1984–1985*. Oxford: Clarendon Press.

Frankenburger, T.R. 1992. *Indicators and Data Collection Methods for Assessing Household Food Security*. In: S. Maxwell and T. Frankenburger, eds. *Household food security: Concepts, indicators, and measurement: A technical review*. UNICEF and IFAD, New York

Gebrehiwot, N. T., Mesfin, K. A., & Nyssen, J. (2015). Small-scale irrigation: the driver for promoting agricultural production and food security (the case of Tigray Regional State, Northern Ethiopia). *Irrig. drain. syst. eng*, 4(2), 1000141.

IFAD. 2009. Research and Innovation for Smallholder Farmers in the Context of Climate Change. Discussion paper prepared for the Round Table organized during the Thirty-second session of IFAD's Governing Council, 18 February 2009. <http://www.ifad.org/events/gc/32/roundtables/3.pdf>

International Federation of Red Cross and Red Crescent Societies (2006). *How to conduct a food security assessment: A step by step guide for national societies in Africa*. Second edition.

Mkodzongi, G. (Ed.). (2022). *The Future of Zimbabwe's Agrarian Sector: Land Issues in a Time of Political Transition*. Routledge.

Mupaso, N., Makombe, G., & Mugandani, R. (2023). Smallholder irrigation and poverty reduction in developing countries: a review. As part of its strategies to enhance food and nutrition security, A Review, 9(2).

Napoli, M., De Muro, P., & Mazziotta, M. (2011). Towards a food insecurity Multidimensional Index (FIMI). *Master in human development and food security*, 10.

Ndiweni, N. J. (2019). *Food insecurity in South Western Zimbabwe: the vulnerability of primary school children in Matobo District* (Doctoral dissertation).

Ochieng, J., Afari-Sefa, V., Lukumay, P.J.; Dubois, T. Determinants of dietary diversity and the potential role of men in improving household nutrition in Tanzania. *PLoS ONE* 2017, 12 e0189022.

Patel SS, Rogers MB, Amlôt R, Rubin GJ. (2017). *What Do We Mean by 'Community Resilience'? A Systematic Literature Review of How It Is Defined in the Literature.*

Rajala, E., Vogel, I., Sundin, A., Kongmanila, D., Nassuna-Musoke, M. G., Musundire, R., ... & Boqvist, S. (2021). How can agricultural research translation projects targeting smallholder production systems be strengthened by using Theory of Change?. *Global Food Security*, 28, 100475.

Reinholz, D. L., & Andrews, T. C. (2020). Change theory and theory of change: what's the difference anyway?. *International Journal of STEM Education*, 7, 1-12.

Ruane, John, and Andrea Sonnino. "Agricultural biotechnologies in developing countries and their possible contribution to food security." *Journal of biotechnology* 156.4 (2011): 356-363.

Rukuni, M. (1990). *The development of Zimbabwe's agriculture: 1890-1990* (Vol. 90). Department of Agricultural Economics and Extension, Faculty of Agriculture, University of Zimbabwe.

Scherr, Sara J., Seth Shames, and Rachel Friedman. (2012). "From climate-smart agriculture to climate-smart landscapes." *Agriculture & Food Security* 1: 1-15.

Scoones, I. (1990). "Livestock Populations and Household Economy: A Case study from Southern Zimbabwe", Unpublished PhD Thesis, University of London.

Scoones, I. (1996). *Hazard and Opportunities: Farming Livelihoods in Dry Land Africa-Lessons from Zimbabwe*. London: ZED books.339

Scoones, I. (1998). *Sustainable Rural Livelihoods: A Framework of Analysis*, New York, Weaver Press

Scoones, I and Wolmer, W. (2003). "Part 1: Contexts and Debates. Introduction: Livelihoods in Crisis: Challenges for Rural Development in Southern Africa". *IDS Bulletin* 34(3): 1-14)

Stirzaker, R., & Pittock, J. (2014). The case for a new irrigation research agenda for sub-Saharan Africa. *Water, food and agricultural sustainability in Southern Africa*.

Torheim, L.E.; Outtara, F.; Diarra, M.M.; Thiam, F.D.; Barikmo, I.; Hatloy, A.; Oshaug, A. Nutrition adequacy and dietary diversity in rural Mali: Association and determinants. *Eur. J. Clin. Nutr.* 2004, 58, 594 -604.

Van Rooyen, A. F., Ramshaw, P., Moyo, M., Stirzaker, R., & Bjornlund, H. (2017). Theory and application of agricultural innovation platforms for improved irrigation scheme management in Southern Africa. *International Journal of Water Resources Development*, 33(5), 804-823.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter gives an overview of the research methodology from description of study sites, research design, sampling procedures, data collection and analysis methods and finally ethical considerations. The study employed a qualitative methodology, where interviews were conducted using semi-structured questionnaires.

3.1.1 Research Methodology

The study adopted a qualitative methodology. McMillan and Schumacher (1993) define qualitative research as, “primarily an inductive process of organising data into categories and identifying patterns (relationships) among categories”. A key strength of qualitative methodology lies in that it is a system of inquiry that seeks to build a holistic, largely narrative, description to inform the researcher’s understanding of a social or cultural phenomenon and this system of inquiry forms the basis of this study. Justification of adopting qualitative methodology lay in that it suited a liberal approach to research that allowed for flexibility in the process of conducting the research.

Qualitative methods are also crucial in that they capture underlying meanings; unearth the unexpected and sensitive issues. This is advanced by Bamburgh (2000) who states that the framework and analysis also tend to be interpretive, with the research relying on naturalistic observation to capture the constraints of everyday life. However, qualitative methods have their own challenges, as observed during the study. There is a growing tendency on the respondents deviating from the objective(s) of the research and giving out historical data that was not directly relevant to the objective of the study.

3.2 Description of study area

The study covers 6 irrigation schemes in semi-arid areas in 3 provinces of Zimbabwe. The provinces covered are Masvingo, Matabeleland South and Midlands. The study sites are located in agroecological regions III, IV and V which are characterised by low and erratic rainfall, long dry spells and dependence on subsistence agriculture.

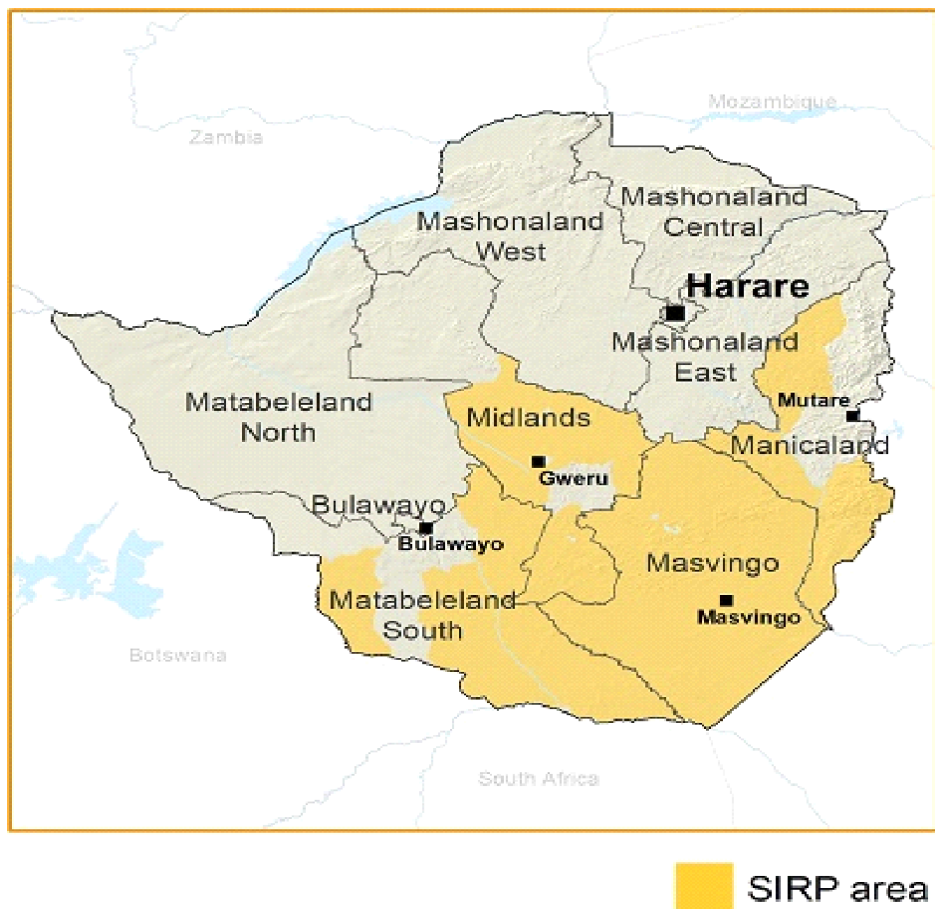


Figure 3: Location of study areas

3.3 Research design

The research is based on three groups namely, beneficiary irrigators, beneficiary rain fed farmers and non-beneficiary non irrigators as the control group. The study employed a case study design which is defined by Merriam (1998) as, “...an intensive, holistic description and analysis of a bounded phenomenon” (Merriam, 1998). Potential data sources may include, but are not limited to documentation, archival records, interviews, physical artefacts, direct observations, and participant-observation (Baxter and Jack, 2008).

3.4 Sampling procedure

The study used purposive sampling techniques to identify the research sites for the study. According to Teddlie and Yu (2007) purposive sampling techniques may be defined as selecting units (e.g., individuals, groups of individuals, institutions) based on specific purposes associated with answering a research study’s questions. Maxwell (1997) further defined purposive sampling as a type of sampling in which, particular settings, persons, or events are deliberately selected for the important information they can provide that cannot be gotten as well from other choices.

Sampling of irrigation schemes and survey participants was done using the steps that follow:

Step 1:

Selection of Irrigation Schemes this involved the selection of 6 irrigation schemes.

Step 2:

Selection of two key informants for each study area was done from among the following; Agritex, Lead farmer, Village Head, Councillor, Program Officer

Step 3:

Selection of participants for Focus Groups Discussions

The researcher purposively selected 3 focus groups. Each focus group had 8 – 10 men, women, youth randomly selected from lists provided by extension workers.

Step 4:

Selection of 2 case studies per study area

Step 5:

Selection of participants for household survey

Random selection using multistage stratified random sampling according to location, type of beneficiary and gender was done.

The actual selection of households was done in 2 stages

Stage 1:

Six irrigation schemes were selected, 2 in each of the provinces preselected.

Stage 2:

Households were selected from existing lists of beneficiaries and non-beneficiaries provided by Agritex extension officers from each irrigation scheme and surrounding dryland areas.

3.5 Data collection procedure

Quantitative approach was used to assess the impact of smallholder irrigation schemes on livelihoods of irrigation farmers. Qualitative approach was instituted to complement household information. Secondary data was collected through desk review of program documents and baseline survey reports. Designing of primary data collection tools Quantitative data collection tool – Household survey questionnaire Qualitative data collection tools – Focus Group discussion guide, Key informant interview schedule, observation diary, case study guide.

3.6 Data analysis procedure

Quantitative analysis of data was done using SPSS software. Qualitative data was analysed using thematic analysis. MicroSoft Excel was used for graphical analysis. Inferential statistical analysis was done using SPSS to validate comparisons of various indicators of achievement. Data was exported into SPSS for analysis. Chi Square test of association was used to show relationship between Food consumption status and irrigation status of households.

3.6.1 To establish the prevalence of food security in the irrigation schemes

The data collection tools used are, Household survey questionnaire, Focus group discussion guide, key informant interview schedule and case study guide. Data variables required for this objective are demographic data and socioeconomic characteristics. Data analysis method used is descriptive statistics.

3.6.2 To analyse the extent of adoption of climate resilient technologies among smallholder farmers in irrigation schemes

Data collection tools used are, Household survey questionnaire, Focus group discussion guide, key informant interview schedule and case study guide. Data variables required for this objective are agricultural practices which include irrigation systems, conservation practices, use of inputs and crop diversification. Data analysis method was done using regression analysis.

3.6.3 To assess the impact of integrated crop management techniques on maize, beans and tomato yields in smallholder irrigation schemes.

Data collection tools used are, Household survey questionnaire, Focus group discussion guide, key informant interview schedule and case study guide. Data variables required are crop yields, crop intensity and crop income. Data analysis was done on correlation between smallholder irrigation activities and productivity.

3.6.4 To determine the contribution of smallholder irrigation programs to food access

Data collection tools used are, Household survey questionnaire, Focus group discussion guide, key informant interview schedule and case study guide. Data variables required are food access, dietary diversity, household income, HDDS, FCS. Data analysis method used is regression analysis.

3.6.5 To analyse the factors influencing Household Dietary Diversity Score and Food Consumption Score of beneficiaries of smallholder irrigation schemes

Data collection tools used are, Household survey questionnaire, Focus group discussion guide, key informant interview schedule and case study guide. Data variables required are HDDS, FCS, and household income. Data analysis method was done using regression analysis.

3.7 Ethical considerations

The research will adhere to ethical guidelines and ensure the confidentiality of participants. According to Resnik (2015), ethics entails the researcher's behaviour being appropriate for the subjects of the study and everyone else who might be impacted by it. The study will be carried out in accordance with guiding ethical standards, such as respecting participants' right to privacy, maintaining the confidentiality of any information submitted, and avoiding unauthorized access to corporate property. Organizations that participated in the study will benefit from the findings and recommendations of the research. Researcher will seek consent from all participants and their identity will remain anonymous in reports.

3.8 Summary

This chapter gave presented the methodology, the research design, data collection and data analysis techniques used in the study. This study utilised qualitative research techniques due to their flexibility in application. Purposive sampling methods were also utilised to identify respondents and these allowed for quick and easy identification of the respondents. The next chapter presents the results and findings of the study.

3.9 References

Bamberger, Michael. 2000. *Integrating Quantitative and Qualitative Research in Development Projects*. World Bank, Washington DC.

Baxter P and Jack S. 2008. “Qualitative Case Study Methodology: Study Design and Implementation for Novice Researchers”.*The Qualitative Report*: 13 (4): 544-559.

Frankenburger, T.R. 1992. *Indicators and Data Collection Methods for Assessing Household Food Security*. In: S. Maxwell and T. Frankenburger, eds.*Household food security: Concepts, indicators, and measurement: A technical review*. UNICEF and IFAD, New York

Maxwell S, Frankenburger T, eds. *Household Food Security: Concepts, Indicators, and Measurements*. Rome: IFAD

Maxwell S, Smith M. 1992.*Household Food Security: A Conceptual Review (Part 1)*. In:

Mcmillan, J and Schumacher, S. 2010. *Research in education evidence based inquiry* 7th ed.

Pearson Education: USA Mercy Corps. 2007. *Climate Challenges – Bridging the Knowledge Gap*. Mercy Corps Climate Change Unit, Edinburgh.

Resnik, D. B. (2015). What is ethics in research & why is it important.

Teddle, Charles and Yu, Fen. 2007. ‘Mixed Methods Sampling: A Typology With Examples.’
Journal of Mixed Methods Research 1; 77.

Tongco, Dolores.2007. “Purposive Sampling as a Tool for Informant Selection”.*Ethnobotany Research and Applications* 5:147-158.

Yin, R. 2003. *Case study research: Design and methods* (3rd Ed.). *Thousand Oaks, CA: Sage Publications*.

CHAPTER 4

RESULTS

Abstract

The effectiveness of smallholder irrigation schemes in enhancing agricultural productivity and food security of rural farmers in semiarid regions was investigated. A sample size of 300 randomly selected respondents was interviewed. Data on demographics, prevalence of food security amongst households, crop yields, adoption of technology food access and dietary diversity was gathered and analysed. A majority (54%) of households adopted new agricultural technologies promoted by the project, indicating a positive response to the initiative. Beneficiaries of irrigation schemes have higher average crop sales (\$490.47) compared to non-beneficiaries (\$185.38), indicating that participation in the schemes significantly boosts crop production and sales

A significant association exists between beneficiary type and access to nutritious food (Chi-Square $p = .000$). Beneficiaries report much better access to nutritious food compared to non-beneficiaries. Beneficiaries have a higher average HDDS (4.3628) compared to non-beneficiaries (3.7523), indicating better dietary diversity among beneficiaries. Female-headed households have lower FCS compared to male-headed households ($\text{Exp}(B) = .468$, $p = .014$).

➤ Key words: HDDS, FCS, food access, dietary diversity, crop yields

4.1 Introduction

This chapter gives the results and discussion of the findings emanating from a research study that was carried out in 6 irrigation schemes from 3 provinces namely Masvingo, Midlands and Matabeleland South.

4.2 Material and Methods

4.2.1 Description of study area

Masvingo, Midlands and Matabeleland South provinces are situated in the semi dry regions of Zimbabwe and are characterised by low erratic rainfall, long dry spells and dependence on agriculture. Major sources of livelihoods are livestock rearing, small grains production. Mopane worms and wild fruits harvesting, mining and diaspora remittances.

4.2.2 Research Design

The research design used was a case study. Data on prevalence of food security in six irrigation schemes from three provinces was collected. Data on adoption of climate resilient technologies, crop yields, food access and dietary diversity was also collected.

4.2.3 Sampling procedure

Purposive sampling techniques were used to identify the research sites for the study. 300 people were interviewed. The 3 provinces selected are in the semidry regions and the government and partner organisations have done a lot of work in establishing irrigation schemes in these areas.

4.2.4 Data collection procedure

Data collection tools employed include household survey questionnaire, focus group discussion guide, key informant interview schedule and case study guide. The diverse tools used allowed collection of valuable information on efficiency and effectiveness of irrigation schemes as they contribute towards food security.

4.2.5 Data analysis procedure

Analysis of the qualitative data obtained in the study was done using thematic analysis. Quantitative analysis of data was done using SPSS software.

4.2.6 Challenges encountered during data collection

Data collection was cumbersome given the large number of respondents and geographical spread resulting in missing data for some variables.

4.3 Results and Discussion

4.3.1 Demographics

Table 4.1 Socio demographic Characteristics of Household Heads

Characteristics	Description	Number of Respondents	Percentage of Respondents
Family head	Child headed	1	.3
	Female headed	112	34.6
	Male headed	211	65.1
Marital status	Divorced/ Separated	15	4.6
	Married	212	65.4
	Single	8	2.5
	Widowed	89	27.5
Education	No Education	19	5.9
	Primary	128	39.5
	Secondary	169	52.2
	Tertiary	1	.3
	University	7	2.2
Main income source	Irrigation plot crop production	53	16.4
	casual labour	26	8.0
	dry land crop production/sales	26	8.0
	Remittance	26	8.0
	livestock production/sales	16	4.9

	formal salary/wages	12	3.7
Food security	not food secure	195	60.2
	food secure	129	39.8

Family Head: The majority of households are male-headed (65.1%), with a significant proportion being female-headed (34.6%). Marital Status: Most household heads are married (65.4%), with 27.5% widowed and a small percentage divorced/separated (4.6%) or single (2.5%). Education: A majority of household heads have secondary education (52.2%), followed by primary education (39.5%). Only a small percentage has tertiary education (2.5% combined). Main Income Source: The largest income source is irrigation plot crop production (16.4%), followed by casual labour, dry land crop production, and remittance, each contributing 8%. Food Security: A significant proportion of households are not food secure (60.2%).

Table 4.2 Beneficiary by province

		PROVINCE			Total
		Masvingo	Matabeleland South	Midlands	
BENEFICIARY TYPE	Beneficiary	75	72	68	215
	Non- beneficiary	37	35	37	109
Total		112	107	105	324

Beneficiaries and non-beneficiaries are fairly evenly distributed across the three provinces with slight variations. Masvingo has the highest number of beneficiaries (75), while Midlands has the least (68).

Table 4.3 Beneficiary by irrigation scheme

		BENEFICIARY IRRIGATION SCHEME						Total
		Banga	Guyu	Hamamavhaire	Insukamini	Silalabuhwa	Tshovane	
BENEFICIARY	Beneficiary	38	38	35	33	34	37	215
	Non-beneficiary	19	18	18	19	17	18	109
Total		57	56	53	52	51	55	324

Beneficiaries are evenly spread across the six irrigation schemes, with each scheme having around 33-38 beneficiaries and 17-19 non-beneficiaries.

Table 4.4 Household Characteristics

	N	Minimum	Maximum	Mean	Std. Deviation
Age of Household Head	324	16	104	54.65	13.971
How many people live in this Household?	324	1	14	5.87	2.448
How many people in your household are living with disability?	324	0	3	.17	.420

The average age of household heads is 54.65 years, with a wide range from 16 to 104 years. Households have an average of 5.87 members, with some households as large as 14 members. The average number of people with disabilities per household is quite low (0.17).

4.2 **Objective 1:** To establish the prevalence of food security in the irrigation schemes

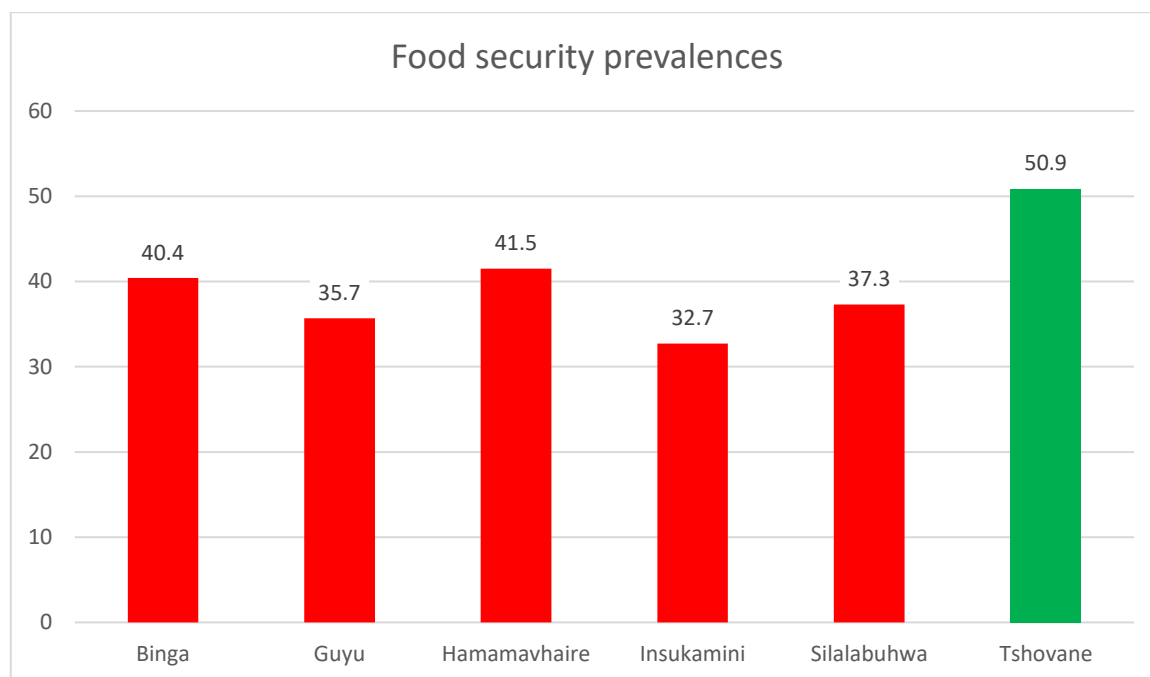


Fig 4.1 Prevalence's of food security in irrigation schemes

The diagram shows that Tshovane scheme is the only irrigation project that has high food security in compared to the other five irrigation schemes.

Objective 2: To analyses the extent of adoption of climate resilient technologies among smallholder farmers in irrigation schemes

Table 4.5 Irrigation

F2.1 Do you use irrigation for any part of your crop production?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	214	66.0	66.0	66.0
	Yes	110	34.0	34.0	100.0
	Total	324	100.0	100.0	

Only 34% of households use irrigation for crop production, indicating that irrigation adoption is not yet widespread.

Table 4.6 New agriculture technology

Since start of the SHIP project did you used new agricultural production technology?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	149	46.0	46.0	46.0
	Yes	175	54.0	54.0	100.0
	Total	324	100.0	100.0	

A majority (54%) of households adopted new agricultural technologies promoted by the project, indicating a positive response to the initiative.

Table 4.7: Adoptions to climate resilience practices

Practices	Contributed significantly	Not Contributed	Partially Contributed	No response
Conservation agriculture	24.7	15.4	37.0	22.8
Integrated soil fertility management	25.6	16	35.5	22.8
Planting of drought and heat tolerant crops and varieties	24.1	20.4	32.7	22.8
Planting a diversity of crops by the household	28.7	17.9	30.6	22.8
Early and timely planting and weeding	30.2	16.4	30.6	22.8

Integrated disease and pest management	25.9	17.9	33.3	22.8
Postharvest loss saving technology	25	19.1	33	22.8
Gulley reclamation and natural resource management	22.8	20.1	34.3	22.8
Integrated crop-livestock	22.2	21	34	22.8
Agroforestry	18.8	26.9	31.5	22.8
Conservation agriculture	24.7	16.7	35.2	22.8

High Adoption Practices: Early and timely planting and weeding (30.2%), planting a diversity of crops (28.7%), and integrated disease and pest management (25.9%) have significantly contributed to resilience. Moderate Adoption Practices: Conservation agriculture and integrated soil fertility management have notable partial contributions (37% and 35.5%, respectively). Low Adoption Practices: Agroforestry has the highest percentage of no contribution (26.9%) and the lowest significant contribution (18.8%).

4.3 Objective 3: To assess the impact of integrated crop management techniques on maize, beans and tomato yields in smallholder irrigation schemes.

Table 4.8 Mean difference

Group Statistics					
	BENEFICIARY TYPE (2 groups)	N	Mean	Std. Deviation	Std. Error Mean
Agricultural production in the season 2023/2024?- Crop Sales	Beneficiary	157	490.47	695.574	55.513
	Non-beneficiary	26	185.38	243.413	47.737

Beneficiaries of irrigation schemes have higher average crop sales (\$490.47) compared to non-beneficiaries (\$185.38), indicating that participation in the schemes significantly boosts crop production and sales.

Table 4.9 Mean difference

Group Statistics					
	BENEFICIARY TYPE (2 groups)	N	Mean	Std. Deviation	Std. Error Mean
Agricultural production this year?- Crop Sales	Beneficiary	157	490.47	695.574	55.513
	Non-beneficiary	26	185.38	243.413	47.737

Beneficiaries of irrigation schemes have higher average crop sales (\$490.47) compared to non-beneficiaries (\$185.38), indicating that participation in the schemes significantly boosts crop production and sales

Table 4.10 Independent t test

Independent Samples Test										
		Levene's Test		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Agricultural production this year?- Crop Sales	Equal variances assumed	5.091	.025	2.210	181	.028	305.087	138.063	32.668	577.506

The t-test shows a significant difference ($p = .028$) in crop sales between beneficiaries and non-beneficiaries. Beneficiaries have significantly higher crop sales, with a mean difference of \$305.087.

Objective 4: To determine the influence of smallholder Irrigation programs to food access

Table 4.11 Mean differences on beneficiary type and dietary diversity

Group Statistics						
	BENEFICIARY TYPE (2 groups)	N	Mean	Std. Deviation	Std. Error	
HD DS	Beneficiary	215	4.3628	2.07534	.14154	
	Non-beneficiary	109	3.7523	1.80614	.17300	

Beneficiaries have a higher average HD DS (4.3628) compared to non-beneficiaries (3.7523), indicating better dietary diversity among beneficiaries.

Table 4.12 Independent test on beneficiary type and dietary diversity

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
HD DS	Equal variances assumed	3.366	.067	2.610	322	.009	.61050	.23388	.15036	1.07063

The t-test results show a significant difference ($p = .009$) in dietary diversity between beneficiaries and non-beneficiaries. Beneficiaries have a higher mean HD DS, indicating better dietary diversity.

Food access

Table 4.13 Association test of beneficiary type and access to nutritious food

		Access to nutritious food					Total
			Better	Much Better	No Change	Worse	
BENEFICIARY TYPE (2 groups)	Beneficiary	1	107	30	40	37	215
	Non-beneficiary	0	30	2	36	41	109
Total		1	137	32	76	78	324
Chi-square test							
		Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)		
Pearson Chi-Square		49.010 ^a	2	.000	.000		
Likelihood Ratio		49.487	2	.000	.000		
Fisher's Exact Test		49.112			.000		
N of Valid Cases		324					
Symmetric Measures^c							
			Value	Approx. Sig.	Exact Sig.		
Nominal by Nominal	Phi		.389	.000	.000		
	Cramer's V		.389	.000	.000		
N of Valid Cases			324				

A significant association exists between beneficiary type and access to nutritious food (Chi-Square $p = .000$). Beneficiaries report much better access to nutritious food compared to non-beneficiaries.

Objective 5: To analyse the factors influencing the Household Dietary Diversity Score and Food Consumption Score of beneficiaries of smallholder Irrigation schemes

HDSS

Table 4.14: Logistic model

Variables in the Equation ^a							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1^b	Total Size of owned land now	.381	.110	12.124	1	.000	1.464
	GENDER OF HH(1)	-.696	.339	4.225	1	.040	.499
	Health status of Household Head			4.272	2	.118	
	Health status of Household Head(1)	.661	.365	3.270	1	.071	1.936
	Health status of Household Head(2)	1.162	.724	2.580	1	.108	3.198
	Constant	-1.284	.427	9.041	1	.003	.277

Total Size of Owned Land Now: A significant positive effect on HDSS (Exp (B) = 1.464, p = .000), indicating that owning more land increases dietary diversity.

Gender of Household Head: Female-headed households are less likely to have high HDSS compared to male-headed households (Exp (B) = .499, p = .040).

Health Status: Although not all health status variables are significant, there is a trend suggesting that healthier household heads may positively impact dietary diversity.

Logistic Regression Equation for HDSS:

$\log (p / \{1-p\}) = -1.284 + 0.381 \text{Total Size of Owned Land Now} - 0.696 \text{ Gender of HH}$ Where: - p is the probability of having a higher HDSS. Gender of HH is coded as 1 for female and 0 for male.

Table 4.15: Linear regression model

Coefficients^{a,b}						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.057	1.663		-.034	.973
	Age of Household Head	.072	.028	.392	2.595	.013
	Size of owned irrigated land	1.159	.536	.588	2.163	.037
	Poultry owned	.029	.019	.220	1.525	.136
	Sale of agricultural production this year Crop Sales US\$	-.001	.001	-.369	-1.372	.178
	Amount borrow in US\$ (total last 12 months)	.001	.001	.223	1.551	.129
	a. BENEFICIARY TYPE (2 groups) = Beneficiary					
b. Dependent Variable: HDDS						

- Age of Household Head: A significant positive impact on HDDS ($p = .013$), suggesting older household heads may achieve better dietary diversity.

- Size of Owned Irrigated Land: Significant positive impact on HDDS ($p = .037$), indicating that owning more irrigated land improves dietary diversity.

- Other Factors: Number of poultry, crop sales, and borrowing amounts are not statistically significant in this model.

Linear Regression Equation for HDDS:

$$\text{HDDS} = -0.057 + 0.072 \text{ Age of Household Head} + 1.159 \text{ Size of Owned Irrigated Land Now}$$

FOOD CONSUMPTION SCORE

Table 4.16 Logistic model

Variables in the Equation		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1^a	Total Size of owned land now	.422	.145	8.493	1	.004	1.525
	BENEFICIARYTYP E2groups(1)	-.267	.307	.757	1	.384	.765
	GENDEROFHH			6.001	2	.050	
	GENDEROFHH(1)	19.881	40192.970	.000	1	1.000	430546604.489
	GENDER OF HH(2)	-.760	.310	6.001	1	.014	.468
	Health status of Household Head			1.572	2	.456	
	Health status of Household Head(1)	.206	.333	.383	1	.536	1.228
	Health status of Household Head(2)	-.544	.667	.664	1	.415	.581
	Constant	.962	.422	5.197	1	.023	2.616

- Total Size of Owned Land Now: Significant positive effect on FCS ($\text{Exp}(B) = 1.525$, $p = .004$), indicating larger land ownership improves food consumption.
- Gender of Household Head: Female-headed households have lower FCS compared to male-headed households ($\text{Exp}(B) = .468$, $p = .014$).
- Beneficiary Type: Not a significant predictor of FCS in this model.

Logistic Regression Equation for FCS:

$$\log\left(\frac{p}{1-p}\right) = 0.962 + 0.422\text{Total Size of Owned Land Now} - 0.760\text{Gender of HH}$$

Where: - p is the probability of having a higher FCS.

- Gender of HH is coded as 1 for female and 0 for male.

Table 4.17: linear regression model

Coefficients^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	14.189	11.804		1.202	.244
	Size of owned irrigated land	7.051	4.236	.375	1.664	.112
	Poultry owned	.500	.198	.467	2.524	.021
	Borrowing Capacity US\$ (total last 12	.091	.035	.676	2.595	.018

months)					
Total Size of owned land	3.333	1.603	.377	2.080	.051
Time spent on fire wood gathering for fuel (in hours)	-5.197	2.406	-.413	-2.160	.044
Time spent on household water collection? (in hours)	12.838	6.995	.326	1.835	.082
Agricultural produce income this year? - Crop Sales US\$	-.031	.011	-.958	-2.844	.010
Distance to the main market for agriculture products from your household	.331	.121	.458	2.742	.013
Age of respondent at first birth	.534	.304	.279	1.756	.095
a. Dependent Variable: FCS					

Size of Owned Irrigated Land Now: Positive but not significant ($p = .112$).

- Number of Poultry: Significant positive effect on FCS ($p = .021$).

- Amount Borrowed (US\$): Significant positive effect on FCS ($p = .018$).

- Time Spent Collecting Wood: Significant negative effect on FCS ($p = .044$).

- Crop Sales (US\$): Significant negative effect on FCS ($p = .010$).

- Distance to Main Market: Significant positive effect on FCS ($p = .013$).

Linear Regression Equation for FCS:

$$\text{FCS} = 14.189 + 0.500 \text{ Number of Poultry} + 0.091 \{\text{Amount Borrowed}\} - 5.197 \{\text{Time Spent Collecting Wood}\} - 0.031 \{\text{Crop Sales}\} + 0.331 \{\text{Distance to Main Market}\}$$

4.7. Recommendations

According to demographics analysed in this chapter, benefits of irrigation schemes in terms of food security indicators appears to be in favour of male headed households at the expense of the female headed households. Female-headed households have lower FCS compared to male-headed households ($\text{Exp}(B) = .468, p = .014$).

There is need to consider gender mainstreaming when carrying out activities in irrigation schemes. Policy formulation also needs reconsider issues like land tenure and the patriarchal nature of the African culture so that women fully benefit from the development initiatives in their communities.

4.7 Conclusion

The results and findings of this study show that there is a positive relationship between participation in smallholder irrigation schemes activities and agricultural productivity and food security.

4.8 References

- Glonek, G. F., & McCullagh, P. (1995). Multivariate logistic models. *Journal of the Royal Statistical Society: Series B (Methodological)*, 57(3), 533-546.
- Holcomb, Z. (2016). *Fundamentals of descriptive statistics*. Routledge.
- LaValley, M. P. (2008). Logistic regression. *Circulation*, 117(18), 2395-2399.
- Rana, R., & Singhal, R. (2015). Chi-square test and its application in hypothesis testing. *Journal of Primary Care Specialties*, 1(1), 69-7

CHAPTER 5

SUMMARY, CONCLUSIONS, RECOMMENDATIONS

5.1 Introduction

This chapter summarises the research study procedures that were followed from chapter one which outlined the background to the study and chapter two which reviewed literature on the study. This chapter will also present the summary, conclusions and recommendations. The researcher made an assessment of the effectiveness of smallholder irrigation Schemes in enhancing agricultural productivity and food Security of rural farmers in semiarid regions of Zimbabwe.

5.2 Summary of Findings

The study covered six irrigation schemes in semi-arid areas in three provinces of Zimbabwe. The study sites are located in agroecological regions III, IV and V which are characterised by low and erratic rainfall, long dry spells and dependence on subsistence agriculture. The research design involved three groups: beneficiary irrigators, beneficiary rain-fed farmers, and non-beneficiary non-irrigators as a control group. Sampling procedures included selecting irrigation schemes, key informants, focus groups, case studies, and participants for household surveys. Data collection involved a quantitative approach, qualitative methods, and secondary data. Data analysis was performed using SPSS for quantitative data, thematic analysis for qualitative data, and Microsoft Excel for graphical representation. Inferential statistical analysis included chi-square tests and regression analysis to assess relationships between variables, such as food consumption status, climate-resilient technology adoption, crop yields, dietary diversity, and factors influencing dietary scores.

The findings of the study indicate varying levels of food security among the selected irrigation schemes, with Hamamavhaire having the highest prevalence of food security at 41.5%. While irrigation adoption is not widespread, with only 34% of households using it, there is a positive response to new agricultural technologies, with 54% of households adopting them. Early and timely planting, crop diversity, and integrated pest management have significantly contributed to resilience. Beneficiaries of irrigation schemes have significantly higher crop sales, with a mean difference of \$305.087 compared to non-beneficiaries, indicating a boost in crop production.

Dietary diversity, as measured by the Household Dietary Diversity Score (HDDS), is better among beneficiaries (mean: 4.3628) than non-beneficiaries (mean: 3.7523), and there is a significant association between beneficiary status and access to nutritious food. Owning more land, larger land ownership, and increased irrigated land size positively impact dietary diversity and food consumption. However, female-headed households are less likely to have high HDDS and Food Consumption Scores (FCS) compared to male-headed households. Healthier household heads may positively influence dietary diversity, and older household heads tend to achieve better dietary diversity.

The linear regression equation for FCS includes significant factors such as the number of poultry, the amount borrowed; time spent collecting wood, crop sales, and distance to the main market. These variables collectively influence the FCS, providing insights into the complex factors affecting food consumption in these communities.

5.3 Conclusion

Objective 1: To establish the prevalence of food security in irrigation schemes

The prevalence of food security varies across the selected irrigation schemes, with Hamamavhaire exhibiting the highest level of food security at 41.5%. This indicates that the implementation of smallholder irrigation schemes can effectively enhance food security in arid regions.

Objective 2: To analyze the extent of adoption of climate-resilient technologies by smallholder farmers in irrigation schemes

Conclusion 2.1: While irrigation adoption is not yet widespread, with only 34% of households using irrigation, there is a positive response to new agricultural technologies promoted by the project, as evidenced by a majority (54%) of households adopting these practices.

Conclusion 2.2: High adoption practices, including early and timely planting, crop diversification, and integrated pest management, have significantly contributed to the resilience of smallholder farmers in arid regions.

Objective 3: To assess the impact of integrated crop management techniques on maize, beans and tomato yields in smallholder irrigation schemes.

Conclusion 3.1: Beneficiaries of smallholder irrigation schemes have significantly higher crop sales, with a mean difference of \$305.087 compared to non-beneficiaries. This indicates that participation in irrigation schemes boosts crop production and provides economic benefits to farmers.

Objective 4: To determine the contribution of smallholder irrigation programs to food access and dietary diversity

Conclusion 4.1: Beneficiaries of smallholder irrigation schemes have better dietary diversity, as evidenced by higher HDDS scores, and they also report improved access to nutritious food.

Conclusion 4.2: Land ownership, including irrigated land, positively influences dietary diversity and food consumption, highlighting the importance of secure land rights in enhancing food security.

Conclusion 4.3: Gender disparities exist, with female-headed households achieving lower HDDS and FCS, indicating the need for targeted interventions to empower women and promote gender equality in access to resources and nutrition.

Objective 5: To analyze the factors influencing the Household Dietary Diversity Score (HDDS) and Food Consumption Score (FCS) of beneficiaries of smallholder irrigation schemes

Conclusion 5.1: The regression analysis revealed that factors such as land ownership, gender, health status, age of the household head, number of poultry, borrowing amounts, and distance to the main market collectively influence dietary diversity and food consumption patterns.

Conclusion 5.2: The linear regression equation for FCS includes significant variables, providing insights into the complex relationships between various factors and food consumption, which can inform policy interventions to improve the nutritional outcomes of beneficiaries.

5.4 Recommendations

After interpreting the data for this study and making conclusions the researcher made the following recommendations:

Objective 1: To establish the prevalence of food security in irrigation schemes

Recommendation 1.1: Continue promoting and supporting smallholder irrigation schemes in arid regions, as they have proven effective in enhancing food security. Specifically, replicate and build upon the successful model exhibited by the Hamamavhaire scheme.

Objective 2: To analyze the extent of adoption of climate-resilient technologies by smallholder farmers in irrigation schemes

Recommendation 2.1: While there is a positive uptake of new agricultural technologies, efforts should be made to further encourage the adoption of irrigation practices. Provide technical support, infrastructure, and resources to smallholder farmers to increase access to and utilization of irrigation systems.

Recommendation 2.2: Highlight and promote the high adoption practices, such as early and timely planting, crop diversification, and integrated pest management, as these have significantly contributed to resilience. Organize training programs and demonstrations to educate farmers about the benefits of these practices.

Objective 3: To assess the impact of integrated crop management techniques on maize, beans and tomato yields in smallholder irrigation schemes.

Recommendation 3.1: Given the significant impact of smallholder irrigation schemes on crop production and sales, ensure sustained and increased investment in the development and maintenance of these schemes. Provide necessary infrastructure, equipment, and training to maximize crop yields and economic benefits for beneficiaries.

Objective 4: To determine the contribution of smallholder irrigation programs to food access.

Recommendation 4.1: Recognizing the positive impact on dietary diversity and access to nutritious food, expand and enhance smallholder irrigation programs to reach more vulnerable communities.

Recommendation 4.2: Address gender disparities by implementing targeted interventions to support female-headed households. This may include providing specific training, resources, and access to land and irrigation schemes to empower women and improve their dietary diversity and food security outcomes.

Objective 5: To analyze the factors influencing the Household Dietary Diversity Score (HDDS) and Food Consumption Score (FCS) of beneficiaries of smallholder irrigation schemes

Recommendation 5.1: Consider the multifaceted factors influencing dietary diversity and food consumption when designing interventions. For example, promote poultry rearing, facilitate access to credit, reduce time spent collecting wood (e.g., by providing alternative energy sources), and improve access to markets to enhance dietary diversity and food consumption.

Recommendation 5.2: Utilize the linear regression equation for FCS to identify areas of intervention. For instance, promoting poultry rearing and providing support for borrowing could positively impact FCS, while also addressing issues related to crop sales and distance to markets.

5.5 Suggestions for further Study

5.5.1 Further Research on Irrigation Adoption:

Despite the positive impact of smallholder irrigation schemes, the low adoption rate of irrigation practices warrants further investigation. Future studies could explore the barriers and incentives for adopting irrigation technologies, including access to resources, knowledge gaps, and cultural factors. Understanding these factors can inform targeted interventions to promote wider adoption.

5.5.2 Impact of Climate Change:

With arid regions facing increased climate variability, future research could delve into the resilience of smallholder irrigation schemes under changing climatic conditions. Assessing the long-term sustainability and adaptability of these schemes in the face of more frequent and severe droughts, heat waves, or unpredictable rainfall patterns can provide valuable insights for climate-resilient agriculture.

5.5.3 Gender Dynamics and Empowerment

The identified gender disparities in dietary diversity and food security outcomes call for further exploration of the underlying causes and potential solutions. Future studies could focus on understanding the specific challenges faced by female-headed households and designing interventions to enhance their access to resources, empowerment, and nutritional outcomes.

5.5.4 Integrated Approaches to Food Security:

Building upon the findings of this study, future research could explore the potential for integrated approaches that combine smallholder irrigation schemes with other interventions, such as nutrition education, agricultural diversification, or income-generating activities. This could provide a more comprehensive understanding of the most effective strategies for improving food security and dietary diversity in arid regions.

5.6 References

Fanadzo, M. (2012). Revitalisation of smallholder irrigation schemes for poverty alleviation and household food security in South Africa: A review. *African journal of agricultural research*.

1. Appendices

Appendix 1: Quantitative and Qualitative Data collection tools

Household Questionnaire

My name is Naume Sihlola, a Masters in Food Security (MFS) student with Bindura University who is carrying out a survey in your area. Your household has been randomly selected from a list of smallholder irrigation farmers. Kindly assist in answering the following questions. These are key guidelines for the interview that you should know:

- i. Your involvement in this interview is voluntary.
- ii. The information that you provide will be kept trustworthy.
- iii. Your responses will be summed together with those of other households who have been randomly selected like yourself and general averages from analysis will be reported.
- iv. Your private details, such as your address and contact details will remain private.

Please ask for clarification. It will take about 45 minutes for the interview and we welcome your involvement. Would you like to continue with the interview?

1. Yes, let us proceed
2. No, I am busy for now

A – IDENTIFICATION OF HOUSEHOUSEHOLD		
A1	Provence	1 = M a n i c a l a n d, 2 = M a s v i n g o 3 = M i d l a n d, 4 = M a t S o u t h
A.3	Scheme	1=Musikavanhu 2=Exchange 3= Rupangwana, 4= Sebasa 5= Mayorca, 6= Gudo
A.4	Beneficiary type	1= Beneficiary irrigator 2= Beneficiary non-irrigator 3= Non-Beneficiary non- irrigator
A.5	Respondent Name:	
A6	Respondent Gender	1= Male, 2= Female
A.7	Nature of head of the household	1= Male Headed, 2= Female headed 3= Child headed
A.8	How old is household head	years
A9	Marital status of Household Head	1= Married, 2= Widowed 3= Divorced/ separated, 4= single
A.10	Household Head Highest Educational Attainment	1= No education, 2= Primary 3= Secondary, 4= Tertiary 5= Other
A.11	Health status of Household Head	1= Healthy, 2= Sometimes Sick 3= Sick, 4= bed ridden
A.12	How many people live in this Household?	... Total
A.12.	Of these people who live with you how many are aged	Below 18years, 18-35 yrs. Over 35 yrs.
A.13	Compared with other villagers in this community, in which of the following income categories does your households belong?	1= Well off, 2= Average 3= Poor, 4= Very poor
A14	How many people in your household are living with a disability?	
A15	How many orphans are there in your HH? below 18yrs	

B.	PARTICIPATION IN PROJECT ACTIVITIES	
B.1	When did you or any member of your family join irrigation project?	
B.2	Looking at the previous 12 months, was there any members of your house who participated irrigation activities	1= Yes; 2= No
B.3	Could you identify types of irrigation activities that you were involved in during the past 12 months:	
B.3.1	Post-harvest	1= Yes; 2= No
B.3.2	Farming as a business	1= Yes; 2= No
B.3.3	Natural resource management	1= Yes; 2= No
B.3.4	Nutrition Education	1= Yes; 2= No
B.3.5	Good agricultural Practices e.g. conservation Agric, Integrated Soil Fertility Management, use of adapted varieties	1= Yes; 2= No
B.3.6	Operations and maintenance	1= Yes; 2= No
B.4.	Post-harvest handling and storage	We were trained in:
B4.1	What activities regarding postharvest handling and storage of fresh horticultural products and other agricultural products (e.g., grain) did your household benefit from during last year?	<ol style="list-style-type: none"> 1. PHHS of fresh horticultural products. 2. HHS of grains and pulses 3. PHHS facilities for fresh horticultural products. 4. PHHS facilities for grains and pulses 5= None

B4.2	What benefits have gained from participating in cooperate irrigation programs	<ol style="list-style-type: none"> 1. RPL of fresh horticultural products 2. RPL of stored grain and pulses 3. Increased income from sale of fresh horticultural products, grains, and pulses
------	---	--

		4. Increased food and nutrition security from consuming fresh horticultural products, grains and pulses saved by using good postharvest handling and storage
B4.4	To what extent is the contribution of the irrigation projects: to the benefits that have accumulated to your household from participating in activities in postharvest handling and storage of agricultural products?	1= 0-25% low 2= 26-50% medium 3= 51-75% high 4= 76-100% very high

Group Membership and Influence	
Are you or is any member of the household a member of a producer organization/cooperative/Water organization/community group?	1= Yes 2= No
Who in this household is an active member of an irrigation group?	1= Respondent 2= Spouse/ partner 3= Children
To what extent do you feel like you can influence decisions in this irrigation group?	1= Very high 2= High 3= Moderate 4= Low 5= very low 6= No influence at all
To what extent do you feel like irrigation group membership can influence decision-making of local authorities and community level?	1= Very high 2= High 3= Moderate 4= Low 5= very low 6= No influence at all

C – LIVELIHOODS		
C.1	What is your source of cash income	1= Yes 2= No (no cash income, only subsistence agriculture)
C.1.1	Compared to past twelve months has your income is:	1= Higher 2= Equal 3= Lower
C.2	Main source of income for your household 1. Remittance 2. Dry land crop production/sales, 3.Irrigation plot crop production, 4. Casual labour, 5.Begging, 6.Livestock production/sales, 7. Skilled trade/artisan, 7. Own business, 8. Petty trade, 10.Pension, 11. Formal salary/wages, 12, fishing, 13. Gifts, 14. Vegetables production, 15. Small scale mining/mineral sales, 15. Other Specify	
C.3	Do you have other sources of income?	1= Yes 2= No
C.3.1	Name other income sources for your household	Many Responses
C4	What would you say is the average income in past year in US dollars?	

D – FOOD SECURITY				
D.1	Number of meal consumed by the following categories of people:	Children	Lactating Mothers	Adults
D.2	Has there been a period where household head could not offer 3 meals in a day for your household?	1= Yes 2= No		
D.2.1	Looking at the past twelve months could you tell me the frequency failure to provide 3 meals per day			
D.2.2	Do you notice any improvement as compared to previous year?	1= Small improvement 2= No change 3= Worse		
D3	Compared with last year, have you experienced reduction in the prevalence of chronic malnutrition children under five	1= Yes 2= No		

E. Nutrition		
E.1	Is there a family member who participated in a project designed to help improve nutrition?	1= Yes 2= No
E1.1	Gender of the person who participated in the project designed to help improve nutrition?	
E1.2	Who is responsible for household food purchases (food for daily consumption or other household needs)	1= Respondent 2= Spouse/ partner 3= Both respondent and spouse 4 =Other
The following questions ask about food consumed in during the day (Questions only for women 18 - 49 years old). Did you eat any of the following food items from sunrise to evening? If so how many times.		
Is there a woman aged 18 -49 in this household who can answer a few nutrition questions?		Yes No
Food made from grains or tuber		1 2

Beans or peas	1	2
Nuts or seeds	1	2
Milk or milk products	1	2
Meat, poultry and fish products	1	2
Eggs	1	2
Dark green leafy vegetables	1	2
Vitamin A rich fruits, vegetables and roots	1	2
Other vegetables	1	2
Fruits	1	2

D. DIETARY DIVERSITY

1	2	3	4	5	6	7	8	9	10	11	12	13
How many meals did the members in your household aged 5 years and above eat yesterday?	Is this the usual number of meals members have in a day?	In the previous 6 days; How many days did you/ others in your household consume: Mahewu, porridge, sadza, bread, rice	Did you/ others in your household consume: Mahewu, porridge, sadza, bread, rice or Other	In the previous 6 days; How many days did you/ others in your household consume: Potatoes, sweet potatoes or tubes	Did you/ others in your household consume: Potatoes, sweet potatoes or tubes	In the previous 6 days; How many days did you/ others in your household consume: beans peas, butternut	Did you/ others in your household consume: beans peas, butternut, nuts	In the previous 6 days; How many days did you/ others in your household consume: vegetables or leaves	Did you/ others in your household consume, vegetables or leaves / roots	In the previous 6 days; How many days did you/ others in your household consume: Any fruits	Did you/ others in your household consume: Any fruits	In the previous 6 days; How many days did you/ others in your household consume: Any form of meat
Number	Yes – 1 No - 2	Number	Yes – 1 No - 2	Number	Yes – 1 No - 2	Number	Yes – 1 No - 2	Number	Yes – 1 No - 2	Number	Yes – 1 No - 2	Number
14	15	16	17	18	19	20	21	22	23	24	25	26
Did you/ others in your household consume: Any form of meat	In the previous 6 days; How many days did you/ others in your household consume: Eggs	Did you/ others in your household consume: Eggs [NB If no one record Zero]	In the previous 6 days; How many days did you/ others in your household consume: Fish or Kapenta	Did you/ others in your household consume: Fish or Kapenta	In the previous 6 days; How many days did you/ others in your household consume: Milk	Did you/ others in your household consume: Milk or dairy products	In the previous 6 days; How many days did you/ others in your household consume: Sugar, honey	Did you/ others in your household consume: Sugar, honey, juice or any other sugary drinks	In the previous 6 days; How many days did you/ others in your household consume: Oil, fats, margarine	Did you/ others in your household consume: Oil, fats, margarine used for cooking	In the previous 6 days; How many days did you/ others in your household consume: Tea, spice	Did you/ others in your household consume: Tea, spice, tomato sauce or any condiments
Yes – 1 No - 2	Number	Yes – 1 No – 2	Number	Yes – 1 No - 2	Number	Yes – 1 No - 2	Number	Yes – 1 No - 2	Number	Yes – 1 No - 2	Number	Yes – 1 No - 2

If the response is no one, record Zero

F - AGRICULTURAL PRODUCTION AND IRRIGATION		
F1	For what purpose do you use dry land	A. For household food only B. We sale C. Both
F1.1	Name the crops that you grow in your dry land?	1=tomatoes 2=maize 3=Other specify
F1.2	Compared to last year would you say there was change in productivity of crops?	A. Change B. No Change
F1.3	This change of productivity did it result in increase or decrease?	1= Increase 2= Decrease 3= No change
F1.4	Is this increase related to trainings from other project activities in the community?	1= Yes 2= No
F1.5	To what extent is this crop productivity change related to the trainings?	1= 0-25% low 2= 26-50% medium 3= 51- 75% High 4= 76-100%- very high
F.2	Do you use irrigation for any part of your crop production?	A. Yes B. NO
F2.1	What is the purpose of your irrigation production	A. For household food only B. We sale C. Both
F2.2	What is the number of crops grown repeatedly on one piece of land in the irrigation plot in the same year?	
F2.3	Which crops do you grow in irrigation plot?	1=tomatoes, 2=maize 3=Vegetables 4=Other
F2.4	Compared to last year would you say there was change in productivity of crops?	B. Change C. No Change
F2.5	How would you measure this increase in yield per unit area?	A. Small B. Medium B. Large
F2.6	Give reasons for the noticed crop production changes	1= Good rains 2=Improved Agric practices 3=Others

F.3 CROP OUTPUT AND INCOME

CROP NAME

<i>Crop Name</i>	<i>Area planted</i>	<i>Area planted units (units e.g. acres, ha, lima, beds)</i>	<i>Input cost</i>	<i>Land price</i>
1=tomatoes; 2=maize 3=groundnuts; 4=beans 5=vegetables; 6=Sorghum 7=finger millet; 8=pearl millet 8.=Any other; 10 = None				
<i>Total Input Cost (US\$)</i>	<i>Total Input Cost (US\$)</i>	<i>Crop Output CONSUMED</i>	<i>Output</i>	
<i>Fertilizer/Herbicides/Pesticides</i>	<i>Labour</i>	<i>+ RETAINED FOR CONSUMPTION</i>	<i>90kg bag bundle d</i>	
<i>Crop Output Lost to POST HARVEST LOSSES</i>	<i>Crop Output GIVEN AWAY AS GIFTS</i>	<i>Crop Output SOLD + RETAINED FOR SALE</i>	<i>Selling I</i>	<i>US\$</i>

F- Technology Adoption and Resilience scores		
F.4.1	Since the beginning of the irrigation project, have you adopted to some extent new farming invention technology?	Yes/No
F4.2	<p>Agricultural practices promoted and technology adopted? (on the resilience scorecard</p> <p><i>1= Conservation agriculture</i></p> <p><i>2= integrated soil fertility management</i></p> <p><i>3= Planting of drought and heat tolerant crops and varieties,</i></p> <p><i>3= Planting a diversity of crops by the household</i></p> <p><i>4= Early and timely planting and weeding</i></p> <p><i>6= Integrated disease and pest management</i></p> <p><i>7= Postharvest loss saving technology</i></p> <p><i>8= Gully reclamation and natural resource management</i></p> <p><i>11= Integrated crop-livestock</i></p> <p><i>12= Agroforestry</i></p>	<p>Yes/No</p> <p>Yes/No</p> <p>Yes/No</p> <p>Yes/No</p> <p>Yes/No</p> <p>Yes/No</p> <p>Yes/No</p> <p>Yes/No</p> <p>Yes/No</p> <p>Yes/No</p>
F4.3	<p><i>To what extent has the adoption of new agricultural technologies increased the resilience of your household to food and nutrition insecurity (answer for only those technologies that have been adopted</i></p> <p><i>[no (N) = 0, partially contributed (PC) = 1, contributed significantly (CS) = 2]</i></p>	N, PC, CS
F4.4	<p><i>To what extent has the adoption of new agricultural technologies promoted by SIRP increased the resilience of your household to climate change (droughts, floods, cyclones) (answer for only those technologies that have been adopted</i></p> <p><i>(On the resilience scorecard, no</i></p> <p><i>(N) = 0, partially contributed (PC) = 1, contributed significantly (CS) = 2)</i></p>	N, PC, CS

Measuring household general welfare improvement/ gain

How is your household situation today (i.e. the day of the interview) compared to last year?

ITEMS	Worse	No Change	Better	Much Better	Reasons for Change
i. Household Income					
ii. Food security					
iii. Access to nutritious food					
iv. Availability of food					
v. Capacity to participate in community group or start and manage own business					
vi. Learning opportunities and knowledge gained from REP					

Appendix 2: Focus Group Discussion Guide

Name of group (irrigation scheme, type of farmer):

District and province:

Total number of participants:

Males:

Females:

1. Targeting and selection of beneficiaries

- (a) How were farmers selected to participate in the irrigation programme?
- (b) In your opinion, was the targeting done properly? Explain.
- (c) How could the selection be done in a more efficient manner in future programmes?

2. Production

- (a) Prior to irrigation schemes what were the crop production patterns?
- (b) How has irrigation farming affected your production (cropping patterns, productivity, intensity, post-harvest practices and technology)
- (c) What new production technologies/knowledge areas and practices have you adopted from the irrigation project activities and programmes

No.	Technology/knowledge area	Number of participants adopting	Number of participants not Adopting
1			
2			
3			
4			
5			
6			

- a) For those members of the FGD adopting the technologies, state reasons for adoption?
- b) For those not adopting, what are the reasons?

3. Sources of Income

- a) Have your income sources and levels changed since you joined irrigation scheme?
Yes/No
- b) What previously existing sources of income have changed (increased/decreased because of irrigation activities and programmes?
- c) What are the new sources of income attributable to irrigation interventions and by how much (percentage) have they contributed to increased/decreased household income?

4. Post-harvest handling and storage

- a) Did irrigation programmes include any postharvest handling and storage of fresh horticultural products? Yes/No
- b) What activities in postharvest handling and storage of fresh horticultural products were implemented in which members of your irrigation scheme or community participated?
- c) What activities in postharvest handling and storage of grains and pulses were implemented in which members of your irrigation scheme or community participated?
- d) What benefits accrued to the households in the irrigation scheme or community from the above activities?

5. Food Security

- a) Prior to the implementation of irrigation schemes in your district, were there some months in the year that people would not have enough food? Yes/No
- b) Describe your food security and nutrition status following your involvement in irrigation practices.
- c) Do you have enough food throughout the year since you benefitted from irrigation programme?
- d) What food insecurity coping strategies:
 - (i) before irrigation scheme and
 - (ii) Now?

6. How has participation in irrigation gardening affected your acquisition of household assets now?

7. Skills/Knowledge Acquisition

- a) What specific skills/knowledge have you acquired through participation in irrigation gardening?
- b) How has the skillset/knowledge impacted on your agricultural production?

8. What opportunities have you gained through this irrigation initiative?

9. Access to markets

- a) Prior to irrigation scheme how were you selling your agricultural products?
- b) How has irrigation schemes affected your marketing of agricultural products?
- c) What benefits have accrued to your households and to the community because of irrigation interventions in marketing of agricultural products

10. Irrigation scheme governance

- a) How is your irrigation scheme governed?
- b) How are women and youth involved in scheme governance?

How many males and females do you have in your irrigation management committee? Which positions do women occupy?

- c) How has (SHIP) influenced how your irrigation scheme is governed?
- d) What benefits have accrued to your households and to the community because of (SHIP) interventions in improving the governance of your irrigation scheme?

11. Operations and maintenance

- a) How do you manage the tasks and preservation of the irrigation infrastructure to ensure that the irrigation scheme runs sustainably?
- b) How has Smallholder Irrigation Scheme (SHIP) contributed to the improvement in the management of operations and maintenance of irrigation infrastructure to ensure that the scheme runs sustainably?
- c) What benefits have accrued to your households and community because of smallholder irrigation (SHIP) interventions to improve management and maintenance of irrigation infrastructure?

12. Do you encounter any challenges with the irrigation production of crops? If yes, what are these challenges?

13. Any other comments

Appendix 3: Focus Group Discussion Non-Beneficiaries

Name Of Group, Type of Farmer):

District, Province:

Date:

Total Number of Participants:

MALES:

FEMALE:

1. Do you know about Smallholder Irrigation Programs (SHIP)? Yes /No
2. If not, why did you not participate in (SHIP) activities?
3. What are your crop production patterns?
4. a). What new production /knowledge areas and practices have you adopted?
b) Number of adopters and non-adopters of the above-named technologies.

No.	Technology/knowledge area	Number of participants adopting	Number of participants not adopting
1			
2			

- c). Reasons for adopting?
 - d). Reasons for not adopting?
5. a). Do you know of any post-harvest technologies and knowledge?
b). What benefits accrued to your households from the use of these technologies/ knowledge?
 6. a). Are there some months of the year when people would not have any food to eat?
b). Describe your state of food security and nutrition?
c). What food insecurity coping strategies do you use?
 7. Which assets do you own?
 8. How do you use/sell your agricultural products?
 9. What challenges do you face as farmers?
 10. Do you have any general comments?

Appendix 6: Key Informant Guide

Name:

Province:

Village:

Scheme:

Title:

6. For how long has this irrigation program been running?
7. What role do you play in this area and in the irrigation scheme?
8. What crops are grown by the people in this community under irrigation and dryland
9. What benefits is the SHIP project bringing to you and the community?
 - i. Benefits to Key Informants being interviewed
 - ii. Benefits to the community:
10. In your opinion, to what extent were project activities that you were a participant, well- structured and organized, elaborate, and justify your opinion:
 - i. What would you describe as a major success of the project?
 - ii. What factors would you say contributed to this success?
 - iii. In your view what would you say are the unintended results from the project
11. Has the income of village members improved on account of programme interventions?
12. Give the number of families with improved living conditions.

Give an estimate of the total number of households in the area

Number of Families showing change in their living conditions		
Food security:		
Water		
Sanitation:		
Shelter		
Education		
Health		

13. State some challenges faced by villagers?

14. What do you think can be done to alleviate these challenges?

Thank you

