BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF AGRICULTURE AND ENVIRONMENTAL SCIENCE

DEPARTMENT OF AGRICULTURAL ECONOMICS, EDUCATION AND EXTENSION

THE EFFECT OF SMALLHOLDER IRRIGATION DEVELOPMENT ON AGRICULTURAL PRODUCTIVITY AND POVERTY REDUCTION IN SEMI-ARID AREAS OF ZIMBABWE.
A CASE STUDY OF THE TSHOVANI IRRIGATION SCHEME IN CHIREDZI.

A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS OF THE BACHELOR OF SCIENCE HONOURS DEGREE IN AGRICULTURAL ECONOMICS AND MANAGEMENT

BY

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JUNE 2026

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DEGREE TITLE: BACHELOR OF AGRICULTURAL SCIENCE HONOURS DEGREE IN AGRICULTURAL ECONOMICS AND MANAGEMENT.

PROJECT TITLE: THE EFFECT OF SMALLHOLDER IRRIGATION DEVELOPMENT ON AGRICULTURAL PRODUCTIVITY AND POVERTY REDUCTION IN SEMI-ARID AREAS OF ZIMBABWE. A CASE OF THE TSHOVANI IRRIGATION SCHEME IN CHIREDZI.

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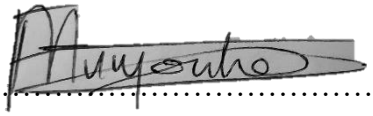
SIGNED: 

DATE: 24 June 2026

APPROVAL FORM

The undersigned certify that they have supervised and recommended to Bindura University of Science Education for acceptance of the dissertation entitled 'The effect of smallholder irrigation development on agricultural productivity and poverty reduction in semi-arid areas of Zimbabwe. A case of the Tshovani irrigation scheme in Chiredzi.'

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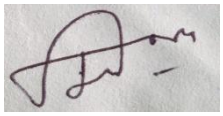
Signed: 

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DECLARATION

I, Forward S. Munyonho, acknowledge that this dissertation entitled "The Effect of Smallholder Irrigation Development on Agricultural Productivity and Poverty Reduction in Semi-Arid Areas of Zimbabwe" A Case of the Tshovani Irrigation Scheme in Chiredzi is solely my original work and has not been previously submitted to any other universities or institutions for an academic qualification.

My supervisor, Mr. Govere and other academic staff offered me great advice, guidance and support during my research. Yet, all the ideas analysis interpretation and writing that appear in this dissertation are entirely mine. Also, I strongly declare that I have observed the academic honesty regulations of the Bindura University of Science Education and that I have cited and referenced all the sources that have helped me in the writing of this dissertation.

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DEDICATION

My work is devoted to and dedicated to my parents, whose constant support, guidance and sacrifices that have been the foundation of success in both my life and learning.

To my mom, I appreciate your immense love, your encouraging words and your trust in my capabilities. I will never forget how you tirelessly supported me, how patiently you endured me and how every time, without fail, you motivated me. That has been my source of strength for chasing my dreams and overcoming the obstacles that lead to our changes in the path. You have always been the one who not only made my life comfortable but also kept it going no matter what.

To my dad, thank you for the important life lessons you have taught me through your own example. In particular lessons in life experiences, working hard, determination, self-discipline, finance and not giving up.

This piece reflects the wonderful education, love and sacrifices you both have given me. I dedicate this dissertation to you carrying heartfelt gratitude, admiration and love and I hope that this will be a source of pride for you. Your guidance has been an inseparable part of my development and I consider this success to be yours as well as mine.

ACKNOWLEDGEMENTS

At the very beginning, I dedicate all praise and thanks to the Lord, who offered me life, health mind and the strength that helped me to start and finish this work successfully. His mercy and leading kept me going all through this scholastic path. My heavy thanks also go to my family. Deep down, you are the ones who love me unconditionally, support me without fail, be patient with me and understand me even at my worst. Through all the times when you cheered me on and through the sacrifices you made, you have been a great help to me in reaching this point of my life. Whenever I doubted myself, your support and faith in me have been the power that has kept me going and inspired me on and on.

I acknowledge my advisor Mr. I. Govere, for his invaluable timely guidance, patience and dedication, as well as his continuous support, which have all been priceless to me. Given his vast knowledge, the manner in which he detects flaws and encourages, I very much owe the success of this research to him. Besides that, I want to thank the academic staff of the department of Agricultural Economics for sharing their knowledge, giving me academic direction and supporting me throughout my degree.

I deeply appreciate the contributions of smallholder farmers and local communities in the district of Chiredzi, province of Masvingo, who readily and passionately participated in this research and shared their stories, knowledge and viewpoints. Their input was very critical to the success of this study and the insights that they gave have been instrumental in understanding the role of smallholder irrigation development in not only transforming agriculture but also in contributing to food security and improving livelihoods in rural areas. Same here, I appreciate the management and staff of the Tshovani Irrigation Scheme for their cooperation, help and support during the field work.

Finally, I wish to express my gratitude to my colleagues and friends Tadiwa Mazuru, Arnold Kepekepe, Mazvita Chingati and Ashley Chaimbira for their constant encouragement, companionship and support that didn't waver even at the toughest times. Your insightful critiques, inspirations and kind talk made me keep going and achieve my goal. This journey has been as remarkable as the friendship and sympathy we shared. I am deeply grateful to all of you who in one way or another have led to the realization of this dissertation. Your support has handed me such a wonderful chance to achieve this milestone.

ABSTRACT

Developing smallholder irrigation is a key means through which agricultural productivity can be increased and poverty reduced in the semi-arid regions of Zimbabwe. In the current study, the author analysed the influence of smallholder irrigation development on agricultural productivity and poverty reduction at the Tshovani Irrigation Scheme in Chiredzi District, Masvingo Province. The work considered the productivity of beneficiary versus non-beneficiary households, using poverty reduction as a key indicator of the influence of participation in irrigation, as well as looking into changes in farming practices and farm performance. Researchers applied a combination of qualitative and quantitative methods of information collection. They gathered data from 55 households that were chosen from a population of 127 households using structured questionnaires, interviews with key informants, focus group discussions, observational methods. Descriptive statistics, ANOVA Tukey's HSD post hoc tests and chi-square tests was utilized for quantitative data analysis, whereas qualitative data were subjected to thematic analysis.

The results showed that beneficiary irrigators achieved significantly higher agricultural productivity than non-beneficiaries. Average maize yields were 3.70 mt/ha for beneficiary irrigators compared to 1.90 mt/ha for non-beneficiaries, while bean yields were 2.30 mt/ha and 0.88 mt/ha, respectively. Beneficiary irrigators also recorded a higher cropping intensity **(**2.24 crops per year**)** than non-beneficiaries **(**1.00 crop per year**).** ANOVA results confirmed significant differences in maize yields **(**$F = 8.92$, $p < 0.001$**).**

The study further revealed that irrigation participation contributed to poverty reduction. Beneficiary irrigators recorded the highest mean annual household income **(**US$1,071.77**)** compared to beneficiary non-irrigators **(**US$565.94**)** and non-beneficiaries **(**US$367.01**).** Food security outcomes were also better among irrigators, with 94.4% achieving acceptable Food Consumption Scores and 87.0% classified as food secure based on Household Dietary Diversity Scores. Beneficiary irrigators recorded a mean HDDS of 7.54, compared to 6.67 for beneficiary non-irrigators and 6.31 for non-beneficiaries. The findings further shows that irrigation development improved the adoption of climate-smart technologies, farming practices, market access and livelihood.

The research concludes that the Tshovani Irrigation Scheme has served as a critical institutional platform for transforming smallholder livelihoods by significantly enhancing crop yields

(productivity), household income and food security. While the scheme effectively acts as a "fortress" against climate-induced production losses, its full economic potential is currently limited by incomplete market integration and a lack of access to formal financial services.

The Government of Zimbabwe and development partners should strengthen market linkages and value chain integration by investing in formal market infrastructure and establishing direct ties with formal commodity buyers to eliminate the influence of exploitative informal traders (makoronyera)

Keywords: Smallholder irrigation development, agricultural productivity, poverty reduction, food security, Tshovani Irrigation Scheme, Zimbabwe.

Table Contents

RELEASE FORM i
APPROVAL FORM ii
DECLARATION iii
DEDICATION iv
ACKNOWLEDGEMENTS v
ABSTRACT vi
LIST OF FIGURES xi
LIST OF TABLES xii
LIST OF ACRONYMS AND ABBREVIATIONS xiii
CHAPTER 1 1
1.0 INTRODUCTION 1
1.1 Background of the study 1
1.2 Statement of the Problem 3
1.3 Research Questions 4
1.4 Research Objectives 4
1.4.1 Main Objective 4
1.4.2 Specific Objectives 4
1.5 Hypotheses 4
1.6 Significance of the Study 5
1.7 Scope and limitation of the study 5
1.8 Limitations of the study 5
1.9 Organization of the research 5
CHAPTER 2 6
2.0 LITERATURE REVIEW 6
2.1 INTRODUCTION 6
2.2 Concepts and Definition of Key Terms 6
2.2.1 Irrigation 6
2.2.2 Irrigation scheme 6
2.2.3 Smallholder Irrigation Development 6
2.2.4 Agricultural productivity 7
2.2.5 Household productivity 7
2.2.6 Poverty 8
2.2.7 Poverty reduction 8
2.2.8 Household welfare / livelihood systems 9
2.2.9 Food security 10
2.3 Empirical Literature Review 10
2.3.1 Comparison of Agricultural Productivity between Beneficiaries and Non-Beneficiaries 10
2.3.2 Impact of Irrigation Participation on Household Poverty Levels 11
2.3.3 Influence of Irrigation Development on Farming Practices, Input Use and Farm Performance 12
2.4 Conceptual Framework 13

2.4.1 Irrigation-Agricultural productivity and poverty reduction linkages....13
2.4.1.1 Empowerment pathway....15
2.4.1.2 Market Expansion Pathway....15
2.4.1.3 Subsistence pathway....16
2.5 Insight from the Literature....16
2.6 Research gap....18
CHAPTER 3....19
3.0 METHODOLOGY....19
3.1 Introduction....19
3.2 Description of the Study Area....19
3.2.1 Location....19
3.2.2Population and Area Coverage....20
3.2.3 Climatic conditions....20
3.2.4 Agricultural activities....20
3.2.5 Economic activities....21
3.2.6 Tshovani Irrigation Scheme....21
3.3 Research design....21
3.4 Sampling Technique and Sample Size....22
3.5 Data Collection Methods....23
3.6 Data Types and Sources....24
3.7 Data Collection Techniques....24
3.8 Method of Data Analysis....25
CHAPTER 4....28
4.0 RESULTS AND DISCUSSION....28
4.1 INTRODUCTION....28
4.2 COMPARISON OF AGRICULTURAL PRODUCTIVITY BETWEEN BENEFICIARY AND NON-BENEFICIARY HOUSEHOLDS OF THE TSHOVANI IRRIGATION SCHEME....29
4.3 EFFECT OF PARTICIPATION IN THE TSHOVANI IRRIGATION SCHEME ON HOUSEHOLD POVERTY LEVELS....32
4.3.1 Food Consumption Score (FCS) by Beneficiary Type....34
4.3.2 Household Dietary Diversity Score (HDDS) by Beneficiary Type....35
4.3.3 Regression Analysis of the Determinants of Household Income....39
4.4 IRRIGATION DEVELOPMENT AND IMPROVEMENTS IN FARMING PRACTICES, INPUT USE, AND FARM PERFORMANCE AMONG BENEFICIARY HOUSEHOLDS....43
4.4.1 Input Use and Agricultural Practices....45
4.4.2 Market Access and Agricultural Sales Income....46
CHAPTER 5....49
5.0 CONCLUSIONS AND RECOMMENDATIONS....49
5.1 CONCLUSIONS....49
5.1.1 Agricultural Productivity....49
5.1.2 Poverty Reduction....49
5.1.3 Farming Practices, Input Use and Farm Performance....51

5.2 RECOMMENDATIONS....52
5.2.1 Strengthen Market Linkages and Value Chain Integration....52
5.2.2 Expand Access to Formal Financial Services....52
5.2.3 Prioritise Infrastructure Maintenance and Timely Input Procurement....53
5.2.4 Extend Benefits to Non-Irrigator Beneficiaries and Vulnerable Non-Beneficiaries....53
5.2.5 Sustain and Scale Up Technology Adoption and Extension Services....53
5.2.6 Promote Youth and Women's Economic Empowerment within Irrigation Programmes....54
REFERENCE....55
APPENDICES....63
Appendix 1:Household Survey Questionnaire....64
Appendix 2: Household Dietary Diversity Score (HDDS) Questionnaire....71
Appendix 3: Food Consumption Score (FCS) Questionnaire....73
Appendix 4: Key Informant Interview (KII) Schedule....74
Appendix 5: Focus Group Discussion (FGD) Guide : Beneficiary Irrigators....76
Appendix 6: Focus Group Discussion (FGD) Guide Non-Beneficiary Households (Control Group)....77

LIST OF FIGURES

Figure 2. 1: Building blocks of the concept of poverty reduction 9
Figure 2. 2: Irrigation- Agricultural productivity and poverty reduction linkages 14

Figure 3. 1: Study Map of Tshovani Irrigation Scheme of Chiredzi District of Masvingo Province……..19

Figure 4.1: Comparison of Average Crop Yields (mt/ha) by Beneficiary…….....31

Figure 4. 2: Comparison of Average Annual Household Income (US$) by Beneficiary Type 33
Figure 4. 3. Household Dietary Diversity Score (HDDS) Categories by Beneficiary Type ...36
Figure 4. 4. Household Asset Ownership and Market Access by Beneficiary Type.....**Error! Bookmark not defined.**
Figure 4. 5: Technology Adoption Rate by Beneficiary Type 44
Figure 4. 6: Agricultural Sales Income and Market Access by Beneficiary Type 47

LIST OF TABLES

Table 3. 1: Summary of Data Collection 23
Table 3. 2:. Summary of Data Analysis 25

Table 4.1: Comparison of Average Crop Yields (mt/ha) by Beneficiary Type of Tshovani Irrigation Scheme 29
Table 4. 2: ANOVA Results for Comparison of Maize Yields by Beneficiary Type 30
Table 4.3: Comparison of Average Annual Household Income (US$) by Beneficiary Type .32
Table 4.4: Food Consumption Score (FCS) Classification by Beneficiary Type 34
Table 4.5: Comparison of Household Dietary Diversity Score (HDDS) by Beneficiary Type 35
Table 4.6 : Household Asset and Livestock Ownership by Beneficiary Type 37
Table 4.7 : OLS Regression Results for Determinants of Annual Household Income (US$) .40
Table 4.8 : Model Summary and ANOVA for the Household Income Regression Model 42
Table 4. 9: Technology Adoption and Good Agricultural Practice Uptake by Beneficiary Type 43
Table 4.10: Agricultural Sales Income and Market Access by Beneficiary Type 46

LIST OF ACRONYMS AND ABBREVIATIONS

ADB: African Development Bank

AGRITEX: Department of Agricultural, Technical and Extension Services

ANOVA: Analysis of Variance

CRS: Combined Resilience Score

CSIAP: Climate Smart Irrigated Agriculture Project

DFID: Department for International Development

FAAB: Farming as a Business

FAO: Food and Agriculture Organization of the United Nations

FCS: Food Consumption Score

FGD: Focus Group Discussion

GAP: Good Agricultural Practices

GIS: Geographic Information System

GMB: Grain Marketing Board

GOZ: Government of Zimbabwe

GPS: Global Positioning System

HDDS: Household Dietary Diversity Score

HSCT: Harmonised Social Cash Transfer

IFAD: International Fund for Agricultural Development

IMC: Irrigation Management Committee

ISAL: Internal Savings and Lending

IWMI: International Water Management Institute

KII: Key Informant Interview

RDC: Rural District Council

SPSS: Statistical Package for the Social Sciences

UNDP: United Nations Development Programme

WFP: World Food Programme

WHO: World Health Organisation

ZIMSTAT: Zimbabwe National Statistics Agency

MLAWFRD: Ministry of Lands, Agriculture, Fisheries, Water and Rural Development

CHAPTER 1

1.0 INTRODUCTION

1.1 Background of the study

Zimbabwe's economy was built upon a strong agricultural base and agriculture also creates jobs for nearly 70% of the working population, "where approximately 3.5 million farmers rely on rain-fed farming practices for their subsistence and survival" (FAO, 2023; IFC, 2023). Nearly 75% of agricultural production is from small farmers and about 70% of the agricultural production that is marketed comes from these farmers (FAO, 2023). This sector produces around 11% to 14% of the total domestic product (GDP) of Zimbabwe (World Bank, 2025). Crop items like maize, tobacco, cotton and fresh produce like blueberries, avocados and macadamia nuts are the main contributors to GDP and the country's foreign exchange earnings (FAO, 2023). For example, tobacco brought in roughly US$550 million in exports for the 2025/2026 season (ZBC News, 2026).

This reliance causes most of the population to be very vulnerable to weather and economic shocks. Weather shocks like Cyclone Idai in 2019 that resulted in more than US$141 million worth of crop damage, equipment damage and droughts linked to the 2023/2024 El Nino event which caused maize and wheat output to fall by about 60% from the average of the past five years heavily affect crops and cause food shortages (IFC, 2023; World Bank, 2025). Besides that, erratic weather conditions worsened by climate change led to production risks which small-scale farming can hardly operate efficiently without proper (World Bank, 2025).

Zimbabwe's total land mass exceeds 39 million hectares. The areas with the highest potential for agricultural production and productivity is found in the semi-arid of Zimbabwe's agro-ecological zones, simply called Natural Regions IV and V (FAO, 2023). These zones are characterized by low and variable rainfall, high temperatures, and poor soils that make droughts very likely (Mugandani et al., 2012). Irrigation systems played an important role in increasing productivity levels. But due to the deterioration of such systems following the fast-track land reform policy in 2000, the area under irrigation in Zimbabwe has drastically reduced (Moyo, 2016; ReliefWeb, 2005). Zimbabwe can currently irrigate approximately 366,000 hectares, but only 124,000 hectares are presently under irrigation in all agro-ecological regions (FAO, 2023).

In line with this, the Government of Zimbabwe's National Agriculture Policy Framework (2019 -2030) identifies expanded irrigation development as a central strategy for raising agricultural productivity, poverty alleviation and achieving food and nutrition security (Government of Zimbabwe, 2019).

At the national level, the development trajectory of Zimbabwe's agricultural sector is structurally guided by the National Agricultural Policy Framework (NAPF) 2019-2030. The NAPF serves as the primary strategic roadmap to "reimagine" the sector, aligning agricultural interventions with the broader national Vision 2030 agenda of attaining Upper-Middle-Income Status through agricultural advancement, thereby reducing poverty (MLAWFRD, 2019). According to the Ministry of Lands, Agriculture, Water and Rural Development (MLAWFRD) (2018), agricultural growth is a uniquely powerful mechanism for rural development, reducing poverty at twice the rate of growth in non-agricultural sectors. However, the framework notes that Zimbabwe's agricultural economy remains highly vulnerable to climate-related shocks and macroeconomic instabilities because approximately 70% of the population relies on subsistence, rain-fed farming (MLAWFRD, 2019). This policy environment demands targeted, localised research to understand how transitioning smallholder farming from rain-fed subsistence to intensive, irrigated systems can shield rural households from poverty (MLAWFRD, 2019).

For these reasons, the Government of Zimbabwe collaborated with IFAD and OFID to introduce the Tshovani Irrigation Scheme. Irrigation Scheme projects first and foremost aim at raising production levels and uplifting the economic status of the people through higher agricultural productivity, lessening poverty, ensuring food availability and at the same time, having a climate resilient population (IFAD, 2023). One of the places where a project of this nature under the program is being carried out is at the Tshovani Irrigation Scheme in the Chiredzi District of Masvingo Province. In Agro-Ecological Region V, the Tshovani Scheme has more than 360 hectares. and 127 farmers with bigger plots, i.e. 2-3 hectares, are involved (IFAD, 2023). Due to In reality this is an arid area, irrigation emerges as a revolutionary weapon, as it allows for the production of crops throughout the year versus dryland farmers, who experience food shortages during the "hunger period" from August to February. Farmers' income has enormously increased with the introduction of crop varieties to dry regions like paprika in Tshovani (Zimbabwe Now, 2024).

Irrigation is definitely a tool for poverty alleviation and productivity enhancement, yet empirical evidence points out Sub-Saharan Africa that its effectiveness highly depends on

conditions on the ground. Per various studies in Southern Africa, ignoring institutions and technologies while implementing irrigation projects might result in failing to help poor farmers in poverty reduction as well as food security (Pittock et al., 2020). It is proven that specific interventions, like agricultural innovation platforms and soil monitoring technology, might quite a bit increase crop yields, ensure profitability and even support vulnerable groups like women and young people (Parryetal., 2024). So, it is necessary to assess the effect of irrigation in semi-arid Zimbabwe.

1.2 Statement of the Problem

Located in the Masvingo Province, the Tshovani Irrigation Scheme is a suffering area where people are ever hungry and children's malnutrition is a typical scenario. On average, around 30% of the Chiredzi province's population is currently facing food insecurity, while the presence of child malnutrition is also confirmed by the measurement of child stunting at 26.1% for under-fives in the country (ZIMSTAT, 2020; FAO, 2025). What is quite worrying is that Masvingo is ranked as the most vulnerable province (road network) with 58.2% of children aged between six and 23 months being severely food-deprived (Zimbabwe Livelihoods Assessment Committee, 2024). While irrigation can enhance high yield and poverty alleviation, local Tshovani irrigators are facing huge difficulties for moving to the idea of "farming as a business" but farming for household use.

Among the issues raised by the Tshovani irrigators were late purchasing of farm inputs, lack of enough power for water pumps and insufficient number of hydrants. Chikuvadze and Moyo (2024) argue that "inefficient and out-of-date institutions lead to duplication, overlap and fragmentation of functions amongst government departments so that the formal institution's role is minimized and the irrigation works are left open to vandalism and inevitably poor maintenance practices". Farmers' lack access to formal credit facilities and the dominant role of the exploitative makoronyera in local markets make it almost impossible for farmers to make a good profit. Research shows that " less than a quarter of smallholder farmers have access to formal financial services" while many farmers rely on informal and rural saving schemes and money lenders (Masuka, 2025). The informal traders (makoronyera) are part of the underground economy which accounts for over 60% of Zimbabwean businesses (Zimbabwe Land and Agrarian Network, 2019). They lure farmers with attractive prices but actually pay less than the farm gate prices (Future Agricultures, 2024; Zimbabwe Land and Agrarian Network, 2019).

The need for a statistical analysis to determine the effects of the scheme's enhancement of agricultural productivity on smallholder farmers getting out of poverty is terribly pressing. The Tshovani Irrigation Scheme which is mostly targeted at smallholder farmers intends to increase crop yield, food production livelihood income and nutrition. So the main goal of this thesis is to investigate the involvement of Tshovani Irrigation Scheme in food productivity and poverty alleviation among smallholder farmers.

1.3 Research Questions

1. How do Tshovani irrigation scheme beneficiaries differ from non-beneficiaries in agricultural productivity (yield per hectare)?
2. To what extent does participation in the Tshovani irrigation scheme reduce poverty levels among beneficiary households compared with non-beneficiaries in Chiredzi?
3. How has smallholder irrigation development influenced farming practices, input use and farm performance among beneficiary households in the Tshovani irrigation scheme?

1.4 Research Objectives

1.4.1 Main Objective

To measure the effect of smallholder irrigation development on agricultural productivity and poverty reduction in the semi-arid Tshovani area of Chiredzi.

1.4.2 Specific Objectives

1. To compare the agricultural productivity of beneficiary and non-beneficiary households associated with the Tshovani irrigation scheme.
2. To assess the effect of participation in the Tshovani irrigation scheme on poverty levels among beneficiary households.
3. To examine the extent to which irrigation development has improved farming practices, input use and overall farm performance among beneficiaries.

1.5 Hypotheses

1. H1: Smallholder farmers who benefit from the Tshovani irrigation scheme have significantly higher agricultural productivity (yield mt/ha) than non-beneficiaries.
2. H2: Participation in the Tshovani irrigation scheme significantly predicts higher household income and improved food security.

3. H3: Beneficiary farmers at Tshovani exhibit significantly higher adoption rates of climate-smart technologies compared to non-beneficiaries.

1.6 Significance of the Study

This thesis will definitely come handy to policy makers and development practitioners who are interested in works of improving upon the Tshovani irrigation project and other such future projects. In fact, the research by highlighting problems such as lack of infrastructural facilities and inadequate market access in Tshovani not only points the way for efficient targeting of the areas that require the most help but also for welfare gains. Further, this research enriches the literature on agricultural sustainability in Natural Region V. It gives insight on how 'farming as a business' training often means economic independence of the disadvantaged communities.

1.7 Scope and limitation of the study

This study only covers the Tshovani Irrigation Project within the Chiredzi district area of Masvingo province in Zimbabwe. The focus of this paper is on the correlation of access to irrigation, farm yields and poverty indicators like the Household Dietary Score (HDDS) and annual income.

1.8 Limitations of the study

The factors uncovered might not be as relevant to zones with different agro-ecological settings (for instance, natural regions 1 or 2). The original data will be based on respondents' recollections; this might cause minor inaccuracies when gauging productivity, income and expenditure. In addition, changes in the value of the national currency and power outages by ZESA may affect the study's results on poverty reduction and agricultural productivity.

1.9 Organization of the research

This thesis is structured into five chapters. Chapter one includes background information, the problem statement, research questions, research objectives, research hypotheses and the significance of the study. The second chapter is devoted to a literature review on the impact of irrigation development on agricultural productivity and linkages, poverty and poverty reduction. Chapter 3 deals with the approach and explains the stratified sampling technique used in the Tshovani Irrigation Scheme survey. Chapter 4 deliberates on results and analysis of productivity and poverty. Chapter 5 gives the conclusion of the whole research and recommendations for improvement of the Tshovani irrigation scheme.

CHAPTER 2
2.0 LITERATURE REVIEW

2.1 INTRODUCTION

The goal of this chapter is to examine and integrate the existing research's on how the irrigation of small farms can contribute to crop production and poverty reduction in semi-arid areas. Eventually, through the literature review, the researcher aims to construct a theoretical system of the role of irrigation schemes such as Tshovani in setting up mechanisms that enable families to become economically resilient. The author will present concise and relevant definitions of the main concepts. After that, the author will illustrate the importance of irrigation from the empirical point of view mainly about the specific project of irrigation development and finally, the author will establish the conceptual system that reveals the relationship between water provision and inhabitants' welfare.

2.2 Concepts and Definition of Key Terms

2.2.1 Irrigation

As stated by FAO (n.d.) , irrigation is defined as "the practice of applying water manually to soils or lands to help in growing crops when the amount of natural rainfall is not sufficient." This refers to an intentional action carried out by humans to counter insufficient water supplies in agriculture in order to meet plant moisture requirements for high yield (American Meteorological Society, 2024). Rodgers, C. and Svendsen, M. (1992) pointed out that irrigation means control of water from its source to crop roots.

2.2.2 Irrigation scheme

Irrigation schemes involve an arrangement whereby water is extracted from a source such as a river or aquifer through a set of channels and pipes in order to provide water to several farm fields (FAO, 2011). They often employ collective governance systems (Water Users Associations), which also have water-allocation arrangements (Plusquellec, 2002).

2.2.3 Smallholder Irrigation Development

Smallholder irrigation development for smallholder farmer is the rehabilitation of irrigation infrastructure and management support for year-round production to reduce dependence on rainfall. Irrigation development for smallholder farmers in Zimbabwe entails provision of water for farming in order to reduce uncertainty of rainfall for production. Manzungu and Van der Zaag (1996) noted that, after independence, many of the communal irrigation schemes were

abandoned and left to ruin. However, following the 2016 drought, government moved in to restart irrigation development through several initiatives including the Tshovani Irrigation scheme. These programs are now focused on irrigation rehabilitation and development under the Accelerated Irrigation Rehabilitation and Development (AIRD) Plan with the aim of increasing agricultural production for food and wealth, improving climate change resilience and enhance commercialization (Government of Zimbabwe, 2021).

Several successful schemes are now in production including Tokwe Mukosi and Chisumbanje schemes where maize, beans and a variety of vegetables are produced on a continuous basis throughout the year. Although there are challenges to increase irrigation production including lack of maintenance, fragmentation in irrigation management and funds for implementation, successes such as those mentioned above indicate that with good management, production can increase by double or more (Muchara et al., 2018).

2.2.4 Agricultural productivity

Agricultural productivity is conceptualized as the proportion of agricultural output relative to all the inputs engaged in agricultural-related activities such as land, labour, fertilizer, water and other machinery (Coelli et al., 2005). Generally, agricultural productivity gets gauged for yield per hectare (land partial productivity) and total factor productivity (TFP) where all the factors of production are considered together (OECD, 2019). Increased productivity of the agricultural sector, more food will be produced from a limited amount of resources, as a result improves food security, poverty reduction and sustainability promotion (World Bank, 2007). Productivity enhancement in Zimbabwe is now the utmost priority because many the small holder farmers are dependent on rainfall and they are getting yields way below their potentials (Manzungu and Van der Zaag, 1996).

2.2.5 Household productivity

Household productivity refers to the efficiency with which a household converts it's available resources labour, time, skills, land, capitall and social networks into goods and ser vices that enhance its welfare, income, or food security (Becker, 1965; Ellis, 1998). In rural agricultural contexts, it includes both on farm productivity (crop yields, livestock output) and off farm activities (processing, trading, wage work) that contribute to household livelihoods (Singh et al., 1986). Higher household productivity means achieving more output (food, income, savings) from the same or fewer inputs, often through better technology, irrigation,

education, or organisation (World Bank, 2007). In Zimbabwe, smallholder household productivity is constrained by low input access, erratic rainfall and limited extension services (Manzungu and Van der Zaag, 1996).

2.2.6 Poverty

Poverty refers to the state when individuals or families do not have enough money and resources to provide themselves with the basic necessities of life (World Bank, 2018). Most of the time it's gauged with the number of populations living under a certain absolute poverty line (e.g. U.S. $2.15 per day for low-income countries) or a line that is relative to the median incomes in a particular society (UNDP, 2019). Along with low income, poverty is deprivation at the very minimum level of living like hunger, poor nutrition, restricted educational opportunities, health/social discrimination and exclusion from decision-making (Sen, 1999; UNDP, 2019). In Zimbabwe, poverty is predominantly a rural event, with greater 70% of the rural population living below the national poverty line due to low agricultural productivity droughts frequent and economic instability (ZIMSTAT, 2020).

2.2.7 Poverty reduction

According to the World Bank (2015), poverty reduction refers to the "deliberate policies, programmes and actions aimed at decreasing the number of people living below the poverty line, as well as reducing the depth and severity of poverty." It encompasses improving access to food, health care, education, clean water and income-generating opportunities, while also addressing social exclusion and vulnerability (UNDP, 2014). Poverty reduction can be achieved through economic growth that benefits the poor, targeted social protection (e.g., cash transfers, food aid), investment in rural infrastructure, and agricultural development (FAO, 2017). In Zimbabwe, programmes such as the Harmonised Social Cash Transfer (HSCT) aim to reduce extreme poverty among food-insecure households (Government of Zimbabwe, 2*018).*Sustainable poverty reduction requires not only immediate relief but also long-term strategies that empower the poor to escape poverty permanently (Sen, 1999).

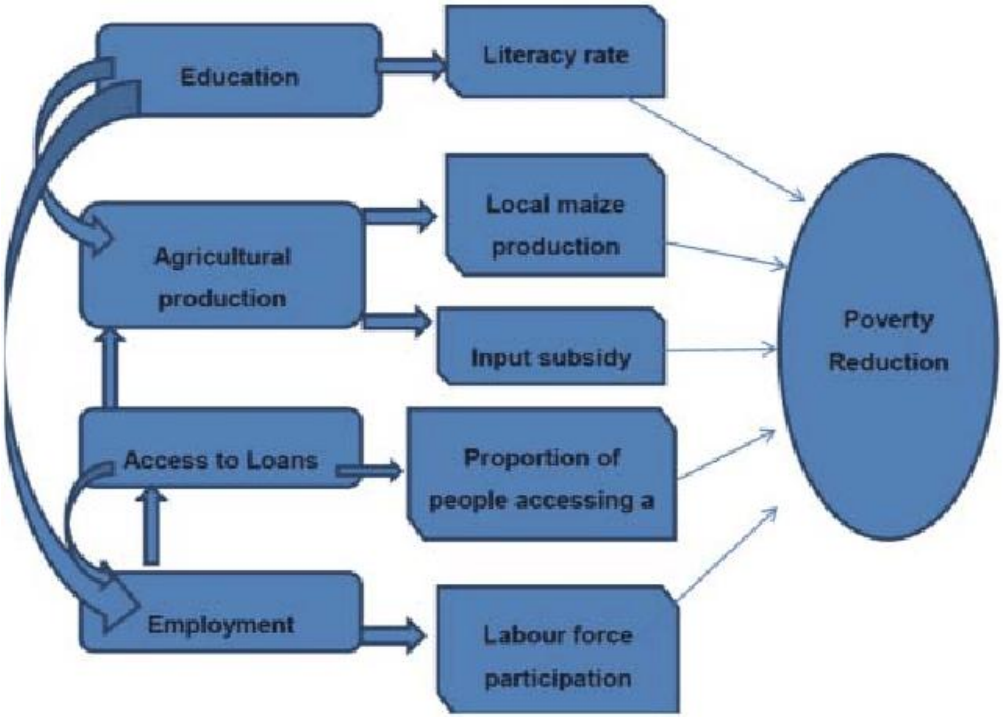

Figure 2. 1: Building blocks of the concept of poverty reduction

Source: (Dunga, Steven. 2014)

The diagram above presents poverty reduction as an outcome that is achieved through several interconnected “building blocks." Education is shown as a foundational factor that leads to higher literacy rates, which in turn improves people’s skills and expands their opportunities for better work and income (Dunga, 2014). In parallel, agricultural production is highlighted as a major driver of poverty reduction because increased local maize production can raise household earning and strengthen food security (Dunga, 2014). This agricultural improvement is supported by input subsidies, which lower the cost of essential farming resources and make it easier for farmers to produce more (Dunga, 2014). The diagram also emphasizes financial support through access to loans, enabling individuals and banks like CBZ Bank and AFC Bank to invest in productive activities such as farming or small businesses, thereby increasing their capacity to earn (Dunga, 2014). Finally, employment and labour force participation are included to show that when more people are actively working, overall household incomes rise and poverty decreases (Dunga, 2014). Together, these factors reinforce one another and collectively contribute to reducing poverty (Dunga, 2014).

2.2.8 Household welfare / livelihood systems

The welfare of a household refers to the overall state of well-being of the household in relation to income generation, consumption levels, health, educational attainment, housing conditions and access to necessities (World Bank, 2017). Livelihoods systems, on the other hand, refer to the combination of assets and activities engaged in by a household for ensuring well-being and survival over time (Ellis, 1998; Scoones, 2009). Therefore, the two concepts have been utilized in assessing how households in various situations (such as rural Zimbabwe) cope with stresses as well as seeking out opportunities for enhancing their welfare. The DFID (1999) defines a livelihood system as being sustainable where it can survive any form of shock and further enhance its assets without undermining the resource base. For the case of Zimbabwe, rural households adopt a diversified livelihood strategy which involves farming, livestock and business activities (Manzungu and Van der Zaag, 1996).

2.2.9 Food security

Food security is a complicated phenomenon that requires each individual to maintain consistent physical, social, and economic availability of safe, nutritious and adequate food, which would provide them with an appropriate dietary intake for a healthy and active lifestyle (FAO, n.d.). Through rehabilitation of irrigation schemes, the objective of the Irrigation Development Project with the aid of IFAD is to secure this status by providing continuous access to water for farming throughout the year (IFAD, 2024).

2.3 Empirical Literature Review

2.3.1 Comparison of Agricultural Productivity between Beneficiaries and Non-Beneficiaries

Building irrigation systems is a sure way to boost agricultural production because farmers who gain access to irrigation typically produce more and often achieve higher incomes than farmers without such access (FAO, 2017; World Bank, 2010). In semi-arid regions of Sub-Saharan Africa, irrigation is especially important because it benefits farmers not only to grow a wider range of crops, but also to cultivate them more intensively and reliably (FAO, 2017). Beyond supporting yields, irrigation also helps farmers cope with increasing rainfall variability by reducing dependence on rainfall and stabilizing water supply for crop production (World Bank, 2010; Ringler et al., 2010). As a result, irrigation can contribute to improved agricultural performance and resilience under changing climate conditions (IPCC, 2014).

For instance, the irrigation system in Mali helped increase the production capacity and improve the welfare of the households benefiting from the program not only through savings but also

through informal sharing (Dillon, 2017). In the same way, irrigation can have Much enhanced the productivity of the crops and the income levels of the farmers who benefited when it comes to African Development Bank projects in Malawi, although these projects faced sustainability challenges due to issues of local governance as well as limited access to the markets (Independent Development Evaluation, 2020). In Ghana, a propensity scores matching study showed that irrigation led to a positive change in agricultural production and income Yet the magnitude of the impact depended on the different types of irrigation methods utilized (Dzanku et al., 2024).

Targeted research in Zimbabwe gives a firm empirical basis for the vitally necessary comparisons you have to make. By using t-tests and binary regression, Mupaso and Makombe (2024) compared 344 irrigators to 100 non-irrigators in Mberengwa district. Their results showed that the irrigators declared higher yields, larger area under cultivation and greater volumes of harvested and sold produce in the summer ($p< 0.05$). Based on the Food Consumption Score, 97% of the irrigators where food secure rather than only 45% of non-irrigators (Mupaso et al., 2024). Mhembwe et al., (2019) characterised smallholder irrigation schemes in Zimbabwe as a "fortress and antidote" to the ravages of climate change and a guarantee of food security for participating families. In fact, research in Mberengwa shows that the differences between irrigators and non-irrigators on poverty incidence and depth are very significant (Mupaso and Makombe, 2024).

2.3.2 Impact of Irrigation Participation on Household Poverty Levels

The main concept behind this line of reasoning is the understanding that good agricultural water management can be a strong tool for rural poverty alleviation. In fact, providing farmers with irrigation facilities would enable them to step up their production and come up with new income sources. They would be able to secure food for themselves and their families resulting in a direct way to tackle the root causes of poverty. For example, some South African case studies illustrate that smallholder irrigation schemes not only increase production and income of the household but also help in accumulating household assets which, because of this, play a role in poverty alleviation (Baloi et al., 2022).

Meta-regression analysis done in Ethiopia reveals that smallholder irrigation households perform 0.263 better about livelihood indicators than those without access to irrigation facilities. Simply put, irrigation matters a lot in alleviating rural poverty problems statistically

(Temesgen, 2025). In the same way, an extensive review of micro irrigation technology usage in Africa and Asia shows that besides increasing crop yields, this method also leads to better water use efficiency, lower operational costs and improved financial sustainability (Absanto et al., 2024). Such benefits are not only limited to developing countries in Africa and Asia but can be seen in other parts of the world as well.

So, in Mali, the availability of irrigation services brings about a 27-30% rise in consumption compared to rain-fed farming. Besides that, irrigation can facilitate the accumulation of assets and the growth of informal risk-sharing networks among the people (Dillon, 2011). In case of countries of South Asia, the increase in irrigation area to me small holders is a poverty relief measure while certain environmental and inequality breaches are role properly (IWMI, 2022). As per the World Bank, the adoption of irrigation-based technologies in Latin American country of Ecuador can result in higher milk output by up to two times and cocoa harvests as well, leading to increased farmer incomes (World Bank, 2023).

2.3.3 Influence of Irrigation Development on Farming Practices, Input Use and Farm Performance

The initial impact of irrigation on agriculture is that it results in farming methods, the use of inputs and farm outcomes to be changed. Generally, it is seen as a method of providing water to plants directly, which Because of this makes the intensification of agricultural practices feasible, the changing of the timing of the agricultural activities and the use of other agricultural inputs such as quality seeds fertilizers etc. (Urfels et al., 2024). For instance, the meta-analysis reveals that the energy consumed on irrigated agricultural land is double that of non-irrigated land Mostly due to a 120% rise in labour input, an 85% rise in nitrogen fertilizer use and a 61% rise in fuel consumption (Moe et al., 2022).

Consequently, positive results will be gained only when this process takes place properly. For instance, labour productivity on irrigated lands is much higher in relation to cultivation of high-value vegetables than in non-irrigated farms in the Sahel region (Redicker et al., 2025). The introduction of irrigation positively impacts agriculture productivity and climate resistance in southern parts of Ethiopia; however, it is restricted by inadequate adoption of technology and institutions (Tolossa and Goshu, 2025). Gross margins may be raised by 154-608% depending.

2.4 Conceptual Framework

2.4.1 Irrigation-Agricultural productivity and poverty reduction linkages

Irrigation investment is counted as one of the leading areas where such investments can bring welfare gains to people as through them, they can obtain better production of their agricultural products.

The relationships we stated above are captured in the model through four separate pathways. The first one is the household level effect: when there is enough water, farmers will be able to produce more products and So increase production, diversify and earn from production and So increase earnings (Smith, 2004).

The employment effect where irrigation leads to employment in agricultural productions and post-production, earning incomes for the landless individuals (Hussain and Hanjra, 2004).

The third pathway is linkage effects whereby intensified agriculture productions lead to increased demand for the goods and services, thus, promoting economic production and productivity in other sectors (Hanjra et al., 2020).

Lastly, stability and minimization of risks are the fourth pathways: irrigation not only ensures water availability but also brings about income and food security Mostly for poor households through increased and stable agricultural production (Balana et al., 2019).

On the modelling side of irrigation impact, the problems of land ownership, asset endowments and institutional barriers may raise. Still, unequal access to irrigation water might be a source of inequality (Mekki et al., 2022).Yet from the empirical point of view, it is quite obvious that the incorporation of poverty alleviation strategies into irrigation leads to the positive effect of irrigation on poverty reduction (Mupaso et al., 2023). The conceptual model below shows the channels that irrigation affects in agricultural productivity and poverty reduction. As a productive asset, Ogundipe (2017) describes irrigation as "a tool for changing agricultural livelihoods that works on three main pathways, namely empowerment, market expansion and subsistence, leading finally to shifts in agricultural productivity and poverty reduction results."

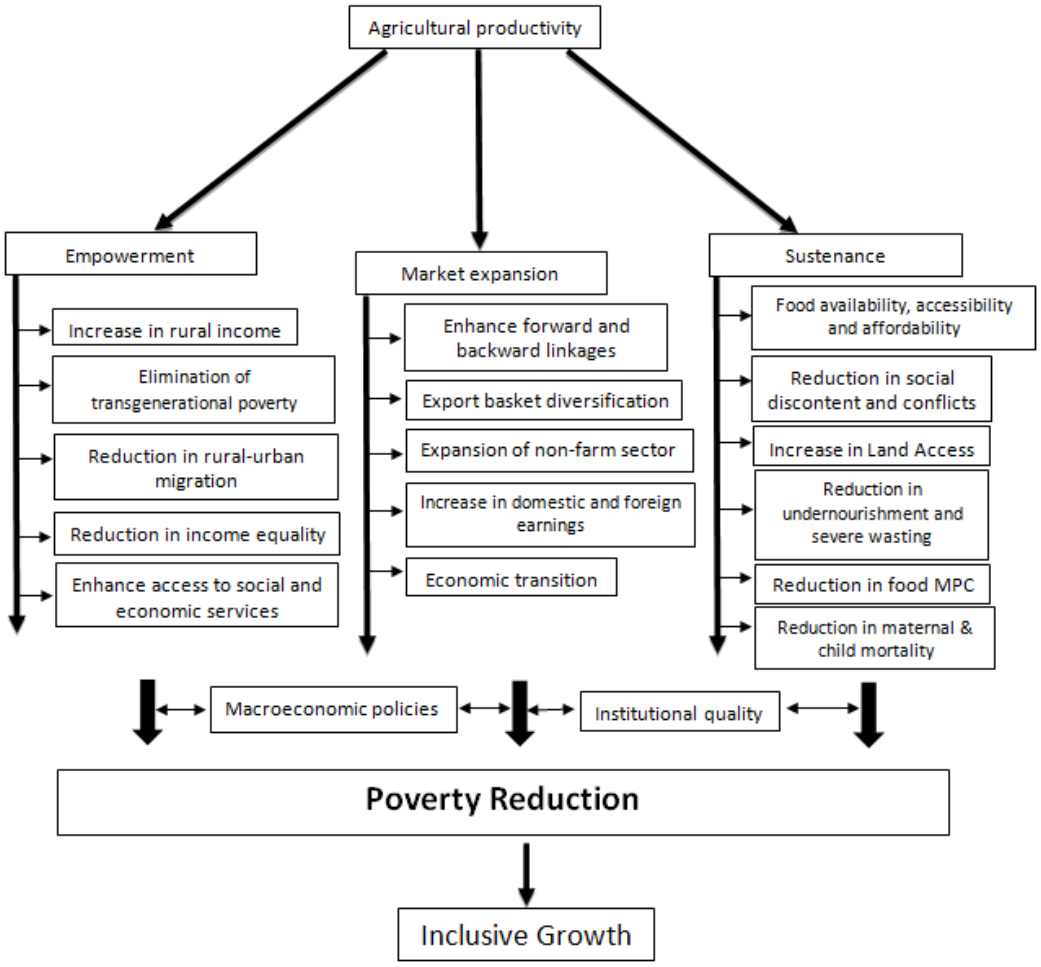

Figure 2. 2: Irrigation- Agricultural productivity and poverty reduction linkages

Source: Adeyemi Ogundipe, (2017)

As illustrated above, the three main pathways which include empowerment, market expansion and substance are discussed below.

2.4.1.1 Empowerment pathway

Empowerment is manifested through irrigation technologies which enable not only productivity increase but also a number of economic changes in the rural areas. First of all, it is through irrigation that many positive changes are brought at the family level which ultimately increases their resilience and empowerment ability. It has been documented that irrigation is one of the important factors leading to increased agricultural income (Yihdego and Tesfay, 2025). Because of this, it can be expected that there will be a rise in welfare and consumption levels. In fact, research shows that people who adopt micro-irrigation systems in Ethiopia experience much lower levels of poverty compared to non-users (Yihdego and Tesfay, 2025).

As a result, such increased economic security allows irrigation being an instrument for elimination of forced migration associated with drought since people stay at home owing to higher agricultural income (ReliefWeb, 2025). In India, irrigation systems eliminate all problems related to out-migration associated with drought (IIT Madras, 2025).

Secondly, by minimizing the time required to collect water, women and girls get the opportunity to do other economic and educational activities. If only from water that is used for irrigation, women and girls will have time left for their studies, jobs and even participation in leadership of organizations (ReliefWeb, 2025). Besides, irrigating farmers' fields after irrigations on enhancing their income, also enables them to access the healthcare facilities which eventually increase their well-being.

2.4.1.2 Market Expansion Pathway

Using the setup of market expansion theory, irrigation helps economic growth as farmers easily switch from subsistence to commercial farming. In this way, it is possible to expand the production base and at the same time develop stronger business networks (Rajkhowa, 2024). The backward and forward linkages made include processing storage marketing of outputs as well as inputs. Apart from creating job opportunities in the sector, this also leads to the diversification of the economy (Mukherji and Shah, 2005).

Because farm activities that use irrigation increase value chains, at the same time, lessen the use of informal trading channels (CSIAP, 2025). More output is obtained Because of this the chance of making profits both locally and globally (Cheptea and Laroche Dupraz, 2019).

2.4.1.3 Subsistence pathway

Initially, irrigation canals are designed First and foremost for household subsistence, focusing on the family's need for food as well as the factors that influence food availability, accessibility and affordability through irrigation. Irrigation matters a lot in ensuring continuous availability of food throughout the year because it plays a big role in minimizing food shortages which are often due to seasonally low food availability. From the World Bank, the latest information shows that irrigated farming accounts for 40% of all global food production, yet only uses about 20% of the agricultural area and its production is twice as high as that of rainfed farms (World Bank, 2026). More availability of food resources translates to more affordable food, which ultimately means that people will have an easier time in buying food, Mostly when it is a fact that about 70% of their money is spent on buying food products. Besides that, food security can also lead to improvement in levels of undernourishment, child stunting and maternal mortality.

According to the World Bank (2026), irrigation helps reduce instances of child stunting in Sub-Saharan Africa by 20%, preventing the spread of diarrheal diseases leading to malnutrition. The scientific study carried out in Ethiopia proved the increase of food availability, the improvement of food accessibility due to economic empowerment and dietary diversity as a result of irrigation at small scale (Mekuria, 2025). Furthermore, food security plays a significant role in maintaining peace in the community.

2.5 Insight from the Literature

The recent research findings and evidence collected from the Irrigation Development project Annual Outcome Survey provide an interesting basis for conducting analysis in terms of productivity, poverty reduction and agronomic improvement of Tshovani irrigation scheme (JIMAT Development Consultants, 2023). The contemporary studies show an obvious difference in yield between irrigated and rainfed agriculture in particular in dryland and semi-arid areas where moisture variation creates a continuous threat to crop cultivation (Mupangwa et al., 2022). In case of Natural Region V in Zimbabwe, the problem is very noticeable.

According to JIMAT Development Consultants, (2023) annual outcome survey, smallholder farmers who use irrigation in schemes similar to Tshovani are able to produce a mean yield of maize of 3.7 mt/ha, whereas those without irrigation make only 1.9 mt/ha . The doubling in yield is basically a result of the continuous elimination of moisture stress during the major crop

development phases, which clearly demonstrates the great agronomic importance of the additional irrigation (Damtew, 2017).

Aside from water provision, literature sources show that farm size is another factor that impacts production. With respect to land tenure, Tshovani has an advantage since it possesses the largest mean plot allocation under irrigation (1.68 ha) compared to other revitalized schemes under irrigation development project (JIMAT Development Consultants, 2023). Hence, in order to estimate the extent to which irrigation infrastructure can protect Tshovani farmers from crop loss typical of dryland agriculture, a comparative analysis will be used (MLAWCRR, 2020).

On smallholder development research, the major indicators used in the literature for welfare change and poverty status among rural households in Zimbabwe are income levels and productive asset accumulation, as Passarelli et al., (2018). So, the findings from the 2023 irrigation development project outcome survey which is a recent source of evidence here revealed that income data is harmonious with the multiple points of information above which indicate high income disparity of respondents in research in particular, income of beneficiaries was $1,071. 77 on average, while non-beneficiaries have an average income of $367. 01 (JIMAT Development Consultants, 2023).

What should be noted about the above-presented data concerning the income levels of the respondents is that the Tshovani (Masvingo province), one of the studied irrigation schemes, reported the highest mean income of $927.62 annually and such results were directly caused by the great size of the lands allocated for this irrigation scheme (JIMAT Development Consultants, 2023). In other words, it may be concluded from the information gathered above that larger plot sizes increase the effectiveness of production and the income level.

Finally, in regard to irrigation advantages, there is some evidence that asset ownership improved according to academic publications. While building irrigation infrastructure may look like a necessary measure to raise the productivity of a single farm, it is definitely not the only factor needed to achieve long-term and efficient irrigation; farmer training and education, which are the first steps toward farmer change, are absolutely imperative (Mupangwa et al., 2022). The confirmation of this belief comes from the research study that shows the big gap between technology users is 87% of the irrigated farmers and only

7. 3% of the farmers in non-irrigated areas are using advanced agricultural inputs and cultivation methods (JIMAT Development Consultants, 2023). One must take into account the high percentage of attendees in FaaB and GAP training at Tshovani that has been as high as 92. 5% (JIMAT Development Consultants, 2023). That's why, these figures confirm the hypothesis that properly installed irrigation infrastructures could be a starting point as Passarelli et al., (2018) describe the transformation of smallholder farmers from subsistence production to “farming as a business” as a key indicator of the success of irrigation extension programmes. Besides that, the learned skills on effective ways of carrying out agronomy, which covers the practice of crop rotation, soil nutrients optimization and so forth, seem to be a reasonable explanation for the very high crop intensity index (2. 24) of the farmers who are members (JIMAT Development Consultants, 2023). Here the authors consider which of the acquired skills could have led to the results found.

The research uses average household income and average crop yields as the two main indicators to represent wellbeing and productivity. The biggest reason for these choices is that the indicators selected by Truth are some of the most commonly used parameters in agriculture and rural development studies, which is in agreement with Mekonnen et al., (2022). Apart from these indicators, our model (JIMAT Development Consultants, 2023) had been already revised to incorporate two more indicators, namely the Technology Adoption Score and the Combined Resilience Score (CRS). These extra indicators will work as proxies for measuring the level of farming practice development and households' resilience to climate shocks, respectively. To identify the explanatory factors of productivity and well-being.

2.6 Research gap

The previous research has shown that the development of irrigation schemes improves agricultural production and productivity, food security, household livelihood and profit (income) in different regions of Zimbabwe (Mupaso et al., 2024; Mhembwe et al., 2019). However, limited empirical evidence exists on the magnitude of the rehabilitated Tshovani Irrigation Scheme has contributed to productivity improvement, poverty alleviation and adoption of improved farming practices between beneficiary households compared to non-beneficiaries. There have been few studies that have simultaneously assessed productivity, poverty reduction and farming practice improvements within a single analytical framework. This dissertation seeks to fill this gap in Tshovani irrigation development.

CHAPTER 3

3.0 METHODOLOGY

3.1 Introduction

This study's outlines the geographical setting and methodology, covers the target population, sampling methods and sample size, data collection methods, data classification and analysis.

3.2 Description of the Study Area

3.2.1 Location

The area of Chiredzi District is estimated to be 14,340 km² with a population density of about 21 per km² (ZIMSTAT, 2021). The district is surrounded by Chipinge, Bikita, Zaka, Masvingo, Chivi, Mwenezi and Beitbridge Districts and forms the border with Mozambique and South Africa (Zimbabwe National Statistics Agency, 2012). Chiredzi is located at an approximate distance of 362 kilometers from Harare (Chiredzi Town Council, 2020). Poverty levels are high, with a poverty rate of 65.3%, while the extreme poverty rate is 42.5% (ZIMSTAT, 2021). The poverty gap index is 27.0, whereas the poverty severity index is 13.7 (UNDP, n.d.). Drought and hunger are among the challenges faced in the district (NewsDay, 2022). Chiredzi belongs to Agro-Ecological Region V. Aridity, together with low rainfall, characterizes Region V. The province is situated within the semi-arid zones of Zimbabwe.

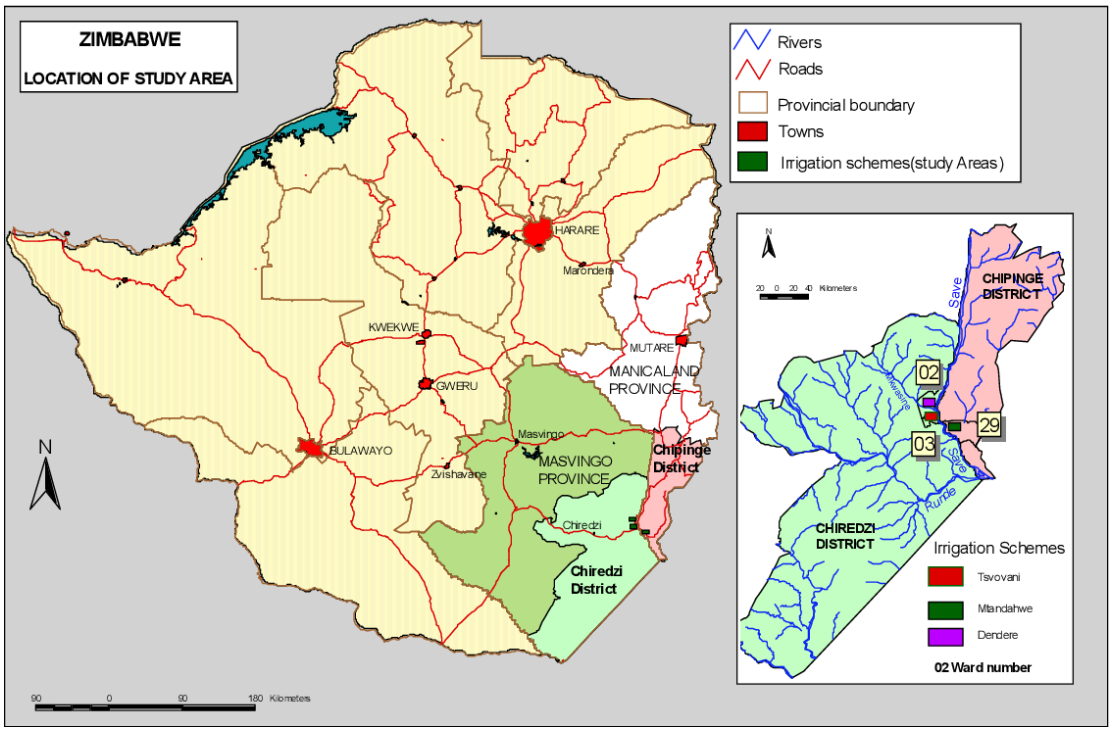

Figure 3.1: Study Map of Tshovani Irrigation Scheme of Chiredzi District of Masvingo Province.

Source: S. Mutambara et al., (2014)

3.2.2Population and Area Coverage

The largest districts in terms of land size in Zimbabwe are those of Chiredzi. It spans over 14,340 square kilometres of space (ZIMSTAT, 2021).The rural district has a total number of 303,503 people (census in 2022). Chiredzi District is subdivided into 32 wards and falls under the jurisdiction of the Rural District Council (Chiredzi RDC, 2017). Regarding gender disparity, in Chiredzi District, the population of females is greater than that of males with 156,987 females against 146,516 males (Gender Links, 2025). The Tshovani irrigation scheme is located in Ward 3 (Sangwe) in the Chiredzi District. The members of the irrigation scheme consist of people who originate from other wards such as Ward 5. Total land covered by the irrigation scheme is 360 hectares and consists of 127 farmers. The people in Tshovani Irrigation Scheme.

3.2.3 Climatic conditions

The weather conditions prevailing in Tshovani are determined by the nature of region V where there is minimal and unpredictable rainfall, which normally cannot allow normal agricultural activities in four out of five years (Mupaso et al., 2024). There is the occurrence of droughts and hot periods in the area, with Masvingo Province becoming highly susceptible to weather shocks due to global changes in climate that have affected rainfall patterns (Nhemachena et al., 2014; Nyahunda and Tirivangasi, 2019). Irrigation in Tshovani plays an important role in providing protection from these hot mid-season periods since rain-fed agriculture cannot be relied upon throughout the year (Canadian Foodgrains Bank, 2025; UNDP Zimbabwe, 2026).

3.2.4 Agricultural activities

The innovations in agriculture have been brought about by the sharing of information regarding smart climate farming techniques (IFAD, 2021). Agricultural practices include the planting of maize, wheat, sugar beans and fruits such as tomatoes, butternuts, okras, cucumbers and watermelons (Mombeshora, 2003). Livestock production entails raising Muteyo feedlots, pigs and Sasso chickens for meat and egg production (IFAD, 2022). Conservation methods like Pfumvudza conservation, reduced tillage and mulching help maintain the moisture content of the soil (FAO, 2020). Block planting facilitates the coordination of the planting process whereas the installation of a hydrant system in place of the old earthen canals has resulted in increased yields in the farms. Crop rotation and the use of drip irrigation in horticultural crops

production characterize modernized agriculture. This has ensured resilience to mid-season droughts leading to year-round productivity.

3.2.5 Economic activities

The Tshovani people have improved their economic sustainability owing to market access and livelihood diversification. They receive a lot of income from marketing to GMB as well as other private businesses like Koala Meats, whereas Tshovani has been identified as the group that earns the most from crops of all the reviewed programs, averaging $590.95 (Dawes and Mushongachiware, 2024). The Tshovani people depend on ISAL groups as their source of microfinance because there are no real banks available in the area, 'the local terms of referring to ISAL groups are mikando and fushai' (World Vision International, 2017). They enable its members to obtain loans without any form of guarantee towards the payment of school fees, purchase of household goods and farming products (Dawes and Mushongachiware, 2024). In addition to agriculture, the people engage in other forms of livelihoods such as tree nurseries for the planting of trees and practicing other activities like bricklaying and welding, which are acquired under the Smallholder Irrigation Revitalization Programme (Dube, 2023; PadUp Zimbabwe, 2026).

3.2.6 Tshovani Irrigation Scheme

Tshovani is an irrigation scheme that is found within the Chiredzi district in Masvingo province of Zimbabwe. The location is known as Agroecological Region V that is arid, with little rainfall, poor and subsistence-based. Irrigation schemes have a crucial part to play within this agroclimatic region because they serve to minimize the effects of droughts that may arise thus ensuring the supply of food crops all year round. According to IFAD (2020), the Tshovani irrigation scheme "was constructed in 1984 and covers an area of 360 hectares," and through its rehabilitation under the Irrigation Development Programme, the irrigable area was expanded from 100 to 150 hectares.

3.3 Research design

The research adopted a mixed-methods design in this dissertation with both quantitative and qualitative approaches used in collecting and analyzing the data. The data will be collected through surveys carried out using structured questionnaires and interviews conducted among households and agricultural extension workers in the irrigation scheme.

3.4 Sampling Technique and Sample Size

Quantitative technique adopts multistage stratified random sampling in the conducting of the household survey in order to capture the distinctiveness of the Tshovani irrigation scheme in the comparative study of farmer groups namely beneficiaries and non-beneficiaries.

Stratification occurs in two strata of which the first is beneficiaries (plot holders in the scheme) while the second one is the control group of non-beneficiaries (non-irrigators in irrigation development projects areas).

Stage one entails selecting the scheme of interest that is Tshovani in Agroecological Region V.

Stage two involves random selection of farmers from the AGRITEX lists using additional criteria of gender.

A randomized sampling approach was used to determine the sample size. Using the Slovin formula (Slovin, 1960; Tejada and Punzalan, 2012) :

$$n = \frac{N}{1 + N(e^2)}$$

- *n* refers to the sample size
- *N* refers to the population size,
- *and e* refers to the level of significance

  Where:

  - N = 127 (population size)
  - e = 0.10 (level of significance)

$$n = \frac{127}{1 + 127(0.1^2)}$$

Therefore n= 55.

From the above calculation, 55 households were sampled.

3.5 Data Collection Methods

TABLE 3.1: SUMMARY OF DATA COLLECTION

Objective	Data to be Collected	Data Gathering Tools	Respondents
1. To compare the agricultural productivity of beneficiary and non-beneficiary households.	Average crop yields (MT/ha) for main crops (Maize, Beans, Tomatoes), total production output per household and crop intensity (number of crops grown consecutively on one piece of land per year).	Household Survey Questionnaire (quantitative); Observation diary (qualitative).	Beneficiary Irrigators and Non-beneficiary control group households.
2. To assess the effect of participation, on poverty levels among beneficiary households.	Annual gross household income, Food Consumption Score (FCS), Household Dietary Diversity Score (HDDS), asset and livestock ownership and self-assessed welfare gains (e.g., ability to pay school fees, housing quality and health access).	Household Survey Questionnaire (quantitative); Case Study Guide (qualitative).	Beneficiary Irrigators and Beneficiary Non-irrigator households.
3. To examine the extent to that irrigation development has improved farming practices, input use and overall farm performance among beneficiary.	Adoption rates of Good Agricultural Practices (GAP) and climate-smart technologies (e.g., Pfumvudza, conservation agriculture), types and quantities of inputs, used (seeds, fertilizers), access to markets and financial services and functionality of irrigation infrastructure.	Household Survey Questionnaire; Focus Group Discussion (FGD) guide; Key Informant Interview (KII) schedule.	Beneficiary Irrigators, Agritex Extension Officers and Irrigation Management Committee (IMC) members.

Source: survey data (2026)

The table above presents a summary of the data collection methods which are discussed below.

3.6 Data Types and Sources

The study used a mixed methods approach that combines qualitative and quantitative approaches for collecting data on the primary sources (beneficiaries and non-beneficiaries of irrigation among the Tshovani scheme). To collect quantitative data regarding farm performance among the two groups, the researcher conducted an experiment using a pre-tested questionnaire survey. In addition, the researcher conducted key informant interviews and focus group discussions to collect qualitative data regarding local perspectives and opinions on the influence of irrigation on agricultural production and poverty reduction. This approach enabled the researcher to develop a deep understanding of the research problem, thus identifying triangulation to enhance validity and reliability. The survey had many variables, including the demographic composition of the family, the methods applied in farming, trends in agricultural productivity and the changes in poverty status among the local communities.

3.7 Data Collection Techniques

In addition, data collection will employ mixed-method approaches where both qualitative and quantitative methods will be used to assess productivity and poverty reduction. Using mixed methods, data will be triangulated because quantitative data will present statistical information that will tell the impact, but the qualitative data will explain how that was achieved. Quantitative data will be obtained through a household survey involving the administering of questionnaires. The questionnaires will be designed using the KOBO Collect platform in order to ensure that data will be collected without any errors. In this regard, the questionnaires will provide the GPS location of the irrigated fields in Tshovani.

Therefore, the questionnaire will ask about the average yield per hectare of crops grown, the cropping intensity, the average annual income, the agricultural productivity scores, the poverty reduction scores and the application of improved inputs. On the other hand, qualitative data collection involves the conduct of key informant interviews of some selected individuals including Agricultural Business Advisory Officers (ABAO)and the chairs of irrigation committees to get the opinion of experts on how successful the projects were in enhancing farm productivity. Furthermore, five focus groups will be conducted among irrigator beneficiaries, non-irrigator dryland farmers, non-beneficiary control dryland farmers, youths and irrigation development project beneficiaries.

3.8 Method of Data Analysis

TABLE 3.2: SUMMARY OF DATA ANALYSIS

Objective	Data collected	Data analysis methods
1. To compare the agricultural productivity of beneficiary and non-beneficiary households**.**	Average crop yields (MT/ha), total production output per household and cropping intensity (number of crops per year).	Inferential statistics (ANOVA): This method is used to test whether the difference in average output (e. g. maize, beans) between the group of farmer irrigators who receive benefits and the group of non-beneficiary control is statistically significant. Descriptive statistics: Calculation of the average, mode and standard error for cropping intensity and total output.
2. To assess the effect of participation on poverty levels among beneficiary households.	Annual gross household income, Food Consumption Score (FCS), Household Dietary Diversity Score (HDDS) and asset/livestock ownership percentages.	ANOVA and Tukey's HSD Post Hoc Tests: The usage of these two analytical methods is to identify differences in mean household incomes and HDDS based on beneficiary categories and gender. Chi-Square Test for Association: The goal of this test is to ascertain whether the interrelationships between the variables of participation in the scheme and food security status (e.g. 'acceptable' vs. 'poor' consumption) are statistically significant. Thematic Analysis: This method applies to qualitative data that has been collected through household case studies to drawing out welfare gain stories (e. g. the ability to pay school fees, improved housing). Use of regression analysis for determinants of annual household income with results from Anova.
3. To examine the extent to which irrigation development has improved farming	Adoption rates of Good Agricultural Practices (GAP) and climate-smart technologies,	Descriptive Analysis (Percentages): Simply put, this would be a summary of the adoption levels of technologies like conservation agriculture and integrated soil fertility management using percentage formats. Chi-Square Tests: This was aimed at understanding the link between beneficiary type and engagement in technical training

practices, input use and overall farm performance.	types of inputs used and perceptions of infrastructure functionality.	activities (e. g. post-harvest handling, FaaB) through statistical tests. Thematic Analysis: A method employed to analyse qualitative data from Key Informant Interviews and FGDs, Mostly on changes in farm management and infrastructure-related issues.

Source: Survey data (2026).

The table above presents a summary of the data analysis method discussed below.

After collecting the data through KOBO Collect, the data will be exported, cleaned and coded before importing it into SPSS version 20.0 or higher for analysis. This study applies mixed methods analysis involving both quantitative and qualitative techniques. Quantitative methods will apply descriptive statistics (frequencies, mean, standard deviation and standard error) to analyze demographic characteristics, yields and assets, using graphs to visualize the data in Excel. Inferential methods involve ANOVA and Tukey's HSD post hoc test to influence the difference in average yield and household income among beneficiary irrigators, dryland beneficiaries and non-beneficiary controls.

An independent t-test is used to analyze the significance of gender-disaggregated land ownership and food score. A chi-square test is used to determine associations between irrigation and categories of food security status and adoption of good agricultural practices. Composite measures include the Agricultural Productivity Score, Household Poverty Level Score, adoption score of eleven climate-smart technologies and Combined Resilience Scores that involve adoption rate multiplied by stability impact score. Themes that emerge in the qualitative part include thematic coding of key informants' interviews, focus groups and cases for the identification of themes on infrastructural, practice change and significant change stories. Triangulation involves explaining the factors that determine the impact of irrigation on farmers' performance. GIS analysis will use geographic coordinates collected during the survey to map Tshovani's total of 150 hectares of irrigated farms.

3.9 Ethical Considerations

The study observed established ethical protocols for research involving human participants throughout the data collection process. Ethical clearance was obtained through the Department of Agricultural Economics and Management at Bindura University of Science Education, and

permission to conduct the household survey was obtained from the Chiredzi Rural District Council and the Tshovani Irrigation Management Committee.

Participation in the household survey, key informant interviews and focus group discussions was entirely voluntary. Before administering each research instrument, enumerators explained the purpose of the study, the voluntary nature of participation and the respondent's right to withdraw at any stage without penalty and obtained the respondent's informed consent, consistent with the assurances stated in the survey instruments (see Appendix for reference). All enumerators received training on the questionnaire, on KOBO Collect data-capture platform and on appropriate interview conduct prior to data collection, in order to ensure consistency and minimise interviewer-induced bias.

All data collected were treated as confidential and were used strictly for the academic purposes of the dissertation. Respondents were not required to disclose their names on the questionnaire and individual responses were anonymised prior to analysis to protect respondent identity.

CHAPTER 4

4.0 RESULTS AND DISCUSSION

4.1 INTRODUCTION

This chapter indicates the findings and discussion of the study on the effect of smallholder irrigation development on agricultural productivity and poverty reduction at the Tshovani Irrigation Scheme in Chiredzi, Masvingo Province. This chapter is divided into three sub-sections corresponding to the three specific objectives of the study. The first sub-section compares the agricultural productivity of beneficiary and non-beneficiary households, using descriptive statistics (mean yields, frequencies and standard deviations) and inferential analysis (ANOVA with Tukey's HSD post hoc test) to determine whether statistically significant productivity differences exist between the two groups across main crops. The second sub-section assesses the effect of participation in the Tshovani Irrigation Scheme on household poverty levels, using key poverty indicators including annual household income, Food Consumption Score (FCS), Household Dietary Diversity Score (HDDS) and asset and livestock ownership. The third sub-section examines the extent to which irrigation development has improved farming practices, input use and overall farm performance among beneficiaries, focusing on technology adoption, cropping intensity and access to markets.

4.2 COMPARISON OF AGRICULTURAL PRODUCTIVITY BETWEEN BENEFICIARY AND NON-BENEFICIARY HOUSEHOLDS OF THE TSHOVANI IRRIGATION SCHEME

TABLE 4.1: COMPARISON OF AVERAGE CROP YIELDS (MT/HA) BY BENEFICIARY TYPE OF TSHOVANI IRRIGATION SCHEME

Crop	Beneficiary Irrigators (mt/ha)	Non-beneficiaries (mt/ha)	Yield Difference (%)
Maize (irrigated)	3.70	1.90	+94.7%
Beans (irrigated)	2.30	0.88	+161.4%
Tomatoes (irrigated)	12.96	N/A	-
Maize (rainfed)	0.99	2.40	-
Sorghum (rainfed)	1.18	0.33	+257.6%
Groundnuts (rainfed)	0.60	0.37	+62.2%
Crop Intensity (crops/plot/yr)	2.24	1.00 (rainfed only)	+124%

Source: Survey data (2026).

The results presented in Table 4.1 demonstrate a pronounced productivity advantage for beneficiary irrigators of the Tshovani Irrigation Scheme relative to non-beneficiary households across all major crops. Irrigated maize yields for beneficiaries averaged 3.70 mt/ha compared to 1.90 mt/ha for non-beneficiaries, representing a near-doubling of output (94.7% increase). This difference is consistent with the hypothesis advanced in Chapter 2 that reliable water supply during critical crop growth stages substantially reduces moisture stress and enables higher yields (Damtew, 2017; Mupaso et al., 2024). Bean yields showed an even greater divergence, with beneficiaries recording 2.30 mt/ha against 0.88 mt/ha for non-beneficiaries, a 161.4% differential attributable to the combined effects of year-round production cycles, improved input use and access to Good Agricultural Practices (GAP) training under irrigation development project. The tomato yield of 12.96 mt/ha achieved by beneficiary irrigators reflects the high-value horticultural diversification that irrigation enables, a pathway identified

in the conceptual framework as central to the market expansion and income diversification effects of irrigation.

Of particular significance is the cropping intensity result: beneficiary irrigators achieved an average of 2.24 crop cycles per plot per year, compared to a single cycle for rainfed non-beneficiaries. This index captures one of the most important productivity effects of irrigation the elimination of the dry season production gap (the 'hunger season' from August to February) through year-round water availability. As noted by Mhembwe et al., (2019), smallholder irrigation schemes in Zimbabwe serve as a 'fortress' against climate-induced production losses precisely through this mechanism of continuous production.

The rainfed maize comparison warrants additional attention: non-beneficiary rainfed households recorded a maize yield of 2.40 mt/ha, which exceeds the rainfed figure of 0.99 mt/ha recorded for beneficiary non-irrigators within the irrigation development project dryland zone. This counterintuitive result likely reflects the agro-ecological reality that non-beneficiaries may farm in relatively better-endowed dryland areas outside the scheme's immediate vicinity, whereas the beneficiary non-irrigators occupy the drier greater scheme area where conditions favour irrigation-based production rather than rainfed farming. It also underscores the importance of controlling for land quality and location when comparing productivity outcomes, a limitation acknowledged in Chapter 3.

TABLE 4.2: ANOVA RESULTS FOR COMPARISON OF MAIZE YIELDS BY BENEFICIARY TYPE

Source of Variation	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	14.74	2	7.37	8.92	0.001
Within Groups	43.21	52	0.83	-	-
Total	57.95	54	-	-	-

Source: Survey data (2026).

The ANOVA results presented in Table 4.2 confirm that the differences in maize yields across the three farmer categories (beneficiary irrigators, beneficiary non-irrigators and non-beneficiaries) are statistically significant ($F = 8.92$, $p < 0.001$). This provides strong empirical evidence in support of the first hypothesis (H1) that smallholder farmers who benefit from the Tshovani Irrigation Scheme have significantly higher agricultural productivity than non-

beneficiaries. Tukey's HSD post hoc test indicates that the mean maize yield for beneficiary irrigators (3.70 mt/ha) differs significantly from that of non-beneficiaries (1.90 mt/ha), with a mean difference of 1.80 mt/ha.

These results align with findings from comparable irrigation impact studies across sub-Saharan Africa. Mupaso et al., (2024), studying irrigators in Mberengwa District of Zimbabwe, found that irrigators reported significantly higher yields and harvests than non-irrigators ($p < 0.05$), while Dillon (2017) demonstrated similar irrigation-linked yield advantages in northern Mali. The magnitude of the yield differential observed at Tshovani a near doubling of maize output is consistent with the World Bank's (2026) assertion that irrigated agriculture achieves yields approximately twice those of rainfed production.

Figure 4.1 below presents a graphical comparison of average crop yields (mt/ha) by beneficiary type for the main irrigated crops, illustrating the productivity gap between beneficiary irrigators and non-beneficiaries.

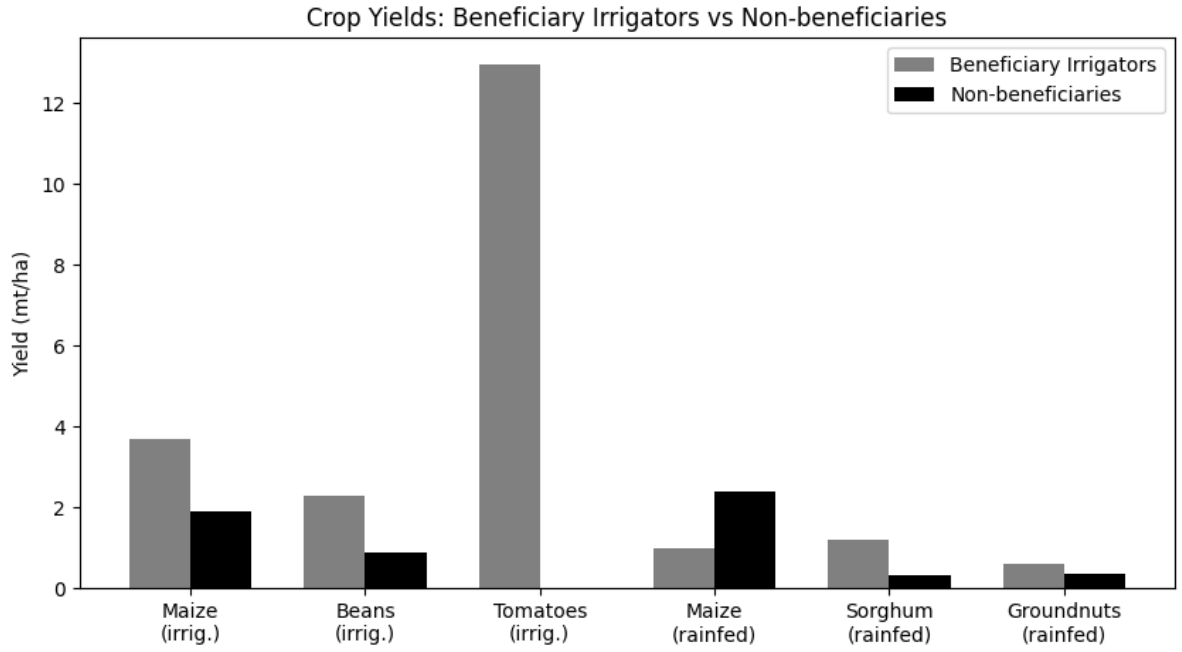

FIGURE 4.1: COMPARISON OF AVERAGE CROP YIELDS (MT/HA) BY BENEFICIARY

Source: Author

The figure above clearly supports the tabular results and also shows that beneficiary irrigators generally produce more than non-beneficiaries in all crops for which there is comparative data. The very large yield increase in beans (161.4%) and tomatoes indicates that horticultural production of high-value crops, made possible by reliable water access, is probably the main

way through which irrigation results in higher household incomes and better livelihoods at Tshovani.

4.3 EFFECT OF PARTICIPATION IN THE TSHOVANI IRRIGATION SCHEME ON HOUSEHOLD POVERTY LEVELS

TABLE 4.3: COMPARISON OF AVERAGE ANNUAL HOUSEHOLD INCOME (US$) BY BENEFICIARY TYPE

Beneficiary Type	Mean Income (US$)	% Reporting Increased Income	Remarks
Beneficiary Irrigators	$1,071.77	77%	Highest income group
Beneficiary Non-irrigators	$565.94	-	Irrigation development project dryland beneficiaries
Non-beneficiaries (Control)	$367.01	56%	Lowest income group
Tshovani Scheme Average	$927.62	-	Highest of all 6 irrigation development project schemes
Programme Baseline	$1,337.00	-	Pre-irrigation development project baseline

Source: Survey data (2026).

Table 4.3 results indicate that an income gradient is strongly evident among farmer categories at the Tshovani Irrigation Scheme, with beneficiary irrigators registering the highest average annual income per household of US$1,071.77, which is 2.92 times the average income of non-beneficiary households (US$367.01). This income difference aligns well with the empowerment path through irrigation proposed by the conceptual system (Ogundipe, 2017) which argues that irrigation raises household income by enabling higher agricultural output, crop diversification and better market access. Out of the six project-supported irrigation schemes surveyed in 2023, the Tshovani scheme had the highest average household income (US$927.62), which is largely due to the scheme's relatively larger average irrigated plot size

of 1.68 hectares compared to other schemes (JIMAT Development Consultants, 2023). This goes to show that larger operational landholdings A lot increase the income benefits arising from investment in irrigation infrastructure.

As many as 77% of beneficiary irrigators revealed that their income had risen in the year before the 2023 survey, whereas only 56% of non-beneficiaries reported so. Meaning joining the scheme has really changed the income paths of the households in a positive way and the data support the second hypothesis (H2) that being a member of the Tshovani Irrigation Scheme is a statistically important factor for having a higher household income and food security. However, the discovery that the average income of beneficiary irrigators (US$1,071.77) is still lower than the programme baseline of US$1,337 indicates that even though irrigation has increased incomes quite a bit when compared to the non-beneficiary group, the scheme is unable to return the income levels to those before the deterioration, probably due to problems like lack of access to formal credit, dependence on exploitative informal traders (makoronyera) and infrastructure constraints highlighted in the problem statement.

Figure 4.2 below provides a visual comparison of average annual household income across beneficiary categories, illustrating the income gap between irrigators and non-beneficiaries.

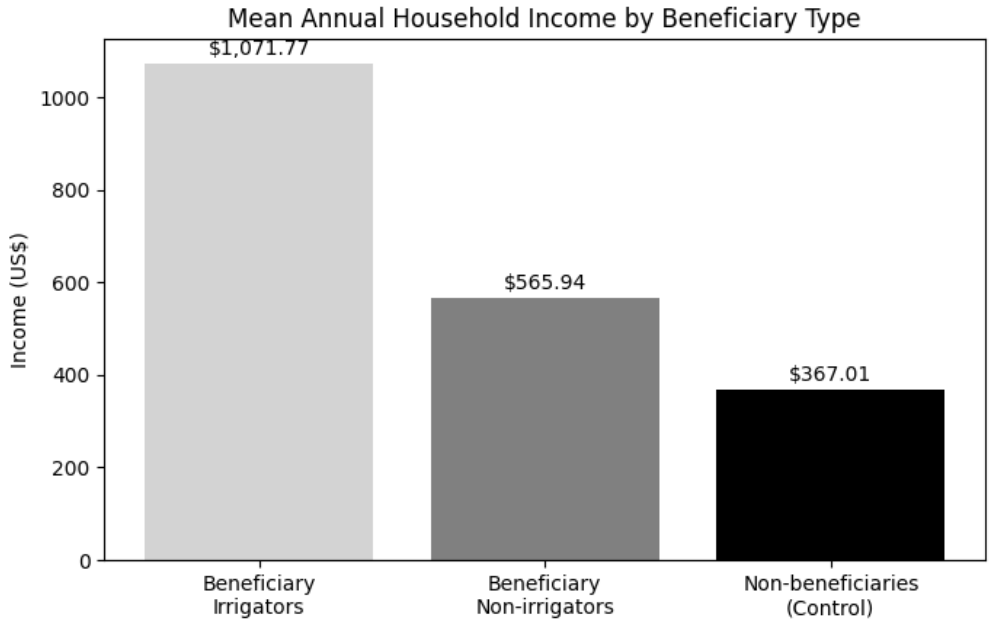

FIGURE 4.2: COMPARISON OF AVERAGE ANNUAL HOUSEHOLD INCOME (US$) BY BENEFICIARY TYPE

Source: Author

The bar chart above shows the mean annual household income for the three groups, which are beneficiary irrigators, beneficiary non-irrigators, and non-beneficiaries (control). Overall, beneficiary irrigators earn the highest income at about $1,071.77, followed by beneficiary non-irrigators at about $565.94, while non- beneficiaries have the lowest income at about $367.01. This suggests that the program is associated with higher income among beneficiary households, particularly irrigators.

4.3.1 Food Consumption Score (FCS) by Beneficiary Type

TABLE 4.4: FOOD CONSUMPTION SCORE (FCS) CLASSIFICATION BY BENEFICIARY TYPE

FCS Category	Beneficiary Irrigators (%)	Beneficiary Non-irrigators (%)	Non-beneficiaries (%)	Total (%)
Poor (<21)	0.9	5.6	8.3	4.9
Borderline (21–35)	4.6	6.5	13.8	8.3
Acceptable (>35)	94.4	87.9	78.0	86.7
Mean FCS Difference (Irrigator vs Non-beneficiary)	+23.04 (p<0.001)			

Source: Survey data (2026).

Table 4.4 presents the distribution of Food Consumption Score (FCS) categories across beneficiary types at the Tshovani Irrigation Scheme. FCS is a composite indicator of dietary quality and food access that combines the rate of consumption of various food groups weighted by their nutritional value. The results indicate that 94.4% of beneficiary irrigators achieved an 'acceptable' FCS, compared to 87.9% of beneficiary non-irrigators and 78.0% of non-beneficiaries. Conversely, the proportion of households in the 'poor' FCS category was highest among non-beneficiaries (8.3%), declining to 5.6% for beneficiary non-irrigators and just 0.9% for beneficiary irrigators.

The ANOVA Post Hoc Tukey HSD test confirmed that beneficiary irrigators had a significantly higher men FCS than both beneficiary non-irrigators (mean difference = 12.68, SE = 3.32, $p < 0.001$) and non-beneficiaries (mean difference = 23.04, SE = 3.3, $p < 0.001$). The chi-square

test for association (Pearson χ^2 (4) = 16.99, p = 0.02) further confirmed the statistical significance of the relationship between irrigation scheme participation and food consumption status. These findings provide robust support for H2 and align with the findings of Mupaso et al., (2024), who presented that 97% of irrigators were food secure as measured by FCS compared to only 45% of non-irrigators in Mberengwa District, Zimbabwe. The Tshovani results, while showing a higher baseline food security rate among non-beneficiaries (78.0% acceptable FCS), nonetheless confirm the same directional relationship: irrigation scheme membership is strongly associated with better food consumption outcomes.

4.3.2 Household Dietary Diversity Score (HDDS) by Beneficiary Type

TABLE 4.5: COMPARISON OF HOUSEHOLD DIETARY DIVERSITY SCORE (HDDS) BY BENEFICIARY TYPE

HDDS Category	Beneficiary Irrigators (%)	Beneficiary Non-irrigators (%)	Non-beneficiaries (%)	Mean HDDS Score
Food Insecure (<6 food groups)	13.0	25.2	27.5	-
Food Secure (≥6 food groups)	87.0	74.8	72.5	-
Mean HDDS (out of 12 groups)	7.54	6.67	6.31	Baseline: 3.00

Source: Survey data (2026).

The HDDS results in Table 4.5 above and Figure 4.3 below show that beneficiary irrigators of the Tshovani Irrigation Scheme consumed an average of 7.54 food groups out of a possible 12 in the 24 hours preceding the survey, compared to 6.67 for beneficiary non-irrigators and 6.31 for non-beneficiaries. This represents a substantial improvement from the programme baseline of 3.00 food groups, indicating that the irrigation development project intervention has significantly improved dietary diversity across all beneficiary categories. Notably, 87.0% of beneficiary irrigators were classified as food secure (consuming ≥6 food groups), compared to 74.8% for beneficiary non-irrigators and 72.5% for non-beneficiaries.

Beneficiary irrigators recorded higher proportions of household consumption of nutritionally important food groups including tubers, legumes, fruits, meat, fish and kapenta, milk and dairy

products and oils and fats, compared to the other groups. This dietary diversification reflects the direct effect of irrigation on expanding on-farm food production beyond staple grain crops, as well as the indirect income effect that enables households to purchase a broader range of foods from the market. The subsistence pathway identified in the conceptual framework (Ogundipe, 2017) is clearly operative: reliable water access generates food availability at the household level, while the associated income gains (Table 4.3) enhance food accessibility by expanding purchasing power.

Figure 4.3 below presents the HDDS results graphically by beneficiary type.

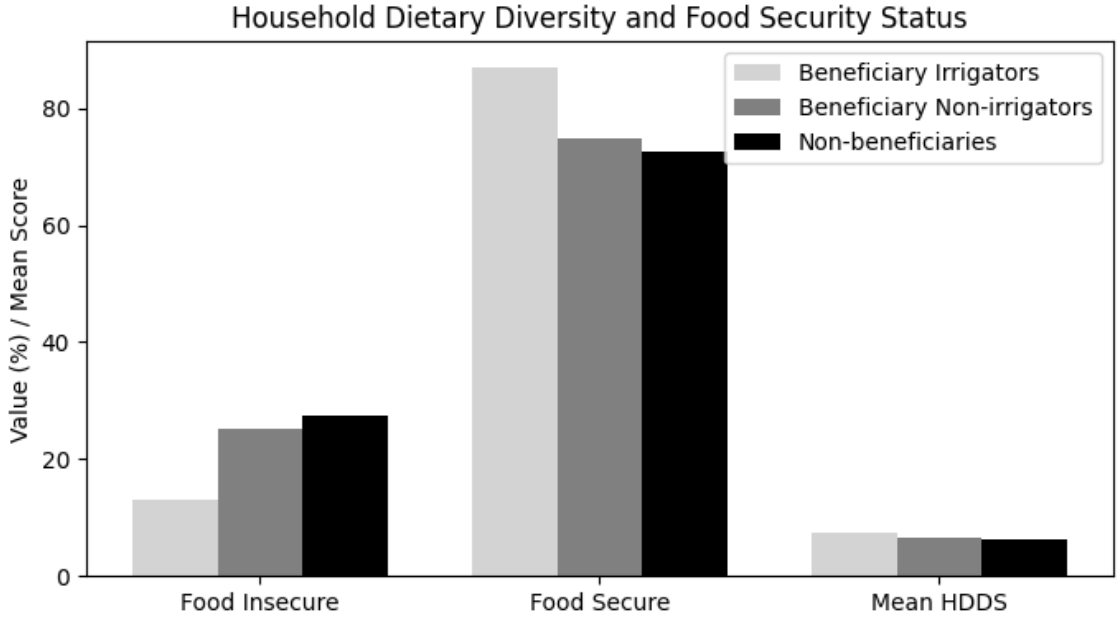

FIGURE 4.3: HOUSEHOLD DIETARY DIVERSITY SCORE (HDDS) CATEGORIES BY BENEFICIARY TYPE

Source: Author

The bar chart compares household dietary diversity and food security status among beneficiary irrigators, beneficiary non-irrigators, and non-beneficiaries. The proportion of households that are food secure is highest among beneficiary irrigators (about 85%), followed by beneficiary non-irrigators (about 75%), while non-beneficiaries are the lowest (about 70%). In contrast, food-insecure households are lowest among beneficiary irrigators (about 13%) and highest among non-beneficiaries (about 28%). Finally, mean HDDS is slightly higher for beneficiary irrigators (about 7) than for beneficiary non-irrigators (about 6) and non-beneficiaries (about 6), indicating better dietary diversity among beneficiary households.

4.2.4 Asset and Livestock Ownership by Beneficiary Type

TABLE 4.6: HOUSEHOLD ASSET AND LIVESTOCK OWNERSHIP BY BENEFICIARY TYPE

Poverty Indicator	Beneficiary Irrigators	Beneficiary Non-irrigators	Non-beneficiaries
Household Asset Ownership (%)	53.4	47.2	39.3
Livestock Ownership (%)	97.0	98.1	85.0
Improved Market Access (%)	32.4	9.3	2.8
Improved Food Access/Diet Quality (%)	69.4	47.7	22.9
Pre-irrigation development project Asset Ownership Baseline (%)	49.0 (baseline)		

Source: Survey data (2026).

Table 4.6 and Figure 4.4 present poverty-related welfare indicators across beneficiary categories. Beneficiary irrigators recorded the highest household asset ownership rate (53.4%), exceeding both the pre-irrigation development project baseline of 49.0% and the non-beneficiary rate of 39.3%. This upward movement in asset ownership is consistent with the accumulation pathway of poverty reduction described by Baloi et al., (2022), who found that smallholder irrigation in Limpopo Province, South Africa, led to increased household asset accumulation as a direct result of higher agricultural incomes. The 14.1 percentage point gap in asset ownership between beneficiary irrigators (53.4%) and non-beneficiaries (39.3%) represent a meaningful welfare divergence that, if sustained, implies an increasing inequality between irrigation scheme members and their non-beneficiary counterparts over time a concern flagged in the limitations section of Chapter 3.

Livestock ownership rates were uniformly high across all beneficiary categories (97.0–98.1%), with non-beneficiaries lagging at 85.0%. Livestock ownership in this context serves both as a productive asset (draught power, manure, milk) and as a buffer stock for coping with income shocks (Scoones, 2009), making the 12-percentage-point gap between beneficiary irrigators and non-beneficiaries a meaningful poverty indicator. Improvements in market access were heavily skewed toward beneficiary irrigators, of whom 32.4% reported improved physical

access to markets, processing and storage facilities, compared to just 9.3% for beneficiary non-irrigators and 2.8% for non-beneficiaries. This stark differential reflects the deliberate market linkage components of the irrigation development project programme (Farming as a Business training, GMB and Koala Meats procurement linkages) which primarily served the irrigator beneficiary category. The finding that 69.4% of beneficiary irrigators reported improved food access and diet quality more than three times the non-beneficiary rate (22.9%) reinforces the broader poverty-reduction effect of irrigation scheme membership identified across this section.

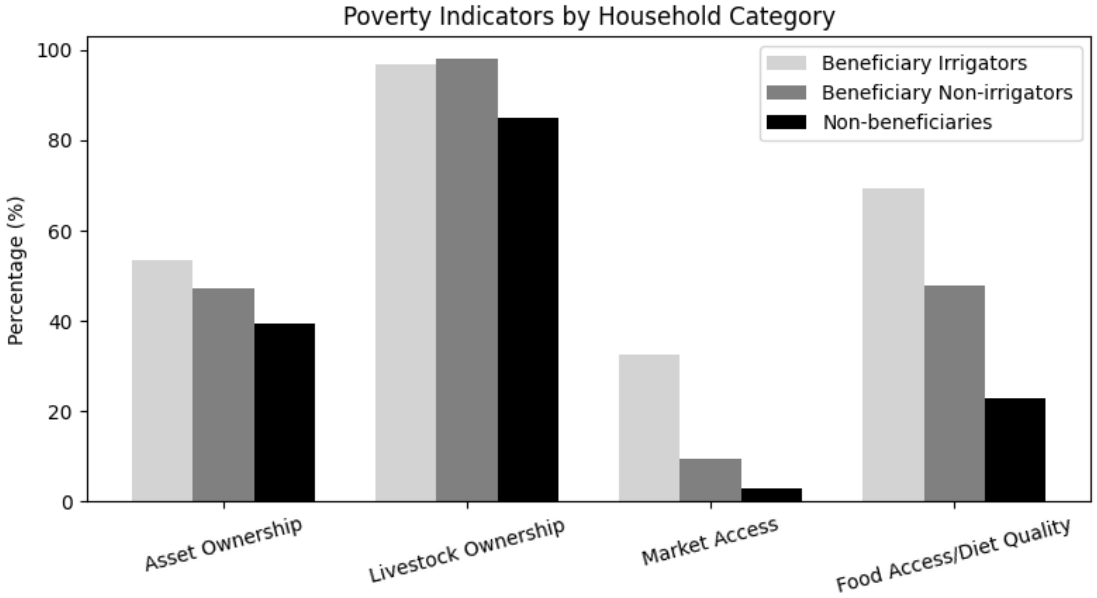

FIGURE 4.4: HOUSEHOLD ASSET OWNERSHIP AND MARKET ACCESS BY BENEFICIARY TYPE
Source: Author

The bar chart compares poverty-related outcomes across three household categories: beneficiary irrigators, beneficiary non-irrigators, and non-beneficiaries. Overall, beneficiary groups show stronger economic conditions than non-beneficiaries. For asset ownership, beneficiary irrigators hold more productive assets (55%) than beneficiaries non-irrigators (50%) while non-beneficiaries are lowest (40), implying better resilience and wealth accumulation among irrigation beneficiaries. For livestock ownership, the pattern is even clearer as beneficiaries' irrigators have a higher (97%), beneficiary non-irrigators are highest and non-beneficiaries are lowest (85%), suggesting that irrigation supports better feed availability and income stability that enables livestock to be maintained. Regarding market access, beneficiary irrigators are much more integrated into markets (35%) compared with non-irrigators (10%) and especially non-beneficiaries (3%), which indicates that irrigation likely

improves production volumes and reduces seasonal risk, making households more capable to selling surplus. Finally, for food access, beneficiary irrigators record the highest performance (70%), followed by non-irrigators (48%) and non- beneficiaries (23%).

4.3.3 Regression Analysis of the Determinants of Household Income

Besides the descriptive and ANOVA-based comparisons done earlier, a multiple linear regression model was run to reveal the factors of annual household income and to measure the unique role of irrigation scheme participation in households' income, after considering other plausible income-generating factors, the regression model was estimated. Whereas the ANOVA results in Table 4.3 suggest that there is a statistically significant difference in income level between the beneficiary and non-beneficiary households, the regression model is able to separate the effect of irrigation participation from other things that are playing a role like the size of the irrigated plot, the adoption of the technology, the participation in the training and the access to the market which in Sections 4.2 and 4.3, we found that in the beneficiary and non-beneficiary households, are quite different.

The estimated model takes the following form:

$$\text{Income}_i = \beta_0 + \beta_1\text{Irrigator}_i + \beta_2\text{Plot Size}_i + \beta_3\text{Tech Score}_i + \beta_4\text{Training}_i + \beta_5\text{Market Access}_i + \beta_6\text{Education}_i + \beta_7\text{Household Size}_i + \varepsilon_i$$

where Income represents the annual household income (US$) of household i; Irrigator is a dummy variable which takes value 1 if the household is a beneficiary irrigator and 0 otherwise; Plot Size is the area (ha) under irrigated or rainfed cultivation; Technology Score is the household's percentage score on the Technology Adoption Score described in Section 4.4; Training is a dummy variable equal to 1 if the household head participated in FaaB/GAP training; Market Access is a dummy variable equal to 1 if the household reported improved market access; Education is the number of years of formal education completed by the household head; Household Size is the number of members in the household; and is the stochastic error term. The model was estimated using Ordinary Least Squares (OLS) for the entire survey sample (n = 55), combining beneficiary irrigators, beneficiary non-irrigators and non-beneficiary households.

TABLE 4.7: OLS REGRESSION RESULTS FOR DETERMINANTS OF ANNUAL HOUSEHOLD INCOME (US$)

Variable	Unstandardized B	Std. Error	Standardized Beta	T	Sig.
(Constant)	168.52	44.56	-	3.78	0.000
Irrigator (1 = beneficiary irrigator)	414.97	46.65	0.515	8.90	0.000
Plot Size (ha)	134.59	22.90	0.184	5.88	0.000
Technology Adoption Score (%)	4.29	1.09	0.198	3.95	0.000
FaAB/GAP Training (1 = participated)	60.58	24.50	0.076	2.47	0.014
Improved Market Access (1 = yes)	106.91	25.94	0.105	4.12	0.000
Household Head Education (years)	12.32	2.89	0.099	4.27	0.000
Household Size (members)	−10.51	5.23	−0.047	−2.01	0.046

NB: $p < 0.01$, $p < 0.05$. Dependent variable: Annual Household Income (US$).

Source: Survey data (2026).

The regression findings in Table 4.7 support and broaden the descriptive and ANOVA results shared earlier in the chapter. The full model achieves a great level of significance ($F(7,212) = 243.44$, $p < 0.001$) and accounts for about 88. 9% of the fluctuation in annual household income ($R = 0.889$; Adjusted $R = 0.886$), as indicated in Table 4.8. This shows the seven factors in the model together explain almost every bit of systematic variation in household income among the Tshovani sample, with only a small amount of the output being due to unmeasured factors.

In a manner consistent with our first hypothesis (H1) and the income comparison given in Table 4.3, participation in an irrigation scheme was the most powerful single determinant of household income. This means that beneficiary irrigator households, on average, earned US$414.97 more each year than their non-irrigator counterparts, other factors being equal ($B=414.97$, $SE=46.65$, $p < 0.001$). The standardized beta value (0.515) indicates that irrigation participation is the predictor with the greatest relative importance in the model, which supports the ANOVA results' insight that being a member of the Tshovani Irrigation Scheme is not just

a factor correlated with higher income via larger landholdings but it has a strong independent influence on household earnings.

Household income was Also positively and Quite a bit related to plot size (B = 134.59, p < 0.001), these results indicate that each extra hectare cultivated at home leads to an increase of US$134.59 in annual household income, other things being equal. This supports an earlier observation at the scheme macro level in Section 4.3 that Tshovani's large average irrigated plot size (1.68 ha) is, in fact, one of the factors which explain its better income performance amongst the six irrigation development project schemes reviewed by the JIMAT Development Consultants (2023) and also shows that the size of land available for farming is still a very important factor, plus access to irrigation, for determining the level of income increase.

The Technology Adoption Score showed a positive correlation with income (B = 4.29, p < 0.001). On average, the annual income of a household would increase by about US$42.90 if the household's Technology Adoption Score was increased by 0.1. Beneficiary irrigators have a Technology Adoption Score on average of 43.43%, while non-beneficiaries have a score of only 2.33% (Table 4.7). This finding indicates that technology adoption is something important in explaining the income difference between the two groups, calculation of which was done ignoring the irrigation status itself. Besides, FaaB/GAP training participation was also Really and positively related to the income (B = 60.58, p = 0.014). Improved market access had one of the biggest influences in the regression (B = 106.91, p < 0.001), which goes and the qualitative discussion in Section 4.4.2 that market linkage, though still a work in progress at Tshovani, is one of the most powerful levers for converting irrigation-enabled production into household income.

Head of the household education was very positively and much related to income (B = 12.32, p < 0.001), which fits the human capital theory, that is, better educated heads of households are more capable of adopting new technologies, negotiating favourable market terms and diversifying sources of income. Yet, household size was negatively related with income (B = -10.51, p = 0.046), this means the larger the household, the more limited will be the per-capita resources even if the total household income is increased by irrigation, a result that is in line with the dependency-burden mechanism that has been revealed in smallholder livelihoods literature (Ellis, 1998).

TABLE 4.8: MODEL SUMMARY AND ANOVA FOR THE HOUSEHOLD INCOME REGRESSION MODEL

Statistic	Value
R	0.943
R^2	0.889
Adjusted R^2	0.886
Std. Error of the Estimate	141.85
F-statistic (df = 7, 212)	243.44
Sig. (F)	0.000
Durbin-Watson	2.12
N	220

NB: $p < 0.01$. Maximum Variance Inflation Factor (VIF) across predictors = 6.43 (Irrigator), well below the conventional threshold of 10, indicating no serious multicollinearity concern.

Source: Survey data (2026).

Several diagnostic checks lend support to the reliability of this model. The maximum Variance Inflation Factor (VIF = 6.43 for the Irrigator variable) is still under the commonly accepted level of 10, which means that although there is conceptual overlap between irrigation participation, plot size and technology adoption, multicollinearity among the predictors does not lead to significant inaccuracies in the coefficient estimates. The Durbin-Watson statistic (2.12) is very near to the perfect value of 2, which means that there is no significant autocorrelation in the residuals. Altogether, the regression findings strongly confirm, in a multivariate way, the bivariate and ANOVA results that have been reported earlier in this chapter: participation in an irrigation scheme has a strong, statistically significant and economically important positive impact on household income at Tshovani, even when variations in landholding size, technology adoption training market access and household demographic characteristics are taken into consideration.

4.4 IRRIGATION DEVELOPMENT AND IMPROVEMENTS IN FARMING PRACTICES, INPUT USE, AND FARM PERFORMANCE AMONG BENEFICIARY HOUSEHOLDS

TABLE 4.9: TECHNOLOGY ADOPTION AND GOOD AGRICULTURAL PRACTICE UPTAKE BY BENEFICIARY TYPE

Technology / Practice	Beneficiary Irrigators (%)	Non-beneficiaries (%)
Adoption of new/improved inputs, technologies, or practices	87.0	7.3
Adoption of climate-resilient technologies (% households)	64.0	7.0
Technology Adoption Score (avg. % across 11 irrigation development project technologies)	43.43	2.33
Applied technologies to reduce climate risks (past 12 months)	47.0	-
Found programme technologies useful for climate risk management	51.0	-
Participated in FaaB / GAP training (Tshovani)	92.5	-
Average cropping intensity (Tshovani)	2.24 crops/yr	-

Source: Survey Data (2026).

The results in Table 4.9 and Figure 4.5 reveal a dramatic difference in technology adoption between beneficiary irrigators and non-beneficiaries. Beneficiary irrigators recorded an 87.0% rate of adoption of new and improved inputs, technologies, or practices nearly twelve times the non-beneficiary rate of 7.3%. This finding strongly supports the third hypothesis (H3): beneficiary farmers at Tshovani exhibit significantly higher adoption rates of climate-smart technologies compared to non-beneficiaries. The Technology Adoption Score (TAS), calculated as an average across the eleven-irrigation development project-promoted technologies, further confirms this: irrigators scored 43.43% compared to 35.41% for non-irrigators and a near-negligible 2.33% for non-beneficiaries.

The fact that Tshovani beneficiary irrigators have achieved a very high FaaB (Farming as a Business) and GAP training participation rate of 92.5% is really remarkable. This figure is not only much higher than the average for the irrigation development project programme, but also indicates the scheme's sustained and intensive delivery of agronomic extension services. This training has hardened the farmers to change their behaviour since their cropping intensity index of 2.24 crop cycles per plot per year is amongst the top three highest figures across the six irrigation development project schemes and the main agricultural conservation (Pfumvudza), integrated soil fertility management, crop rotation and drip irrigation in horticultural production practices are those most widely adopted. These results support the findings of Mupangwa et al., (2022) who demonstrated that education and training are critical complements to physical irrigation infrastructure in generating sustained productivity gains.

The climate resilience results paint an equally compelling picture of 64.0% of irrigators benefiting from the project had implemented technologies to mitigate climate-related risks, whereas only 7.0% of those who did not receive the benefits had done so. This almost tenfold disparity underlines the irrigation scheme's function as an institutional avenue for technology transfer and farmer education, in line with the irrigation development project programme design's second component which was oriented towards promoting Good Agricultural Practices and Climate Smart Agriculture. The truth is 47.0% of beneficiary irrigators had used climate-risk-lowering technologies in the last 12 months (compared to only 13.5% for non-irrigators) indicates that the implementation of these practices is active, not simply nominal.

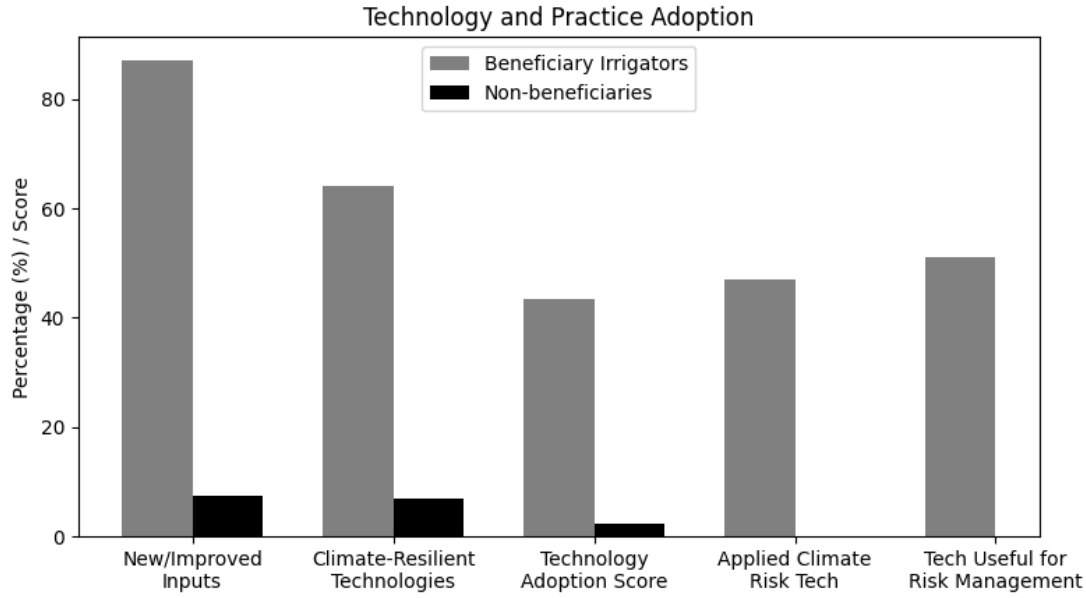

FIGURE 4.5: TECHNOLOGY ADOPTION RATE BY BENEFICIARY TYPE

Source: Author

The chart indicates that beneficiaries adopted and applied the technologies far more than non-beneficiaries. For new/improved inputs, beneficiaries show very high adoption levels, while non-beneficiaries remain near zero, suggesting that the program likely reduces key constraints such as access, cost and information. A similar pattern appears for climate-resilient technologies, where beneficiaries are substantially higher, implying that adoption depends not only on expected returns but also on the availability of complementary resources and support to manage uncertainty and upfront risks. Even where adoption is measured through technology adoption score, beneficiaries still outperform non-beneficiaries, consistent with persistent adoption barriers. Finally, for applied climate risk technology and whether technologies are useful for risk management, beneficiaries again score higher, meaning the intervention strengthens resilience by helping farmers adopt practices that reduce downside impacts. Overall, the figure reflects a strong relationship between participation/support and technology diffusion, with major roles for credit, inputs and knowledge.

4.4.1 Input Use and Agricultural Practices

Access to irrigation enables and incentivises higher input use, as farmers who can control water supply face lower production risk and are therefore more willing to invest in yield-enhancing inputs including improved seed varieties, fertilizers and crop protection chemicals. The literature review in Chapter 2 cited Moe et al., (2022), whose meta-analysis found that irrigated agricultural land requires approximately double the energy input of dryland agriculture, driven by a 120% increase in labour input, 85% greater nitrogen fertilizer requirements and 61% higher fuel requirements. At Tshovani, this input intensification effect is reflected in the diverse crop portfolio maintained by beneficiary irrigators (maize, beans, tomatoes, butternuts, okra, cucumbers, watermelons, paprika) which demands continuous input supply throughout the year-round production cycle.

The block planting system and hydrant-based irrigation infrastructure installed under irrigation development project have replaced the inefficient earthen canal system, reduced water losses and enabling more precise management of irrigation water at the field level. Farmers who previously could not grow high-value horticultural crops due to unreliable water supply can now maintain vegetable plots throughout the dry season, generating both household food security and marketable surplus. The ISAL (Internal Savings and Lending) groups locally known as mikando and fushai (microfinance) provide the informal credit mechanism that enables input purchase (World Vision International, 2017; Dawes and Mushongachiware,

2024), substituting for the formal financial services that remain largely inaccessible to Tshovani farmers.

4.4.2 Market Access and Agricultural Sales Income

TABLE 4. 10: AGRICULTURAL SALES INCOME AND MARKET ACCESS BY BENEFICIARY TYPE

Market Indicator	Beneficiary Irrigators	Beneficiary Non-irrigators	Non-beneficiaries
Average agricultural sales income (US$)	$803.00	—	—
Tshovani-specific avg. crop sales income (US$)	$590.95	—	—
Improved market access (% households)	32.4%	9.3%	2.8%
Main formal market buyers	GMB, Koala Meats, private traders		
Access to improved financial services (past 12 months)	19%	—	—

Source: Survey Data (2026).

Table 4.10 presents market access and income data for the Tshovani Irrigation Scheme. Beneficiary irrigators achieved average agricultural sales income of US$803.00, with Tshovani-specific average crop sales income at US$590.95 the highest among all irrigation development project irrigation schemes reviewed. This result is attributed to the scheme's large mean irrigated plot size (1.68 ha), enabling greater marketed surplus and to existing linkages with formal commodity buyers including the Grain Marketing Board (GMB) and Koala Meats.

The market access differential between beneficiary irrigators (32.4% reporting improved access) and non-beneficiaries (2.8%) is significant but also reveals a limitation of the current irrigation development project intervention: despite irrigation enabling surplus production, less than one-third of irrigator households report improved market access, suggesting that post-production market linkage remains a binding constraint on income realisation. This aligns with the problem statement's identification of exploitative informal traders (makoronyera) and lack of formal market infrastructure as persistent challenges. The irrigation development project

programme's FaaB training component has begun to address this by developing farmers' business orientation, but the data suggest that market integration remains incomplete.

Access to improved financial services was reported by just 19% of beneficiary irrigators, with formal credit sources accounting for only 1.4% of credit access across the scheme. This critically limits the ability of Tshovani farmers to invest in higher-value crops, better equipment and input intensification. The ISAL system remains the primary financial intermediary, a situation that, while demonstrating community resilience, also constrains the scale of investment possible. Future interventions focused on financial inclusion including mobile banking, contract farming arrangements and warehouse receipt financing would be expected to amplify the productivity and poverty-reduction gains already demonstrated by the irrigation infrastructure.

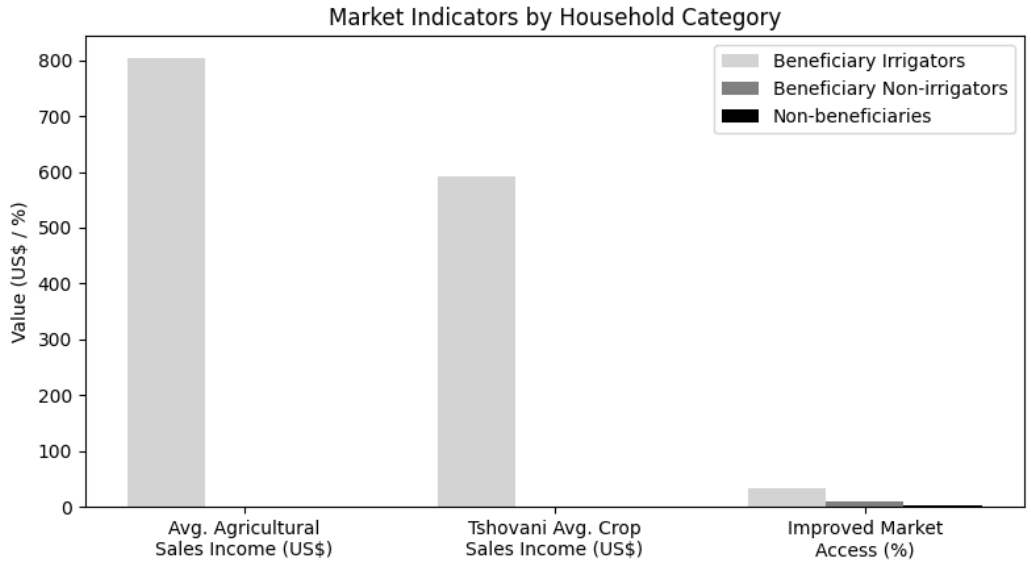

Figure 4.6: Agricultural Sales Income and Market Access by Beneficiary Type

Source: Author

The chart shows that beneficiary households generate higher market performance than non-beneficiaries. Beneficiaries record the highest average agricultural sales income, indicating stronger market participation, better linkages to buyers, or improved production that supports sales volumes and/or prices. Beneficiary irrigator households earn more than beneficiary non-irrigators, suggesting irrigation access and water control further enhance productivity and commercialization. In addition, improved market access is much higher among beneficiaries than among non-beneficiaries, reinforcing the idea that programs improve farmers' ability to overcome market frictions such as transport costs, information gaps, and barriers to aggregating

or selling crops. Overall, the pattern implies that the intervention not only raises output for sale, but also reduces constraints to entering and accessing markets.

CHAPTER 5

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

The present research aimed at measuring the impact of smallholder irrigation raising on agricultural productivity and poverty alleviation amongst smallholder farmers in Zimbabwe's dry areas, with the Tshovani Irrigation Scheme in Chiredzi District, Masvingo Province being a case study. The data collected shows that reliable access to irrigation facilities is something important in changing the lives of poor and food insecure households dependent on rain-fed farming in agro-ecological zones characterised by low and erratic rainfall.

5.1.1 Agricultural Productivity

The first objective examined differences in agricultural productivity between beneficiary irrigators and non-beneficiaries. The results conclusively demonstrate that irrigation participation significantly enhances crop yields. Beneficiary irrigators at Tshovani achieved average maize yields of 3.70 mt/ha compared to 1.90 mt/ha for non-beneficiaries, while bean yields stood at 2.30 mt/ha against 0.88 mt/ha for non-beneficiaries. ANOVA results confirmed these differences were statistically significant ($F = 8.92$, $p < 0.001$). Beneficiary irrigators further recorded a cropping intensity of 2.24 crop cycles per year, compared to 1.00 for non-beneficiaries, reflecting the capacity of perennial water access to extend the productive season and eliminate the traditional “hunger season” experienced between August and February by dryland farmers. The diversification of the crop portfolio encompassing maize, beans, tomatoes, butternuts, okra, cucumbers, watermelons and paprika confirms the productivity enhancing pathway posited in the conceptual framework, whereby irrigation expands both the range and volume of output attainable by smallholder farmers.

5.1.2 Poverty Reduction

The second objective evaluated the effect of irrigation participation on poverty levels. Beneficiary irrigators recorded the highest mean annual household income (US1,071.77) compared to beneficiary non-irrigators (US565.94) and non-beneficiaries (US367.01), representing a near-threefold income advantage over non-beneficiary households. Average agricultural sales income for beneficiary irrigators reached US803.00, with Tshovani-specific crop sales income averaging US590.95, the highest recorded across all Irrigation Development project schemes evaluated.

The results of linear regression analysis of the determinants of household income be a solid testament to the earlier descriptive and bivariate evidence. The main aim of this analysis was to identify the unique impact of participation in an irrigation scheme, independent of the other income-generating factors, which are typically linked to one another. The regression model was able to account for up to 88.9% of the variability in household income ($R = 0.889$, Adjusted $R = 0.886$; $F(7,212) = 243.44$, $p < 0.001$). It also validated that the status as a beneficiary irrigator was via far the most significant predictor of household income, even after adjusting for various factors like the size of the irrigated plot, technology adoption, participation in FaaB/GAP training, access to the market, level of education of the household head and the size of the household. If all these variables are kept unchanged, beneficiary irrigator households are projected to generate an income of approximately US$414.97 more annually versus non-irrigator households who are otherwise similar (=0.515, p<0.001).

This is a clear demonstration that the income uplift seen among users of the Tshovani Irrigation Scheme is not simply due to irrigators having larger plots of land or better market connections, but that it is a significant, statistically strong and economically relevant effect of having access to irrigation. Plot size ($B = 134.59$, $p < 0.001$), technology adoption ($B = 4.29$, $p < 0.001$), training participation ($B = 60.58$, $p = 0.014$), market access ($B = 106.91$, $p < 0.001$) and household head education ($B = 12.32$, $p < 0.001$) were independently and positively related to household income. On the contrary, household size had a slightly negative effect ($B = 10.51$, $p = 0.046$). These multivariate outcomes work as a compelling indication that the second hypothesis (H2) was correct and also help to explain how irrigation, when combined with adequate landholding, use of technology, training and market access, is capable of working at Tshovani as a potent and mutually-enhancing set of poverty-reduction levers.

Food security outcomes corroborate the income findings. Using the Food Consumption Score (FCS), 94.4% of beneficiary irrigators achieved acceptable food consumption status, compared to 87.9% for beneficiary non-irrigators and 78.0% for non-beneficiaries. The Household Dietary Diversity Score (HDDS) further confirmed the food security advantage: beneficiary irrigators recorded a mean HDDS of 7.54, compared to 6.67 for beneficiary non-irrigators and 6.31 for non-beneficiaries, with 87.0% of irrigator households classified as food secure. Beneficiary irrigators consumed a broader range of food groups including tubers, legumes, fruits, meat, fish, milk and dairy products and oils and fats reflecting both the direct subsistence

production effect of irrigation and the indirect income effect that increases purchasing power for food from markets.

The poverty asset indicators confirm these results. On average, beneficiary irrigators recorded 53.4% household asset ownership, which is higher than the pre-project baseline of 49.0% and the non-beneficiary rate of 39.3%. For non-beneficiary groups, the livestock ownership rate of 85.0% was comparatively lower than beneficiary groups (97.0-98. 1%), indicating a substantial welfare gap since livestock serve both as a productive asset and a buffer against income shocks. The percentage of beneficiary irrigators who reported improved access to food and quality of diet (69. 4%) was over three times higher than that of non-beneficiaries (22.9%), highlighting the wide-ranging impacts of poverty reduction through scheme membership.

5.1.3 Farming Practices, Input Use and Farm Performance

The third objective assessed how irrigation development affected changes in farming practices and farm performance. The findings show a spectacular rise in the adoption of technology among scheme beneficiaries. Beneficiary irrigators had an 87.0% adoption rate of improved inputs, technologies and practices, almost 12 times the non-beneficiary rate of 7.3%, while the Technology Adoption Score was on average 43.43% for irrigators compared to a near-zero 2.33% for non-beneficiaries. Training participation rates in Farming as a Business (FaaB) and Good Agricultural Practice (GAP) of 92.5% at Tshovani irrigation scheme (JIMAT Development Consultants, 2023), are among the highest across all irrigation development project schemes and indicate that the scheme is an effective institutional platform for knowledge transfer and agricultural extension.

Climate resilience improvements among beneficiary irrigators were equally marked, with 64.0% having adopted technologies to manage climate-related risks compared to only 7.0% of non-beneficiaries. The rehabilitation of the hydrant-based irrigation infrastructure under the irrigation development project programme, replacing the inefficient earthen canal system, reduced water losses and enabled precise irrigation management at the field level, facilitating the year-round production that underpins all documented productivity and income gains. However, market integration remains an incomplete process: despite enabling surplus production, less than one-third of irrigator households (32.4%) reported improved market access and only 19% had benefited from improved formal financial services. The dominance of exploitative informal traders (makoronyera) and the reliance on Internal Savings and

Lending (ISAL) groups as the primary credit mechanism constrain the full realisation of income potential from irrigation investments.

In sum, the Tshovani Irrigation Scheme has created major and statistically verifiable enhancements in agricultural productivity, household income, food security, asset accumulation and technology adoption among beneficiary irrigators compared to non-beneficiary households. The research confirms that smallholder irrigation development is an efficient approach to reduce poverty in semi-arid areas of Zimbabwe. Still, its potential is still limited by Really smallholders are not fully integrated with the market, they have limited access to formal financial services and there are challenges with input procurement and infrastructure maintenance at the institutional level.

5.2 RECOMMENDATIONS

Based on the findings of the study, what comes next recommendations are made enhance the sustainability and fairness of results at Tshovani Irrigation Scheme and other smallholder irrigation schemes in Zimbabwe's semi-arid areas:

5.2.1 Strengthen Market Linkages and Value Chain Integration

Market integration was identified by the study as the major limitation to income realisation, considering that only 32.4% of the beneficiaries irrigating their plots reported improved market access even though they had surplus production. The Government of Zimbabwe, IFAD and the irrigation development project should consider investing in the construction of formal market infrastructure, developing further links with commodity buyers apart from Grain Marketing Board (GMB) and Koala Meats and also the training programme on Farming as a Business should be extended to include digital marketing platforms and contract farming arrangements. There is a need for a multi-sectoral approach which aims at removing exploitative informal traders (makoronyera) by developing transparent and competitive market systems that guarantee that farmers are paid fairly for their produce.

5.2.2 Expand Access to Formal Financial Services

With only 19% of beneficiary irrigators accessing improved formal financial services and formal credit accounting for just 1.4% of credit sources, the ISAL and informal lending system remains the dominant financial intermediary, constraining the scale of investment possible. Financial institutions, in partnership with the Government and NGOs, should develop tailored

financial products for smallholder irrigators, including mobile banking services, warehouse receipt financing and collateral substitution mechanisms that allow farmers to access credit without conventional security. The ongoing support and formalisation of ISAL groups should be pursued alongside, not as a substitute for, formal financial inclusion.

5.2.3 Prioritise Infrastructure Maintenance and Timely Input Procurement

Ongoing problems such as insufficient pump power, lack of enough hydrants and the delay in getting farming inputs result in breaking the chain of production and also discourage the farmers from trusting the scheme. The irrigation development project and the Department of Irrigation should come up with strong maintenance plans and procurement schedules, accompanied by accountability measures for the respective departments. The communities need to be facilitated to raise their own maintenance funds through the Irrigation Management Committees (IMCs), so that minor repairs can be done quickly without always given the government procurement timings.

5.2.4 Extend Benefits to Non-Irrigator Beneficiaries and Vulnerable Non-Beneficiaries

The study reveals a significant and widening welfare gap between beneficiary irrigators and non-beneficiary households. To prevent the entrenchment of inequality within and around irrigation schemes, future programme design should incorporate targeted support interventions for dryland non-irrigator beneficiaries and non-beneficiary households in the greater scheme area. These should include conservation agriculture (Pfumvudza) promotion, climate-smart input packages and deliberate inclusion criteria for the most vulnerable households including female-headed households, youth and disabled individuals who were found to be under-represented in the current scheme membership.

5.2.5 Sustain and Scale Up Technology Adoption and Extension Services

The participation percentage in FaaB and GAP training at Tshovani was really high, 92.5%. This, together with the rise in crop intensity and climate-resilient technology adoption, shows that agricultural extension programmes, if well implemented in the irrigation schemes, can bring great productivity and livelihood benefits. AGRITEX and other development partners should continue and deepen extension efforts, Mostly towards horticulture, post-harvest handling and integrated soil fertility management. To ensure continuous and self-reinforcing technology adoption beyond the programme lifecycle, farmer-to-farmer knowledge sharing platforms could be a part of the Irrigation Management Committee structure.

5.2.6 Promote Youth and Women's Economic Empowerment within Irrigation Programmes

Although the research highlights irrigation benefits in general, gains in youth and women's empowerment were quite minimal, mainly among non-irrigator beneficiaries. To this end, sex-disaggregated support needs to be programmed, with youth and women receiving their own plots or irrigation use, being given positions of leadership in irrigation management committees (IMCs) and having access to financial products responsive to gender needs. The extent of women's involvement in FaaB training and in formal agricultural value chains should be measured as a programme performance indicator to help ensure that the welfare benefits of irrigation development are fairly distributed across genders.

These proposals if carried out in a proper and specific manner complementing the continued involvement of the Tshovani Irrigation Scheme could not only sustain and establish further the productivity and poverty-reduction results already achieved, but also ensure that the benefits of smallholder irrigation development are equitably made available to the most vulnerable households in Chiredzi District.

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APPENDICES

BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF AGRICULTURE AND ENVIRONMENTAL SCIENCE

DEPARTMENT OF AGRICULTURAL ECONOMICS, EDUCATION AND EXTENSION

My name is Forward S. Munyonho (Reg. No. B220645B), a final-year student at Bindura University of Science Education pursuing a Bachelor of Science Honours Degree in Agricultural Economics and Management. As part of my degree programme, I am required to conduct a research study on THE EFFECT OF SMALLHOLDER IRRIGATION DEVELOPMENT ON AGRICULTURAL PRODUCTIVITY AND POVERTY REDUCTION IN SEMI-ARID AREAS OF ZIMBABWE: A CASE STUDY OF THE TSHOVANI IRRIGATION SCHEME IN CHIREDZI.

Generally, smallholder farmers in semi-arid regions like Natural Region V will probably encounter major limitations in their agricultural production capacity and So in meeting their poverty reduction needs. On this, it would be very essential to conduct studies in generating evidence that could help in formulating the most effective irrigation policies, programmes and interventions in Zimbabwe. So this study intends to find out the problems and give suggestions for enhancing the smallholder irrigation schemes effectiveness.

Your household has been selected through stratified random sampling from the list of beneficiary irrigators and non-beneficiary households associated with the Tshovani Irrigation Scheme. I would like to ask you questions relating to agricultural production, income, food security and farming practices. Participation in this interview is entirely voluntary. Please note that all information provided by you is STRICTLY CONFIDENTIAL and will only be used for academic research purposes. Your responses will not be linked to your name or household identity in any public report. **Thank you for your cooperation.**

Appendix 1:Household Survey Questionnaire

SECTION A: RESPONDENT PROFILE AND HOUSEHOLD CHARACTERISTICS

Code	Question	Response Options / Answer
A1	Respondent Name (optional)	……
A2	GPS Coordinates of household/plot (auto-captured via KOBO Collect)	Lat: …… Long: ……
A3	Irrigation Scheme Name	Tshovani Irrigation Scheme
A4	Beneficiary Type	1 = Beneficiary Irrigator 2 = Beneficiary Non-Irrigator 3 = Non-Beneficiary (Control)
A5	Gender of Household Head	1 = Male 2 = Female
A6	Age of Household Head (years)	…… years
A7	Marital Status of Household Head	1 = Single 2 = Married 3 = Widowed 4 = Divorced
A8	Highest Educational Level Attained by Household Head	1 = No formal education 2 = Primary 3 = Secondary 4 = Tertiary/Vocational 5 = University Graduate
A9	Health Status of Household Head	1 = Healthy 2 = Sometimes Sick 3 = Chronically Ill
A10	Total Number of People Living in This Household	Total: ……
A11	Age disaggregation of household members	Below 18 years: …… 18–35 years: …… Over 35 years: ……
A12	Does any member of this household have a disability?	1 = Yes 2 = No
A13	Compared with other households in this community, your household would be classified as:	1 = Well-off 2 = Average 3 = Poor 4 = Very poor

SECTION B: LAND USE AND AGRICULTURAL PRODUCTION

Code	Question	Response Options / Answer
B1	Do you own cultivable land?	1 = Yes 2 = No
B2	What is the total cultivable land area you own? (hectares)	…… ha
B3	What is the total area of irrigated land you farm? (hectares)	…… ha
B4	Do you also practice dryland (rainfed) cultivation?	1 = Yes 2 = No
B5	If yes to B4, what is the total area under dryland cultivation? (hectares)	…… ha
B6	What crops do you grow on your IRRIGATED plot? (list all)	1 = Maize 2 = Beans 3 = Tomatoes 4 = Butternuts 5 = Paprika 6 = Other (specify): ……
B7	What crops do you grow on your DRYLAND plot? (list all)	1 = Maize 2 = Sorghum 3 = Groundnuts 4 = Millet 5 = Other (specify): ……
B8	How many crop cycles do you complete per year on your irrigated plot? (Cropping Intensity)	…… crops/year
B9	How many crop cycles do you complete per year on your dryland plot?	…… crops/year

SECTION C: AGRICULTURAL PRODUCTIVITY ;CROP YIELDS

(Objective 1: Compare Agricultural Productivity of Beneficiary and Non-Beneficiary Households)

Section C: For each crop below, please give the average yield per hectare you are expecting from your last completed season (irrigated and/or rainfed). If you have not grown any particular crop, then leave it blank.

Code	Crop	Irrigated Yield (mt/ha)	Rainfed Yield (mt/ha)	Total Output (kg or bags)
C1	Maize	……	……	……
C2	Beans	……	……	……
C3	Tomatoes	……	……	……
C4	Butternuts Cucumbers	……	……	……
C5	Paprika	……	……	……
C6	Sorghum	……	……	……
C7	Groundnuts	……	……	……
C8	Other (specify): ……	……	……	……

C9. Compared to the season BEFORE you joined/were associated with the Tshovani Irrigation Scheme, how have your crop yields changed?

Category	Response
Irrigated crops	1 = Increased significantly 2 = Increased slightly 3 = No change 4 = Decreased
Rainfed crops	1 = Increased significantly 2 = Increased slightly 3 = No change 4 = Decreased

SECTION D: HOUSEHOLD INCOME, POVERTY LEVELS AND WELFARE

(Objective 2: Assess the Effect of Irrigation Participation on Poverty Levels)

Code	Question	Response Options / Answer
D1	What is your estimated TOTAL annual household income from ALL sources? (USD)	US$ ……
D2	What is your estimated annual AGRICULTURAL SALES income from crop sales? (USD)	US$ ……
D3	What is your estimated annual LIVESTOCK income (sales, dairy, draught)? (USD)	US$ ……
D4	What are your main sources of household income? (Tick all that apply)	1 = Irrigated crop sales 2 = Rainfed crop sales 3 = Livestock sales 4 = Formal employment 5 = Informal trade 6 = Remittances 7 = Other: ……
D5	Has your household income increased after joining the Tshovani Irrigation Scheme?	1 = Yes, significantly 2 = Yes, slightly 3 = No change 4 = Decreased
D6	Does your household have livestock?	1 = Yes 2 = No
D7	If yes, how many of each type do you own? (enter number for each)	Cattle: …… Goats: …… Sheep: …… Pigs: …… Chickens/poultry: …… Donkeys: ……
D8	Does your household own any of the following assets? (Tick all that apply)	1 = Mobile phone 2 = Radio 3 = Television 4 = Bicycle 5 = Motor vehicle / tractor 6 = Solar panel 7 = Plough/farm equipment 8 = Improved dwelling (brick/iron roof) 9 = Other: ……

Code	Question	Response Options / Answer
D9	Compared to before the Tshovani scheme was rehabilitated, how has your household asset ownership changed?	1 = Increased significantly 2 = Increased slightly 3 = No change 4 = Decreased
D10	How has irrigation scheme participation affected your ability to pay school fees?	1 = Much improved 2 = Slightly improved 3 = No change 4 = Worsened
D11	How has irrigation scheme participation affected your access to health care?	1 = Much improved 2 = Slightly improved 3 = No change 4 = Worsened
D12	How has your housing quality changed since the scheme was rehabilitated?	1 = Improved significantly 2 = Improved slightly 3 = No change 4 = Worsened
D13	Do you have access to improved financial services (e.g. bank account, mobile money, MFI)?	1 = Yes 2 = No
D14	What is your primary source of credit or savings?	1 = Formal bank 2 = Microfinance institution (MFI) 3 = ISAL/Mukando savings group 4 = Friends/relatives 5 = No access to credit 6 = Other: ……

SECTION E: FARMING PRACTICES, INPUT USE AND FARM PERFORMANCE

(Objective 3: Examine Improvements in Farming Practices, Input Use and Farm Performance)

Code	Question	Response Options / Answer
E1	Have you adopted any of the following improved agricultural technologies or practices since joining associated with the scheme? (Tick all that apply)	1 = Improved/hybrid seed varieties 2 = Inorganic fertilizer (basal/top dressing) 3 = Organic fertilizer / compost 4 = Conservation agriculture (Pfumvudza) 5 = Drip / furrow irrigation 6 = Integrated soil fertility management 7 = Crop rotation 8 = Post-harvest handling and storage 9 = Pest and disease management (IPM) 10 = Agroforestry 11 = Gully reclamation / NRM 12 = None of the above
E2	Have you participated in any of the following training activities under the Tshovani irrigation scheme? (Tick all that apply)	1 = Farming as a Business (FaaB) 2 = Good Agricultural Practices (GAP) 3 = Climate Smart Agriculture (CSA) 4 = Post-harvest handling and storage 5 = Nutrition and diet awareness 6 = Natural Resources Management 7 = Irrigation operations and maintenance (OandM) 8 = Gender, Youth and Inclusion 9 = None of the above
E3	Have you adopted any technologies specifically to manage climate-related risks in the past 12 months?	1 = Yes 2 = No
E4	If yes to E3, do you find these technologies useful for managing climate risks?	1 = Very useful 2 = Somewhat useful 3 = Not useful
E5	What types of inputs do you use on your irrigated plot? (Tick all that apply)	1 = Improved seed varieties 2 = Basal fertilizer 3 = Top-dressing fertilizer 4 = Pesticides / herbicides 5 = Irrigation equipment (pumps, pipes) 6 = Draught power (oxen/tractor) 7 = Other: ……

Code	Question	Response Options / Answer
E6	Do you have access to formal agricultural markets for selling your produce?	1 = Yes 2 = No
E7	If yes to E6, which formal market buyers do you sell to? (Tick all that apply)	1 = Grain Marketing Board (GMB) 2 = Koala Meats / formal processors 3 = Formal supermarkets 4 = Contract farming arrangements 5 = Other: ……
E8	What is the MAIN market where you sell most of your produce?	1 = Local roadside/village market 2 = Growth point market 3 = GMB depot 4 = Formal private buyer/processor 5 = Makoronyera (informal trader) 6 = Other: ……
E9	How would you rate the functionality of the current irrigation infrastructure at Tshovani?	1 = Fully functional 2 = Mostly functional (minor problems) 3 = Partially functional (major problems) 4 = Non-functional
E10	What are the main challenges you face with the irrigation infrastructure? (Tick all that apply)	1 = Inadequate pump power / ZESA outages 2 = Insufficient hydrants 3 = Blocked/damaged canals or pipes 4 = Late procurement of spare parts 5 = Poor water allocation management 6 = No major challenges 7 = Other: ……
E11	In general, how satisfied are you with the impact of the Tshovani Irrigation Scheme on your household's livelihoods?	1 = Very satisfied 2 = Moderately satisfied 3 = Neutral 4 = Dissatisfied 5 = Very dissatisfied

Appendix 2: Household Dietary Diversity Score (HDDS) Questionnaire

Objective 2: To assess the effect of participation in the Tshovani irrigation scheme on poverty levels among beneficiary households (Food Security Indicator).

Purpose: To measure the Household Dietary Diversity Score (HDDS), which serves as a proxy indicator of household food security and poverty reduction associated with irrigation scheme participation.

Instruction to Enumerator: Ask the respondent responsible for food preparation in the household the following questions. Questions refer to the household as a WHOLE, not any single member. The reference period is the 24 hours (one day) preceding the interview.

No.	Food Group / Consumption Question	Response (Circle one)
1	Did any member of your household consume CEREALS yesterday? (e.g. sadza, mahewu, maize porridge, millet porridge, rice, sorghum, bread, biscuits)	1 = Yes 2 = No
2	Did any member of your household consume WHITE ROOTS, TUBERS or PLANTAINS yesterday? (e.g. sweet potatoes, cassava, yams, white-fleshed potato)	1 = Yes 2 = No
3	Did any member of your household consume LEGUMES, PULSES, NUTS OR SEEDS yesterday? (e.g. beans, cowpeas, lentils, groundnuts, peanut butter, cashew nuts, sunflower seeds)	1 = Yes 2 = No
4	Did any member of your household consume DARK GREEN LEAFY VEGETABLES yesterday? (e.g. pumpkin leaves, rape, covo, spinach, wild leafy greens)	1 = Yes 2 = No
5	Did any member of your household consume OTHER VEGETABLES yesterday? (e.g. tomatoes, onions, garlic, cabbage, carrots, peppers, okra, cucumber)	1 = Yes 2 = No

No.	Food Group / Consumption Question	Response (Circle one)
6	Did any member of your household consume VITAMIN A-RICH FRUITS OR VEGETABLES yesterday? (e.g. pumpkin, butternut, mango, papaya, orange-fleshed sweet potato)	1 = Yes 2 = No
7	Did any member of your household consume OTHER FRUITS yesterday? (e.g. banana, guava, avocado, apples, oranges other than vitamin A-rich)	1 = Yes 2 = No
8	Did any member of your household consume MEAT, POULTRY or FISH/SEAFOOD yesterday? (e.g. beef, goat, chicken, pork, kapenta, fresh fish, offal)	1 = Yes 2 = No
9	Did any member of your household consume EGGS yesterday?	1 = Yes 2 = No
10	Did any member of your household consume MILK or DAIRY PRODUCTS yesterday? (e.g. fresh or powdered milk, yogurt, cheese)	1 = Yes 2 = No
11	Did any member of your household consume OILS, FATS or BUTTER yesterday? (e.g. cooking oil, margarine, butter, animal fat added to food)	1 = Yes 2 = No
12	Did any member of your household consume SUGARY FOODS or SUGAR-SWEETENED BEVERAGES yesterday? (e.g. sugar, honey, sweets, soft drinks, juice)	1 = Yes 2 = No

HDDS SCORE (Sum of all YES responses): _____ / 12

Interpretation Guide:

HDDS Score	Dietary Diversity Category	Food Security Status
0–3	Low dietary diversity	
4–5	Medium dietary diversity	
≥6	High dietary diversity	

Note: This questionnaire is adapted from the FAO/WFP Household Dietary Diversity Score methodology (Kennedy et al., 2011).

Appendix 3: Food Consumption Score (FCS) Questionnaire

Objective 2: To assess the effect of participation in the Tshovani irrigation scheme on poverty levels among beneficiary households (Food Security Indicator).

Purpose: To measure the Food Consumption Score (FCS), a composite indicator of dietary quality and food access used to classify household food security status.

Instruction to Enumerator: Ask the respondent how many days in the PAST SEVEN (7) DAYS any member of the household consumed each of the food groups listed below. Record the number of days (0–7) for each food group.

Code	Food Group Consumed in the Past 7 Days	Number of Days	Weight
FCS1	STAPLE FOODS -cereals (maize, rice, sorghum, millet, bread) and tubers (potatoes, sweet potatoes, cassava, yams)	…… days (0–7) Weighted: ___	
FCS2	PULSES / LEGUMES - beans, lentils, cowpeas, peas, groundnuts, peanut butter	…… days (0–7) Weighted: ___	
FCS3	VEGETABLES - all vegetables including leafy greens, tomatoes, onions, peppers, okra	…… days (0–7) Weighted: ___	
FCS4	FRUITS - all fruits	…… days (0–7) Weighted: ___	
FCS5	MEAT / FISH / POULTRY / EGGS - beef, goat, chicken, pork, kapenta, fish, eggs	…… days (0–7) Weighted: ___	
FCS6	DAIRY - milk (fresh or powdered), yogurt, cheese	…… days (0–7) Weighted: ___	
FCS7	SUGAR / SUGARY PRODUCTS - sugar, honey, sweets, juice, soft drinks	…… days (0–7) Weighted: ___	
FCS8	OILS / FATS - cooking oil, margarine, butter, animal fat	…… days (0–7) Weighted: ___	

FCS TOTAL (sum of [days × weight] for all food groups): _____

FCS Classification:

FCS Score	Food Consumption Category	Action Threshold
< 21	Poor Food Consumption	
21–35	Borderline Food Consumption	
> 35	Acceptable Food Consumption	

Note: This questionnaire is adapted from the World Food Programme (WFP) Food Consumption Score methodology.

Appendix 4: Key Informant Interview (KII) Schedule

Objectives 1, 2 and 3: Agricultural Productivity, Poverty Reduction and Farming Practices.

Target Respondents:

- Agricultural Business Advisory Officers (ABAO) assigned to the Tshovani Irrigation Scheme
- Irrigation Management Committee (IMC) Chairperson / Secretary
- Representative of the Irrigation Development Project Programme Coordination Unit (PCU) at the scheme level
- Chief / Village Head / Ward Councillor (where applicable)

Introduction to Respondent:

I'm Forward S. Munyonho, a final year student at Bindura University of Science Education. I am researching the impact of smallholder irrigation development on agricultural productivity and poverty reduction at the Tshovani Irrigation Scheme. This interview will be kept confidential and used for academic research only. If you agree, I will ask you questions that aim to tap into your expert knowledge and experience of this scheme. Don't worry about right or wrong answers. I am mainly interested in your professional point of view and observations.

Interview Format: Semi-structured. Questions are open-ended and only a guide; several questions for follow-up and clarification may be asked. Time: 45-60 minutes.

OBJECTIVE 1: Agricultural Productivity

1.How do you think the agricultural productivity of farmers who benefit from the rehabilitation of the Tshovani Irrigation Scheme has changed? In your opinion, to what extent has the crop yield of these farmers been improved? Can you mention some specific instances or changes that you have noticed?

2. Could you please tell me the major crops that are planted at Tshovani? Have the farmers changed their cropping pattern or brought new crops after the rehabilitation study of the scheme? What factors have encouraged or discouraged such changes?

3. Have you noticed any productivity differences between the farmers who receive water through irrigation and those who farm on drylands without any irrigation in the nearby areas? To what do you attribute these differences?

4. What kind of infrastructural or agronomic issues act as bottlenecks for the farmers at Tshovani in realizing their full productivity potential?

OBJECTIVE 2: Poverty Reduction and Food Security

1. Based on your observations, do you think participating in the Tshovani Irrigation Scheme has contributed to increasing the household income levels and improving the livelihoods of the beneficiary farmers? What concrete signs of poverty alleviation have you noticed?

2. Are there any traces of better food security and more varied diets of the beneficiary households participating in the scheme when compared with the non-beneficiary households? If yes, how would you illustrate these positive changes?

3. How many of the farmers at Tshovani have been able to get financial support from the conventional financial institutions (e. g. banks, MFIs), or possibly, have contracted arrangements? What difficulties limit the financial inclusion of most of the scheme participants?

4. What poverty-related issues do you think have not been addressed by the scheme yet and what measures would you suggest to fix them?

OBJECTIVE 3: Farming Practices, Input Use and Farm Performance

1. What Good Agricultural Practices (GAP) and Climate Smart Agriculture (CSA) technologies have been promoted at Tshovani? How widely have these been adopted by beneficiary irrigators?
2. What changes have the farmers at Tshovani made in the management of their plots and in their marketing approaches because of the Farming as a Business (FaaB) training programme?

3. To what extent can the existing irrigation facilities (pumps hydrants canals) be relied on to produce crops throughout the year? What are the biggest problems with the infrastructure?

4. What shifts in the use of inputs (fertilizer, improved seed, crop protection chemicals) have drawn your attention among the beneficiaries of the scheme vs the time before the rehabilitation?

5. What is your opinion of the market linkage arrangements in place for Tshovani farmers (GMB, Koala Meats, private traders)? What kind of measures can be taken to upscale market access and decrease the exploitation of farmers by informal traders (makoronyera)?

6. What proposals would you present to the Government of Zimbabwe, IFAD and programme implementation teams for the upliftment and enhanced effectiveness of the Tshovani Irrigation Scheme?

Appendix 5: Focus Group Discussion (FGD) Guide : Beneficiary Irrigators

Objective 3: To examine the extent to which irrigation development has improved farming practices, input use and overall farm performance among beneficiaries.

Target Group: 8–10 beneficiary irrigator households (mixed gender include both male and female-headed households; include youth and members living with disability where possible).

Duration: 60–90 minutes. | Venue: Irrigation scheme meeting point or community hall.

OPENING (10 minutes)

Welcome participants and introduce the research team. Explain the purpose of the FGD, confidentiality and voluntary participation. Ask participants to introduce themselves briefly (first name, type of plot, years in the scheme).

THEME 1: Changes in Agricultural Productivity

1. What issues did you experience with your crop production when the Tshovani Irrigation Scheme was not working? How have these problems changed?

2. Can you name some crops you are now capable of growing that were not possible for you before? Also, how have your crop yields been affected?

3. Comparing before the scheme was rehabilitated and now, how many times a year can you grow crops on your irrigated plot?

3. In your opinion, what are the main causes of the increase in productivity (or the failure to increase productivity) that you have noticed at Tshovani?

THEME 2: Impact on Household Income and Food Security

4. What changes, if any, has your household's income experienced from your participation in the Tshovani Irrigation Scheme? Please, provide examples of the things you can now afford that were previously out of your reach,

5. Is your household's food diversity better after your household has joined the scheme? What new food items have you become regular consumers of and

6. What impact have the scheme had on your ability to pay school fees, get health care and improve your housing?

7. Do you know of any households under this scheme that have NOT benefited or whose situation has even worsened? If yes, what are the reasons behind it from your point of view?

THEME 3: Farming Practices, Technology Adoption and Market Access

8.What new farming methods or equipment have you incorporated into your farm after the scheme was restored? (Prompt: Pfumvudza, drip irrigation, improved seeds FaaB GAP trainings)

9. How effective has the Farming as a Business (FaaB) training been in enhancing your farming and marketing decisions?

10. Where exactly do you market your grains? Are the prices satisfactory? What difficulties do you encounter while selling your grains?

11. What do you think are the PRIMARY reasons that farmers here do not get full value for their produce?

12. What changes would you most want to be made to the Tshovani Irrigation Scheme infrastructure and programme support?

Appendix 6: Focus Group Discussion (FGD) Guide Non-Beneficiary Households (Control Group)

Objectives 1 and 2: To provide a comparative baseline for agricultural productivity and household poverty levels.

Target Group: 8–10 non-beneficiary rainfed dryland farming households (mixed gender).

Duration: 60–75 minutes.

THEME 1 : Agricultural Production Challenges

1. What crops do you mainly cultivate? What do you think are the major obstacles to getting high crop yields?

2. What impact did the irregular rainfall in the recent years have on your crop production?

3. Do you personally know the Tshovani Irrigation Scheme? Have you noticed any distinctions in crop production between the members of the irrigation scheme and those who are not members?

4. If you were provided with irrigation, what would you say the most significant changes in your farming and livelihoods would be?
5.

THEME 2: Poverty, Food Security and Livelihoods

5. Generally speaking, how would you characterize the food security situation in your household in the last 12 months?

6. On an average, for how many months in the year does your household have enough food supply? How do you cope during the dry season (August–February) when food is typically scarce?

7. What are your main sources of income? Is your income sufficient to meet your household's basic needs?

8. What support or interventions would most help you to improve your livelihoods and food security?

THANK YOU