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FACULTY OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES

INVESTIGATING THE SMALLHOLDER FARMERS' PARTICIPATION IN IRRIGATION SCHEMES IN MASHONALAND CENTRAL PROVINCE, ZIMBABWE. A CASE STUDY OF GULEK IRRIGATION SCHEME MATEPATEPA , BINDURA.

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Dissertation submitted in partial fulfilment of the requirements for the Bachelor of Science Honours in Agriculture Economics and Management degree.

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APPROVAL FORM.

The undersigned certified that they have supervised and recommended to Bindura Universty of Science Education for acceptance of dissertation entitled ‘investigating the participation of smallholder farmers in irrigation schemes in Mashonaland central province zimbabwe’. Case of ward 21 Gulek Irrigation Scheme in Matepatepa submitted in partial fulfillment of the Bachelor of Agricultural Science Honours Degree in Agricultural Economics Management.

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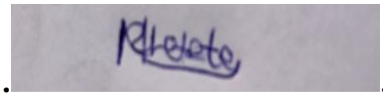
Signature. ……  **……..**

Date……

DECLARATION

I, Natasha Ruvimbo Nhete, hereby declare that this dissertation, ‘investigating smallholder farmers’ participation in irrigation schemes in Mashonaland Central Province, Zimbabwe, case of Gulek Irrigation Scheme Ward 21 , is my own original work and has not been submitted elsewhere for examination or award of any degree. I declare that the research was conducted in accordance with the ethical guidelines and regulations of the Bindura University of Science Education, Department of Agricultural Economics, Education and Extension."

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DEDICATION

I dedicate this research project to my parents, Mr and Mrs Nhete and my sister and family. Surely, you were sources of inspirations.

ACKNOWLEDGEMENT

This dissertation would not have been possible without the support and guidance of several individuals and organizations. First and foremost, I would like to express my deepest gratitude to my supervisor, Dr V.T Munyati, for his unwavering support, guidance, and encouragement throughout this journey. His expertise and feedback were invaluable in shaping my research. I would also like to thank Mr Hove and Mr Watetepa from ARDA for their contributions to the data collection process. Their assistance was instrumental in bringing this study to fruition. I am grateful to the participants who took part in this study, and shared their experiences and insights with me. Your willingness to share your stories has made a significant contribution to our understanding of smallholder farmers' participation in irrigation schemes. Lastly, I would like to thank my family and friends for their unwavering support and encouragement. Your love and belief in me have been a constant source of motivation.

Thank you all again for your contributions to this dissertation.

ABSTRACT

Small-scale irrigation schemes typically refer to water management systems designed to support agricultural activities on a relatively small scale, often on plots of land owned or managed by individual farmers or smallholder communities. These schemes can vary widely in size, technology, and management structure but generally involve the controlled application of water to crops through various methods such as surface irrigation, drip irrigation, or sprinkler systems. With a focus on understanding the factors influencing participation, the study employs a mixed-methods approach combining surveys, interviews, and observational data collection. The main objective of this paper is to identify and assess the key factors influencing smallholder farmers' decision to participate and non participate in irrigation schemes in Mashonaland Central province of Zimbabwe. This paper used a cross-sectional household level survey data and multistage sampling was employed to select a sample of 82 households, whereby 68 were participates and 14 were non participates from Matepatepa Gulek Irrigation Scheme Ward 21. Secondary data were also collected from different sources such as AGRITEX Bindura, and ARDA. As part of the study, the data collected were analyzed through binary logistics and linear regression models,The model exhibits that age, farm size, income, distance to the scheme, access to credit and access to extension services are the statistically significant variables which significantly influence smallholder farmers' decision to participate and non participate on irrigation schemes. Extension services (19.18) odds of participating in irrigation schemes are 19.18 times higher for smallholder farmers who receive extension services compared to those who do not. This means that receiving extension services increases the likelihood of participation by about 19.18%. The results in the research study also shows that farm size has a positive and significant effect on the decision to participate in irrigation schemes, with a coefficient of 12.20, indicating that for every unit increase in farm size, the odds of participating in irrigation schemes increase by a factor of 12.20. However, they are barriers faced by smallholder farmers in participating in irrigation schemes include limited access to water, lack of credit and financing options, inadequate technical knowledge and

training, and ineffective extension services. Additionally, smallholder farmers often face challenges in accessing markets, managing water use, and adapting to climate change. To address these barriers, recommendations include providing affordable credit and financing options, offering training and capacity building programs, improving access to water and irrigation technologies, enhancing extension services and farmer support, promoting market access and value chain development, and developing climate-resilient irrigation schemes. Furthermore, involving smallholder farmers in the planning and management of irrigation schemes, and promoting gender equity and social inclusion are crucial to ensure that the schemes are effective and sustainable.

Keywords: smallholder farmers, irrigation schemes, participation.

ABBREVIATION AND ACRONMYS

AGRITEX	Agricultural Technical and Extension Service.
ARDA	Agricultural and Rural Development Authority
GDP	Gross Domestic Product
GNP	Gross National Product
IAD	Institutional Analysis and Development Framework
SIRP	Smallholder Irrigation Revitalization Program
ZIMASSET	Zimbabwe Agenda for Sustainable Socio-Economic Transformation

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CHAPTER ONE

INTRODUCTION

1.0 INTRODUCTION.

This chapter presents the background of the study on smallholder farmers' participation in irrigation schemes, a crucial aspect of agricultural development. The research questions and objectives are formulated to investigate the factors influencing participation, while the delimitation and limitations of the study are clearly outlined. The justification for the study is also provided, highlighting its significance and potential impact. Finally, the problem statement is clearly defined, setting the stage for the rest of the study to explore the complex issues surrounding smallholder farmers' participation in irrigation schemes.

1.1 BACKGROUND OF THE STUDY

For an extended period, Zimbabwe's agriculture industry has been a vital component of the country's economy, supporting most of its citizens and making a substantial contribution to 15% and 20% of GDP and GNP, respectively. Additionally, the industry generates income for more than 75% of the population and employs 40% of total exports. Historically, the country's agriculture has been characterized by a mix of large-scale commercial farming and smallholder subsistence farming. Large-scale commercial farms, initially owned by white settlers during the colonial era, traditionally produced cash crops such as tobacco, maize, cotton, and horticultural products for domestic consumption and export. These farms were supported by modern infrastructure, technology, and irrigation systems. Small-scale farms in Zimbabwe's agricultural sector typically refer to agricultural operations that are relatively small in size and production scale compared to large-scale commercial farms. These farms are often family-owned or managed by individual farmers or small cooperatives. They are characterized by their reliance on labour-intensive farming methods and limited access to resources and capital.

The agricultural sector in Zimbabwe faces the challenge of receiving few rainfalls per year, with an average of 500 and 800 millimetres occurring during the summer months from November to March. As a country with a history of erratic rainfall patterns and periodic droughts, Zimbabwe has increasingly turned to irrigation as a means to enhance agricultural productivity, ensure food self-sufficiency, and support the livelihoods of rural communities. According to recent statistics, approximately 26, 000 hectares of land are under irrigation,

encompassing the rehabilitation and revitalization of over 450 irrigation schemes in communal areas. With over ten small-scale irrigation projects in operation and over 250 hectares of agricultural land irrigated in some districts, Zimbabwe boasts a high level of smallholder participation. Furthermore, the Smallholder Irrigation Revitalization Program (SIRP) emphasizes the significance of smallholder involvement in irrigation activities by aiming to encompass around 46% of the nation's estimated total irrigation-equipped land, approximately 13,000 hectares.

However, the introduction of plans such as the Zimbabwe Agenda for Sustainable Socio-Economic Transformation (ZIMASSET) and the approval of the More Food for Africa policy indicate that the government recognises the need to rehabilitate all irrigation facilities. Such systems were either struggling to operate due to outdated equipment or had ceased operations due to a variety of issues. This was done to enable the nation to be food secure after understanding the harmful consequences of climate change on agricultural production, as the country experienced significant food insecurity a few years ago. Several parties were invited to join the government's effort to restore small-scale irrigation systems to support smallholder farmers. Through a detailed analysis of the socio-economic, environmental, and institutional aspects of smallholder farmers' involvement in irrigation schemes, this research project seeks to investgate smallholder farmer's participating in irrigation schemes in Mashonaland Central, Zimbabwe. By shedding light on the opportunities and challenges faced by smallholder farmers in adopting and sustaining irrigation practices, this study also aims to pave the way for more inclusive, sustainable, and resilient agricultural systems in the province.

1.2 STATEMENT OF THE PROBLEM.

"Despite the potential of irrigation schemes to improve agricultural productivity and livelihoods for smallholder farmers (World Bank, 2019; FAO, 2016), many smallholder farmers in developing countries do not participate in irrigation schemes, limiting their ability to improve their crop yields, food security, and income (Mwangi, 2017; Nkonya, 2013). Research has shown that smallholder farmers face various barriers to participation, including lack of access to credit, inadequate knowledge and skills, and limited institutional support (Kimalu, 2017; Mdemu, 2016). Moreover, factors such as technology adoption, conservation agriculture, and solar irrigation can also influence smallholder farmers' participation in irrigation schemes

(Mwanga, 2019; Motsa, 2017). However, there is a need for a deeper understanding of the specific factors that influence smallholder farmers' participation in irrigation schemes in Mashonaland Central Province of Zimbabwe, in order to develop effective strategies to increase their participation and improve their livelihoods (Mugodo, 2016). This study aims to investigate the factors that influence smallholder farmers' participation in irrigation schemes in Mashonaland Central Province, Zimbabwe, with a view to identifying strategies for improving their participation and livelihoods."

1.3 RESEARCH QUESTIONS

1. What are the key factors influencing smallholder farmers' decision to participate and non-participate in irrigation schemes in Mashonaland Central?
2. What are the barriers and opportunities associated with smallholder farmers' participation in irrigation schemes?
3. How does smallholder farmers' participation in irrigation schemes impact their income?

1.4 OBJECTIVES OF THE STUDY

1. To identify and assess the key factors influencing smallholder farmers' decision to participate and non-participate in irrigation schemes in Mashonaland Central
2. To assess the barriers and opportunities associated with smallholder farmers' participation in irrigation schemes..
3. To analyze the impact of smallholder farmers' participation in irrigation schemes on income.

1.5 JUSTIFICATION

To the researcher.

This research project is being conducted in fulfilment of the author's Bachelor's degree in Agricultural Economics and Management. The research project can contribute to the advancement of academic knowledge particularly in the fields of agricultural economics, water management, and rural development. It will also provide opportunities for students and researchers to gain practical experience in conducting fieldwork, data analysis, and interdisciplinary research.

The smallholder farmers.

The smallholder farmers may benefit by learning about the potential benefits of irrigation schemes and how to participate in them. They may also gain access to information and resources that can help them improve their farming practices and increase their productivity. Additionally, they may develop relationships with other farmers, irrigation scheme providers, and researchers.

Government Departments.

The research findings can inform the development of evidence-based policies and programs related to irrigation development, smallholder agriculture and rural livelihoods, leading to more effective strategies for sustainable water management and agricultural development. Data and insights from the research project can guide the allocation of resources and investments in irrigation infrastructure, extension services, and capacity building for smallholder farmers.

Agricultural extension services

Extension services can utilize the research findings to disseminate best practices and technological innovations to smallholder farmers, supporting their effective participation in irrigation schemes and sustainable agriculture. The insights from the research can inform the design of training programs and capacity-building initiatives for extension agents, enhancing their ability to support and advise farmers on irrigation-related practices.

1.6 DELIMITATIONS AND LIMITATIONS

1.6.1 Delimitations.

- Geographic scope: The study may be limited to a specific area within Mashonaland Central, excluding other regions where conditions and factors affecting smallholder farmers' participation differ.
- Time frame: The study may focus on a specific period, which could affect the generalizability of the findings to other periods.

- Socioeconomic factors: The study may delimit the analysis to specific socioeconomic groups within smallholder farmers, potentially overlooking the impact of these factors on participation.

1.6.2.Limitations.

- Access to resources: Smallholder farmers may face limitations in access to water, land, credit, and agricultural inputs, which can affect their ability to participate effectively in irrigation schemes.
- Technical knowledge and skills: Limited technical knowledge and skills among smallholder farmers may restrict their ability to maximize the benefits of irrigation schemes.
- Infrastructure: Inadequate infrastructure, such as roads and storage facilities, may limit the ability of smallholder farmers to efficiently participate in irrigation schemes.
- Policy and governance: Limitations in policy support, governance structures, and institutional frameworks may create barriers to effective smallholder participation in irrigation schemes.
- Market access: Limited access to markets and price volatility may restrict the economic benefits that smallholder farmers can derive from participation in irrigation schemes
- Social and cultural factors: Gender dynamics, social hierarchies, and cultural norms may limit the opportunities for certain groups of smallholder farmers to participate fully in irrigation schemes.

CHAPTER TWO

LITERATURE REVIEW

2.0 INTRODUCTION

The literature study will provide an overview of the existing research on smallholder participation in irrigation schemes. In this chapter, the author offered the theoretical and conceptual framework that will guide the study of smallholder farmers' participation in irrigation schemes in Mashonaland Central Province, Zimbabwe.

2.1 DEFINATION OF KEY TERMS

2.1.1 smallholder farmers

There are several ways to approach the idea of a "smallholder farmer," all of which are related to the analysis's goal. Smallholder farmers are defined as those farmers owning small plots of land on which they grow subsistence crops and one or two cash crops relying almost exclusively on family labour (Anon, 2012). Smallholder farmers, in general, face structural constraints such as limited access to resources, technology, and markets. On the other hand, smallholder farmers are farmers who carry out farming activities on pieces of land that are 2 ha or less and dominate agricultural production in Eastern Africa (Salami et al., 2010, Livingston et al., 2011). However, (Hazel et al., 2007) describe small farmers as 'those depending on household members for most of the farm is to produce the bulk of the household's consumption of staple foods'.

2.1.2. Irrigation schemes.

Irrigation schemes, as described by Mati (2019), refer to the organized systems of water distribution and management that support agricultural production, including infrastructure, technologies, and practices that enhance water use efficiency and productivity. According to Kimalu (2018), irrigation schemes involve the controlled application of water to crops through various methods, including sprinkler, drip, and flood irrigation, to support crop growth and yield. As defined by Mwangi (2017), irrigation schemes encompass the social, economic, and

technical aspects of water management, including the role of farmers, communities, and institutions in planning, managing, and maintaining irrigation systems

Globally, smallholder irrigation systems are reviewed as critical common property resources that are needed to increase crop water supply and sustain livelihoods in semi-arid regions (FAO and WWC, 2015).

2.1.3 Participation

Participation, as defined by the United Nations (2020), as a critical aspect of sustainable development, requiring the involvement of diverse stakeholders in decision-making processes and activities that promote social, economic, and environmental sustainability. Mati (2019) emphasizes that participation in irrigation schemes involves the active engagement of smallholder farmers in the planning, management, and utilization of irrigation services, with a focus on improving agricultural productivity and livelihoods. Hickey and Mohan (2017) view participation as creating spaces for meaningful engagement, where individuals and groups can contribute to decision-making processes and shape their own futures. Moreover, Cornwall (2016) defines participation as the process of taking part or sharing in an activity or decision-making process, with a focus on power relations and social justice.

2.2 SMALLHOLDER FARMERS DECISION TO PARTICIPATE AND NON PARTICIPATE IN IRRIGATION SCHEMES.

Assefa, E., Ayalew, Z., & Mohammed, H. (2022), researched how Ethiopian farmers' livelihoods are affected by small-scale irrigation. The authors employed descriptive statistics and an econometric model for analysis. Binary logit and Endogenous switching regression models were employed to identify the determinant of small-scale irrigation participation and its impact on farmers' livelihood respectively. The Binary logit model results indicate that age and age square of the household, own cultivated land, off-farm job participation, extension contact, distance from homestead to a nearly local market, distance from home to the scheme, and having an irrigation user neighbour are significant factors influencing farmers' decision to practice irrigation.

A similar study was also done by Geddafa, T., Abera, E., & Gedefa, F. (2021), to assess factors that determine smallholder farmers' participation and level of participation in small-scale irrigation practice in Gemechis district, West Hararghe Zone Ethiopia. The authors examined the factors that influence farmers' decisions to participate and the extent to which they employ small-scale irrigation techniques using the double hurdle (prohibit) model. Key findings from the double hurdle (prohibit) model showed that farmers' decisions to participate in small-scale irrigated agriculture were significantly influenced at different levels by the sex of household heads, household size, annual income, farm distance from the water source, access to extensions, and credit services.

Furthermore, the determinants impacting farmers' participation in smallholder irrigation schemes in Swaziland have been studied by Sithole, N. L., Lagat, J. K., & Masuku, M. B. (2014). Descriptive statistics and the prohibit model were employed as analytical tools. The research found that households' distance to the scheme, the age and occupation of the household head, farm size, availability to credit, and membership in other groups all have a substantial impact on participation in smallholder irrigation schemes. The study's main conclusion was that the participants' land sizes were bigger than those of the non-participants. The study also showed that factors such as farm size, age, the occupation of the family head, distance to the scheme, and membership in other groups had a substantial impact on household participation in smallholder irrigation schemes. However, the study found that the household head's decision to participate in irrigation schemes was unaffected by variables like sex, marital status, education level, household size, extension, market access, non-farm income, and animal ownership. The results also showed that there was a negative correlation between age and the decision to take part in smallholder irrigation systems.

Lastly, Asayehegn, K., Yirga, C., & Rajan, S. (2011), carried a study to determine the factors influencing Ethiopian smallholder farmers' participation in local irrigation projects. The study estimated the factors influencing small-scale irrigation schemes using analytical approaches like prohibit estimates and descriptive statistics. The findings of the analysis indicated that household health, income, gender, and access to market information were significant predictors of participating in irrigation systems. The study suggests that a household's decision to adopt

technology is significantly influenced by education. The research revealed that the number of irrigation users who finished nine years of schooling or more is double that of non-users.

2.3 IMPACT OF SMALL-SCALE IRRIGATION SCHEMES ON INCOME.

Muleta, G., & Girmay, G. (2021), conducted a study to determine the factors which influence small-scale irrigation on the income of households in Walmara district, Oromia, Ethiopia. Econometric data were analyzed using the logistic regression model and the propensity score matching approach. To calculate the propensity score, logistic regression was utilized. The results showed that small-scale irrigation had a considerable influence on household income, with irrigator households earning significantly more than non-irrigator households. According to the research, participation in small-scale irrigation can greatly increase household income.

A similar study was carried by T. Ghosal, S., & Yihdego, T. G. (2016),), to find out how small-scale irrigation affected rural households' income in Bambasi Woreda, Ethiopia. The authors employed descriptive statistics and the probit model as analytical tools. The results show that the income of small-scale irrigation is significantly influenced by several statistically significant variables, including gender, linear and nonlinear age, education, plot size, social position participation, extension service, access to credit, and total livestock unit.

Furthermore, Rahman, S (2014) conducted a similar study to investigate the impact of rural infrastructure on the decision between farm and non-farm operations in terms of revenue in Bangladesh. The author applied the bivariate Tobit model. By using a bivariate method, the model diagnostic indicates a considerable correlation between the decision to choose enterprises and other factors. In contrast to wealth, rural infrastructure has a substantial but opposite effect on business decisions. Additional significant factors that have differing degrees of impact include farm size, livestock resources, education, prior farming experience, and household assets.

Lastly, Beyan, A., Jema, H., & Adem, K. (2014) conducted a study to evaluate the effect of small-scale irrigation on farm household income in production in Girawa district, Eastern

Hararghe zone, Oromia, Ethiopia. Preliminary statistics and econometric models were employed for data analysis. Data were analyzed using preliminary statistics and econometric models. The logistic regression estimation of factors affecting participation revealed that age of household head, non-farm income, livestock size, size of cultivated land, distance between plot and irrigation scheme, mode of transportation, and participation of household heads in social organizations all had a significant impact on households' decision to participate in irrigation farming. The results demonstrated that irrigation involvement has a large, beneficial impact on farm household income.

2.4 BARRIERS AND OPPORTUNITIES OF SMALLHOLDER FARMERS IN PARTICIPATION IN IRRIGATION SCHEMES.

2.4.1 Opportunities.

Contribution to Food Security.

By boosting agricultural productivity and guaranteeing a steady supply of food, access to irrigation is essential to improving food security, particularly in areas vulnerable to droughts or unpredictable rainfall. Food security is improved at the family, community, and national levels when farmers utilize irrigation to grow surplus crops, diversify their farming practices, and increase their resilience to climate variability (FAO, 2012; You et al., 2010).

Implications for Agricultural Sustainability.

The sustainability of agriculture is significantly impacted by the increase in crop yields linked to irrigation. Although irrigation can increase food production and productivity in the short term, its sustainability over the long run depends on several variables, including water availability, effective water management techniques, the effects on the environment, and socioeconomic considerations (Steduto et al., 2012; Molden et al., 2007). To weigh the advantages of irrigation against any potential disadvantages, sustainable irrigation techniques including integrated water resources management, precision irrigation, and water-saving technology are crucial.

Increasing crop yields.

There are still ample opportunities to increase water use efficiency in smallholder farming, and the opportunity to raise crop yields with the existing technologies seems considerable (FAO, 2009b). provided the appropriate socio-economic incentives are in place, there are still ample gaps in yield that could be exploited (FAO, 2009b). In Africa where most crops have yet reached 70 to 80 of their biological yield potential, public investment in research, education, and extension can result in sizeable improvements (Lobell et al, 2009). Empowering smallholder farmers to increase yields will be the most important strategy to meet growing demand. In smallholder farming, there are still plenty of opportunities to improve water usage efficiency, and there appears to be a good chance that the current technology will increase crop yields (FAO, 2009b).

Higher Yields and Increased Income Opportunities.

Access to irrigation allows smallholder farmers to achieve higher and more consistent crop yields compared to rain-fed agriculture. This increase in productivity translates directly into greater income opportunities for farmers. With irrigation, farmers can produce larger quantities of crops and achieve multiple harvests throughout the year, resulting in higher revenues from crop sales (Fan et al., 2004).

Diversified Crop Production and Income Streams

Irrigation enables farmers to diversify their crop production beyond traditional rain-fed crops. By growing a variety of crops suited to different seasons and market demands, farmers can reduce the risks associated with mono-cropping and market volatility. Diversification also allows farmers to capture niche markets and command higher prices for speciality crops, thereby enhancing overall income (Randhawa et al., 2020).

Value-Added Opportunities

Increased crop yields and diversified production under irrigation create opportunities for value addition and agribusiness development. Farmers can process their crops into higher-value products such as processed foods, beverages, or handicrafts, which fetch higher prices in the market. Value addition not only increases farmers' income but also creates employment opportunities and stimulates local economic growth (Lowder et al., 2016).

Access to Markets and Market Linkages

Improved market accessibility and connections for smallholder farmers are frequently made possible by irrigation programs. Farmers can get higher prices and a wider client base by

participating in formal and informal markets outside of their local communities by using irrigation to produce surplus crops. Farmers may sell their produce at competitive prices when they have better market access, which boosts their income and enhances their financial stability (Mekonnen & Köhlin, 2008).

Poverty Reduction and Improved Livelihoods:

The revenue from irrigation-based agriculture significantly contributes to the improvement of smallholder farmers' livelihoods and the fight against poverty. Increased wages allow farmers to save for future security, invest in healthcare and education, and meet their fundamental requirements. Additionally, the longer-term reduction of poverty is facilitated by the enhanced resilience to unfavorable occurrences and less susceptibility to shocks brought about by the greater economic stability resulting from irrigation-based income (Shah et al., 2016)**Limited Access to Land and Water Resources:**

Smallholder farmers often face challenges in accessing land and water resources for irrigation due to land tenure issues, competition for water rights, and inadequate infrastructure for water delivery and storage. Limited access to suitable land and water sources constrains farmers' ability to participate in irrigation schemes and hampers their agricultural productivity (Snyder et al., 2019).

2.4.2 Barriers

High Initial Investment Costs:

Participation of smallholder farmers in irrigation schemes is severely restricted by the large upfront expenditures of building irrigation infrastructure, including pumps, pipes, canals, and water storage facilities. Many farmers are unable to embrace contemporary irrigation technologies and enhance water management techniques because they lack the financial means to invest in irrigation infrastructure and equipment (Sharma et al., 2018).

Lack of Technical Knowledge and Skills:

Smallholder farmers frequently lack the technical know-how and abilities needed to efficiently plan, run, and maintain irrigation systems. Farmers' capacity to maximize water usage efficiency is hampered by inadequate training and extension services on irrigation technology,

water management strategies, and agronomic approaches, which results in less-than-ideal crop yields and decreased profitability (Belay et al., 2017).

Water Scarcity and Competition:

Smallholder farmers in areas with limited water resources contend with fierce competition from a range of stakeholders, such as urban populations, industry, and other agricultural users. The lack of water makes disputes over its distribution and allocation worse, which makes it harder for irrigation projects to remain sustainable and results in unequal access to irrigation water (Biswas et al, 2008).

Environmental Degradation and Climate Change:

The participation of smallholder farmers in irrigation schemes is severely hampered by environmental deterioration and climate change. Improper irrigation techniques can lead to soil erosion, salinization, and waterlogging, which can lower land productivity and discourage farmers from investing in irrigation infrastructure. Moreover, altered weather patterns, such as a rise in the frequency and severity of floods and droughts, interfere with irrigation plans and make problems with water management worse (IPCC, 2014).

Policy and Institutional Constraints:

Smallholder farmers' participation in irrigation schemes is hampered by inadequate institutional support systems, bureaucratic obstacles, and regulatory frameworks. Farmers are discouraged from investing in irrigation equipment and implementing sustainable water management techniques by complicated regulatory procedures, ambiguous land tenure arrangements, and a lack of tenure security (Meinzen-Dick et al., 2019).

Gender and Social Inequities:

Women and other marginalized groups frequently have limited access to irrigation advantages and are unable to participate in irrigation schemes due to social injustices and gender differences. Women are deprived of irrigation-related resources, training, and extension services due to cultural norms, discriminatory practices, and low representation in decision-making processes. This results in persistent disparities in agricultural productivity and livelihoods (Mekonnen & Köhlin, 2008).

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2.5 CONCEPTUAL FRAMEWORK

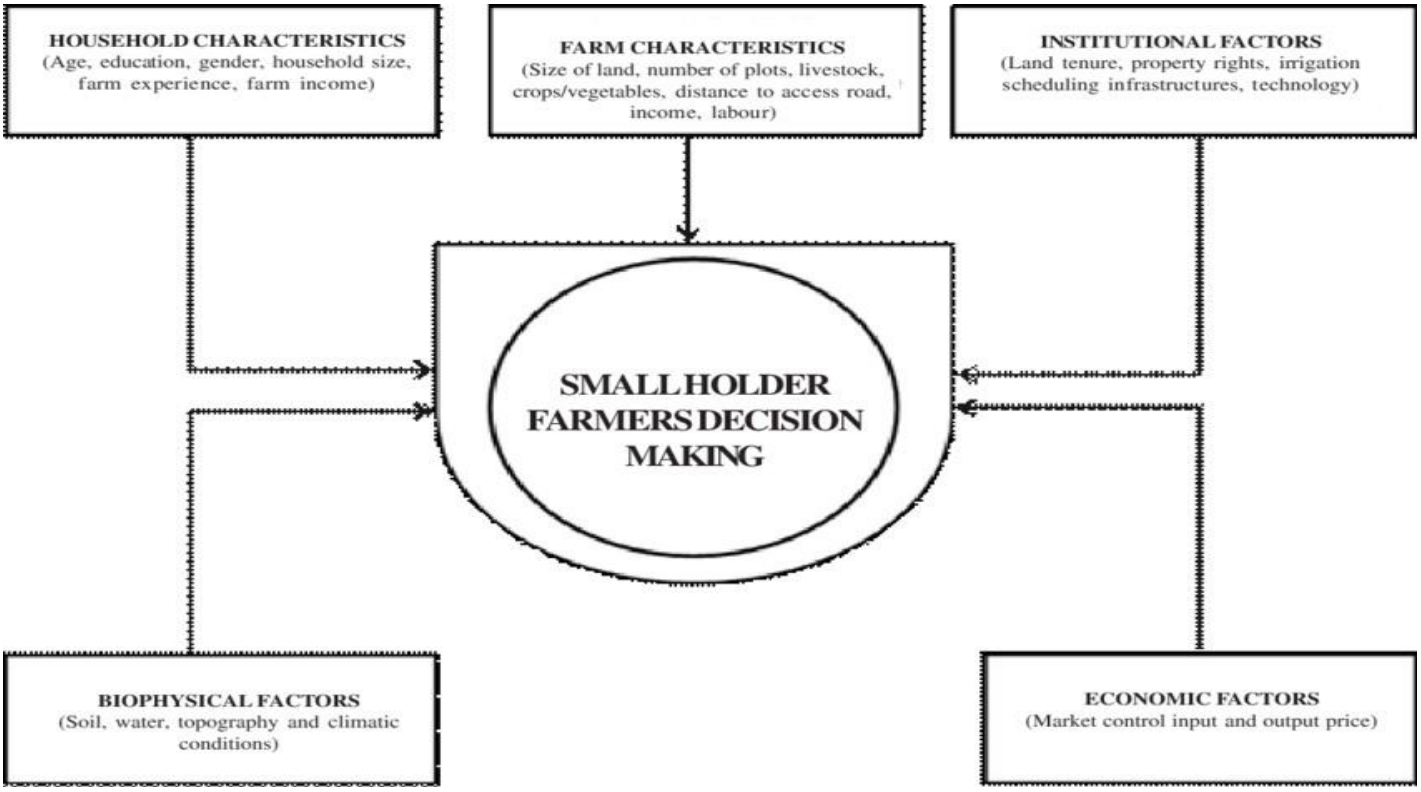

fig 1: Conceptual framework of factors influencing smallholder decisions in irrigation practices
Source: Author compilation 2012.

Household characteristics.

Age: Older farmers may have more experience, but younger farmers may be more open to innovation.

Education: higher education improves farming knowledge, decision-making, and ability to adopt new technologies.

Gender: Female-headed households face challenges (e.g, limited access to credit, land) but may also prioritize irrigation investments.

Farm experience: Experienced farmers may better manage irrigation and farming practices.

2.6 THEORETICAL FRAMEWORK

2.6.1 The Institutional Analysis and Development (IAD) Framework.

The IAD framework was developed by Elinor Ostrom and others and is a conceptual tool used to analyze how institutions, which are the rules, norms, and procedures that govern human behaviour, can influence the outcomes of social and economic activities. In the context of smallholder farmers' participation in irrigation schemes, the first component of the IAD framework involves analyzing the institutional arrangements that govern the irrigation scheme, including formal rules (e.g., laws, regulations, property rights) and informal norms and practices (e.g., customary water allocation mechanisms, community rules). By examining the institutional context, researchers can identify the roles and responsibilities of various actors (e.g., farmers, government agencies, water user associations) in decision-making and resource management. In the aspect of irrigation schemes, development analysis can help identify historical trajectories, policy reforms, and external interventions that have influenced the governance and management of irrigation water resources.

The IAD framework provides insights into how institutional arrangements influence farmers' participation in irrigation schemes. For example, Institutional rules and property rights: Clear and secure water rights can incentivize farmers to invest in irrigation infrastructure, adopt water-saving technologies, and actively participate in collective management efforts. Conversely, insecure property rights or conflicting rules may discourage farmer engagement.

The IAD framework diagram:

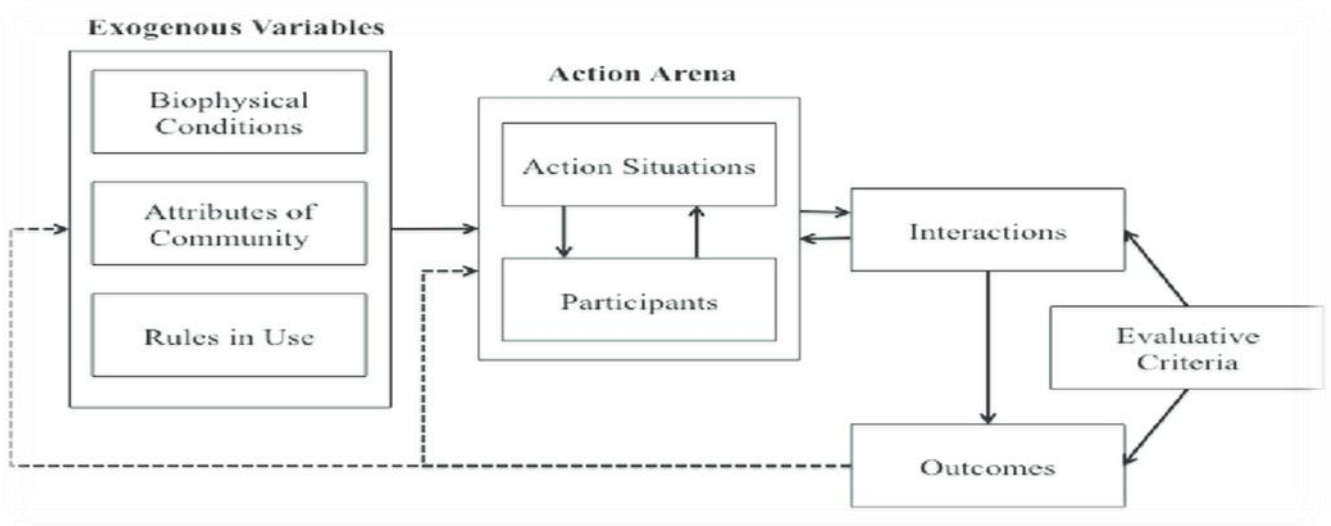

fig2: The Institutional and Development (IAD)Framework. (IAD) Framework (Schoon, 2015 after Ostrom et al., 1994, p. 37).

2.6.2 Diffusion of Innovation Theory

The Diffusion of Innovation Theory, developed by E.M. Rogers in 1962, describes how new ideas, behaviours, technologies, or goods spread through a population gradually, rather than all at once. The theory seeks to explain how, why, and at what rate new ideas and technology spread, and it has been widely applied in various fields including the agriculture sector. In the context of smallholder farmers' participation in irrigation schemes, the theory suggests that the diffusion of innovative irrigation practices among smallholder farmers may follow a pattern where the initial adoption occurs on the edge of the farming community. As early adopters demonstrate the benefits of innovative irrigation schemes, other farmers within their social networks may gradually become interested and start to participate actively in the adoption and implementation of these practices.

CHAPTER THREE
RESEARCH METHODOLODY

3.0 INTRODUCTION.

This chapter presents the research methodology employed to investigate the factors influencing smallholder farmers' participation in irrigation schemes in Mashonaland Central Province, Zimbabwe, A comprehensive understanding of the research design, data collection methods, and analytical techniques is essential to ensure the validity and reliability of the findings.

3.1 RESEARCH DESIGN

Primary data for this research study was collected using phone surveys, virtual interviews, direct observations, and group discussions. The researcher gathered secondary data from publications, journals, AGRITEX, and ARDA.

3.2 STUDY AREA

Mashonaland Central is a province of Zimbabwe. It has an area of 28,347km square and a population of 1,152,520 (2012 census), representing about 8.5% of the total Zimbabwe population. It typically receives about 120.82 millimetres (4.76 inches) of precipitation and has 129.73 rainy days (35.54% of the time) annually. Rainfall 750-1000mm per annum and associated with temperatures ranging from 20-30 degrees Celsius. Ecological regions 2 and 3 upper 4 and 5 are Lowveld with typical Savannah Climate. Mining gold and nickel platinum is done in the province. Crops such as tobacco, soya beans, citrus, cotton and small grains are grown in Mashonaland Central and also livestock production.

The researcher conducted the research study at Geluk Irrigation scheme Ward 21 in Matepatepa Mashonaland Central, Zimbabwe. The Geluk Irrigation scheme Ward 21 is an irrigation scheme under the Agricultural and Rural Development Authority (ARDA). It a group irrigation scheme.

It is an A1 farm growing both summer and winter crops such as maize and wheat under pivot irrigation, getting its water supply from Mazoe river.

The diagram below in (fig3) shows a map of Mashonaland Central, Province of Zimbabwe. The Gulek irrigation scheme is in Bindura District in Matepatepa. The Bindura district is shown on the map below

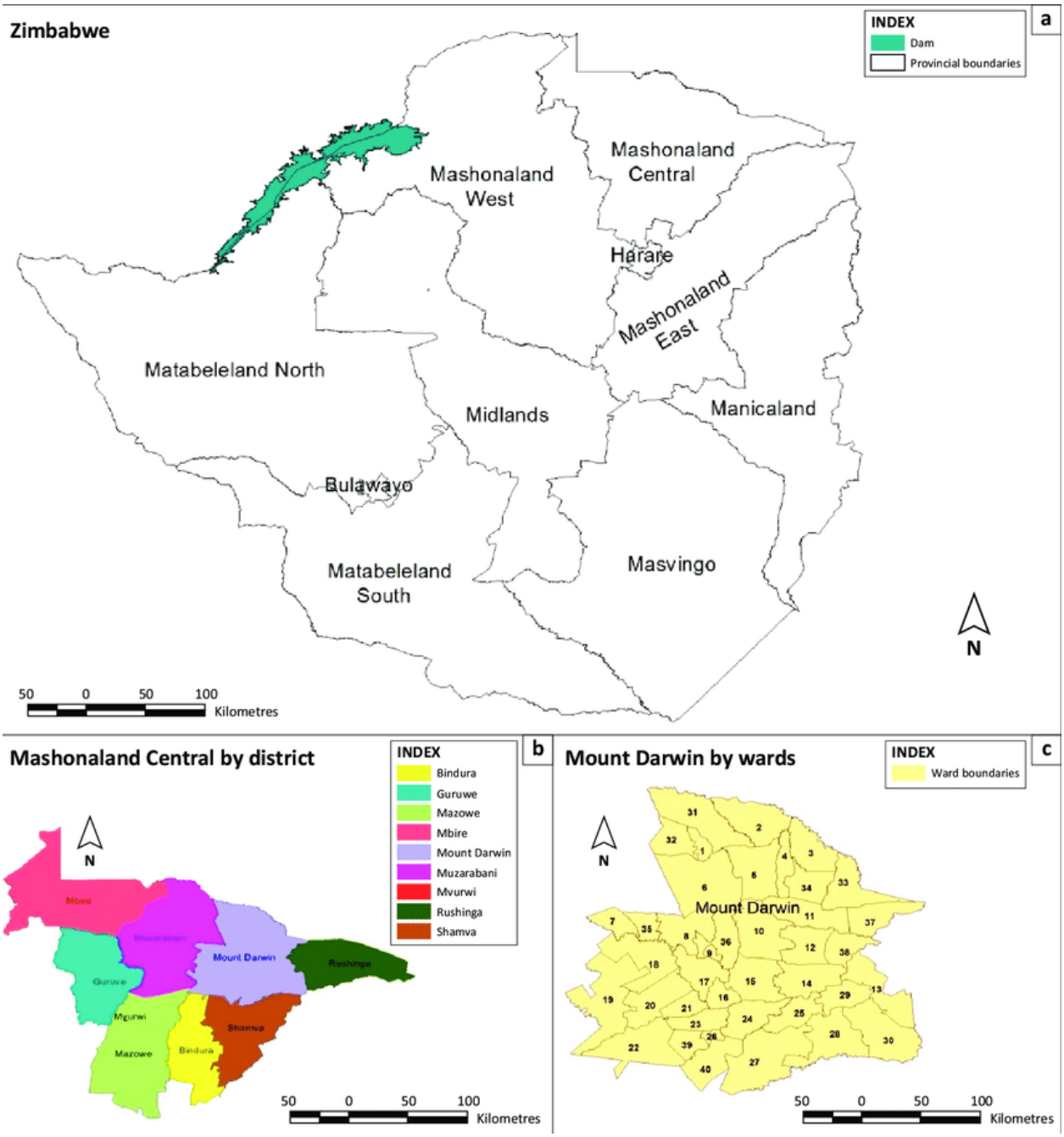

fig 3: Map of Mashonaland Central Province of Zimbabwe

Source: ZIMSTAT, 2013, Annual population and health statistics, Zimbabwe Government Printers, Harare.

3.3 TARGET POPULATION

Target population refers to the specific group of individuals that a research study or intervention aims to investigate or serve. In this research, the targeted population was the smallholder farmers participating in irrigation schemes in Mashonaland Central province, Zimbabwe and also non-participator representatives. The population that the researcher is going to use is the study population. In this research, the study case population would be the smallholder farmers in Mashonaland Central Province, Zimbabwe, who are participating (or not participating) in irrigation schemes.

3.4 SAMPLING METHODS

The researcher applied a cross-sectional household level survey data and multistage sampling was employed to select a sample of 82 households, whereby 68 were participates and 14 were non participates in Matepatepa Geluk irrigation scheme Ward 21 Mashonaland Central Province. The researcher was attached at ARDA, hence decided to conduct the research at one of ARDA's irrigation schemes which is Geluk irrigation scheme. Cluster sampling was used to select a representative group of clusters and sample farmers within those clusters.

To calculate the sample size, the researcher used 'Cochran's Formula' or 'Cochran's Sample Size Formula'.

The formula is as follows:

$n = (Z^2 * \sigma^2) / E^2$

Where:

n = required sample size

Z = Z-score corresponding to the desired confidence level (e.g., 1.96 for 95% confidence)

σ = population standard deviation (or estimated standard deviation)

E = desired margin of error (or maximum allowable error)

We want to find the sample size (n) when:

Z = 1.96 (for a 95% confidence level)

σ = 0.5 (assuming a population standard deviation of 0.5)

E = ? (we want to find the margin of error corresponding to a sample size of 82)

Rearranging the formula to solve for E:

E = √(Z^2 * σ^2 / n)

= √((1.96)^2 * (0.5)^2 / 82)

= √(3.8416 * 0.25 / 82)

= √(0.9604 / 82)

= √0.0117

≈ 0.108

So, a sample size of 82 corresponds to a margin of error of approximately 0.108 (or 10.8%).

Hence to find the sample size (n):

n = (Z^2 * σ^2) / E^2

= ((1.96)^2 * (0.5)^2) / (0.108)^2

= (3.8416 * 0.25) / 0.0117

= 0.9604 / 0.0117

≈ 82.02

3.5 DATA COLLECTION METHODS.

Data from one-on-one interviews, focus groups and phone surveys with participants and non-participant representatives were gathered using two semi-structured questionnaires for participants and non-participants. The survey was designed with multiple choice questions to which farmers were to respond within seven days to provide more detailed data. The questionnaire was drafted with several questions meant to be answered by smallholder irrigation participators and non-participant farmers within a week and returned for in-depth data

collection. Relevant secondary data was obtained from AGRITEX, ARDA, journals, articles and different farm irrigation schemes managers. The researcher applied both qualitative and quantitative method because it is the best analytical tool for both theoretical and empirical relationships between variables.

3.6 DATA ANALYSIS METHODS.

The Analytical Framework

Research	Type of data required	Analytical tool
To identify and assess the key factors influencing smallholder farmers deision to participate and non participate in irrigation schemes.	• Quantitative data including, demographic data, farm related data, irrigation scheme data, economic data. • Qualitative data including , barriers and opportunities associated with participation.	Binary logistic regression
To analyze the impact of smallholder farmers participate in irrigation schemes on income.	Qualitative and quantitative data	Linear regression model
To assess the barriers and opportunities associated with smallholder farmers participation in irrigation schemes.	Qualitative and quantitative data	Linear regression model

table 1: The Analytical Framework

3.6.1 Binary logistic regression formula.

Based on the research, the binary logistic formula for assessing smallholder farmers' decision to participate in irrigation schemes is as follows:

P = 1 / (1 + e^(-z))

Where:

- P is the probability of a smallholder farmer participating in an irrigation scheme (yes/no, 1/0)
- e is the base of the natural logarithm (approximately 2.718)
- z is a linear combination of the predictor variables, represented by:

Where:

-

- AGE, FARM_SIZE, DISTANCE, LIVESTOCK_OWNERSHIP, and HOUSEHOLD_SIZE are the predictor variables

Interpretation:

- The probability (P) represents the likelihood of a smallholder farmer participating in an irrigation scheme.
- The regression coefficients-

represent the change in the odds ratio for a one-unit change in the corresponding predictor variable.

3.7 DESCRIPTION OF EXPLANATORY VARIABLES.

Sex of household head: is a dummy variable (1 if male, 0 if female) that is intended to determine the difference in decision to participate in smallholder irrigation schemes between

males and females because they make the ultimate decisions in the households. Due to the ultimate decision-making, men and women are likely to have different decisions about whether or not to participate in small-holder irrigation projects. However, women are rarely allowed to participate in land-related activities since they are frequently discriminated against and preoccupied with other home duties. Conversely, women can face discrimination in obtaining land and the probability of them participating is very low.

Age: is a continuous variable. Age and involvement in irrigation programs and other agricultural technology were found to be positively correlated in earlier empirical research. Although younger household heads are more willing to adopt new ideas than older ones, they are usually more interested in other forms of employment than farming. Therefore, the direction of the relationship between the household head's age and irrigation scheme membership was not hypothesized in this study.

Education: is a continuous variable that represents years spent in formal education. The likelihood that a individual will be willing to participate is also correlated in both directions with education. It is hypothesized that education level has a positive impact on participation since it allows an individual to make independent decisions and act on them, as well as increases the tendency to cooperate with others and participate in group activities.

Household size: is a continuous variable that shows how many individuals share a home and a meal. It is anticipated that this variable will increase farmers' participation . The size of the household complements the work done by the household heads on the farm and acts as a type of family labour (Martey. et., al 2013). The family head has the chance to share responsibilities and free up time for other developmental pursuits thanks to the availability of family labour. Furthermore, the demand for outside assistance arises from the fact that larger households spend more on food and other necessities.

Farm size: comprises the entire area of both irrigated and non-irrigated land owned by the household. This continuous variable is thought to positively impact the household's decision to take part. More acreage will need better, higher-yielding seed kinds for household heads.

Off-farm income is anticipated to have a negative correlation with the likelihood of participating. In small holder irrigation schemes, the head of the household with an off-farm income might not have much time to participate in farming activities.

Livestock ownership. is a continuous variable with which a negative relationship is anticipated. Due to the time commitment involved in both livestock farming and vegetable cultivation, households that focus more on raising animals may not perceive the need to produce a lot of vegetables.

Credit availability is crucial for purchasing inputs by small-scale farmers. By enabling farmers to obtain financing, they may boost their output and get beyond financial barriers to take part in development initiatives that directly affect their livelihoods. A positive link is theorized because this variable is a dummy, with 1 denoting access to loans for farmers and 0 otherwise. The farmers at Gulek irrigation scheme, receive credit from AFC, PIP, contractors and CBZ

Distance to the irrigation scheme: is a continuous variable which is hypothesized to have a negative relationship. Households near the irrigation scheme are expected to participate more as compared to far households

Extension services. The farmers receive extension services from tAGRITEX, ARDA, and private extensionist.

3.8 Ethical considerations

Ethical considerations are crucial when it comes to participation, requiring informed consent, inclusivity, and addressing power dynamics to ensure diverse voices are represented and marginalized groups aren't excluded. Privacy and confidentiality must be maintained, especially when sensitive information is shared, and fairness and equity are essential to distribute benefits and resources justly. Transparency is vital to open decision-making processes to scrutiny, and

cultural sensitivity is necessary to respect and acknowledge participants' cultural backgrounds and values. By considering these factors, participation can be meaningful, inclusive, and respectful, promoting accountability, trust, and empowerment among all individuals involved.

CHAPTER FOUR
RESULTS AND DISCUSSIONS

4.0 INTRODUCTION

This chapter presents the findings of the study on smallholder farmers' participation in irrigation schemes in Gulex Irrigation Scheme Ward 21 in Mashonaland Central Province, Zimbabwe. The chapter is organized into several sections, each of which addresses a specific research question or objective. The results are presented clearly and concisely, using tables, figures, and graphs to facilitate understanding.

4.1 DEMOGRAPHIC

The following demographic analysis provides an overview of the characteristics of the participants in the irrigation scheme. The demographics explored included gender, education level and age.

4.1.2 Education level

The findings in this research study, indicates that the majority of smallholder farmers (80%) have a moderate level of education (secondary), which may provide them with basic knowledge and skills to manage irrigation schemes. A significant minority (16%) have advanced education (tertiary), which may enable them to adopt more innovative and efficient irrigation practices. A small proportion (4%) have only primary education, which may indicate a need for additional training or support to fully benefit from irrigation schemes. This is shown in the (Fig 4) below

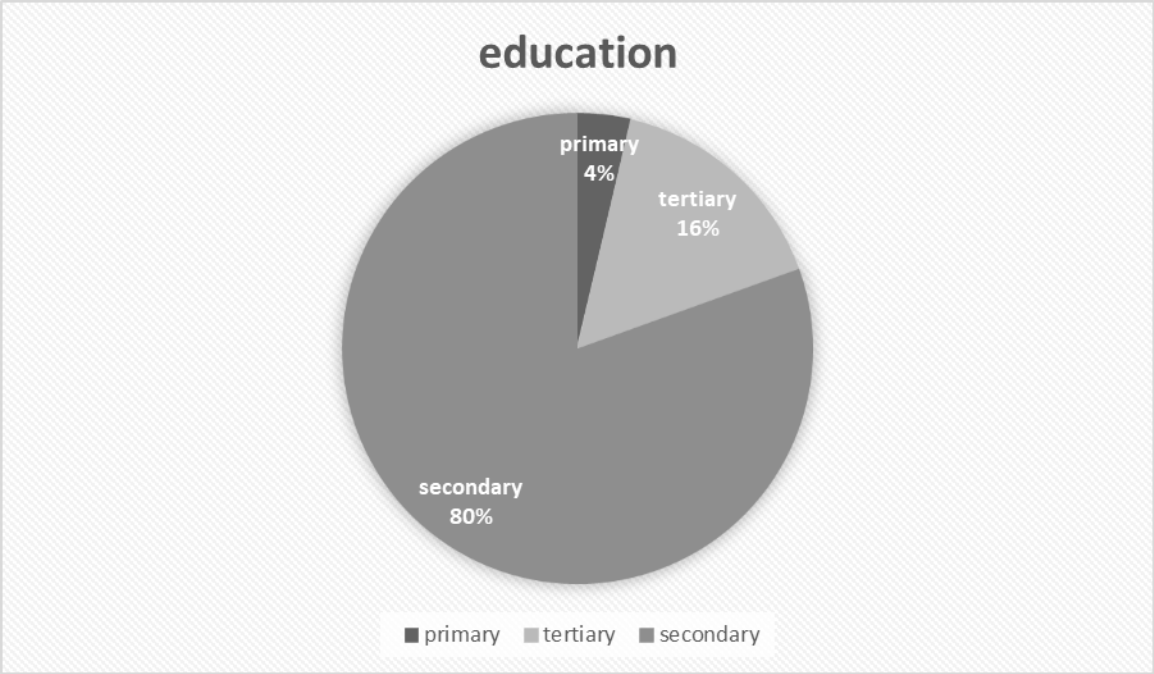

Fig4: summary of education level of smallholder farmers participating in irrigation scheme at Gulek Irrigation Scheme.

4.1.3 Age group under the survey.

The research study indicates that the majority of farmers (56.1%) are middle-aged (41-59 years), indicating a dominant group with established carres and significant experience. This group likely holds significant influence and decision making power in the farming community. On the other hand, younder farmers (25-40 years) make up a substantial proportion (41.5%), indicating a promising arrival of new talent and ideas. Older farmers (60-72 years), comprising only 2.4% of the total, suggesting that few farmers continue to work beyond the age of 60, potentially leading to a loss of valuable knowledge and expertise. This is shown in the(Fig5) below:

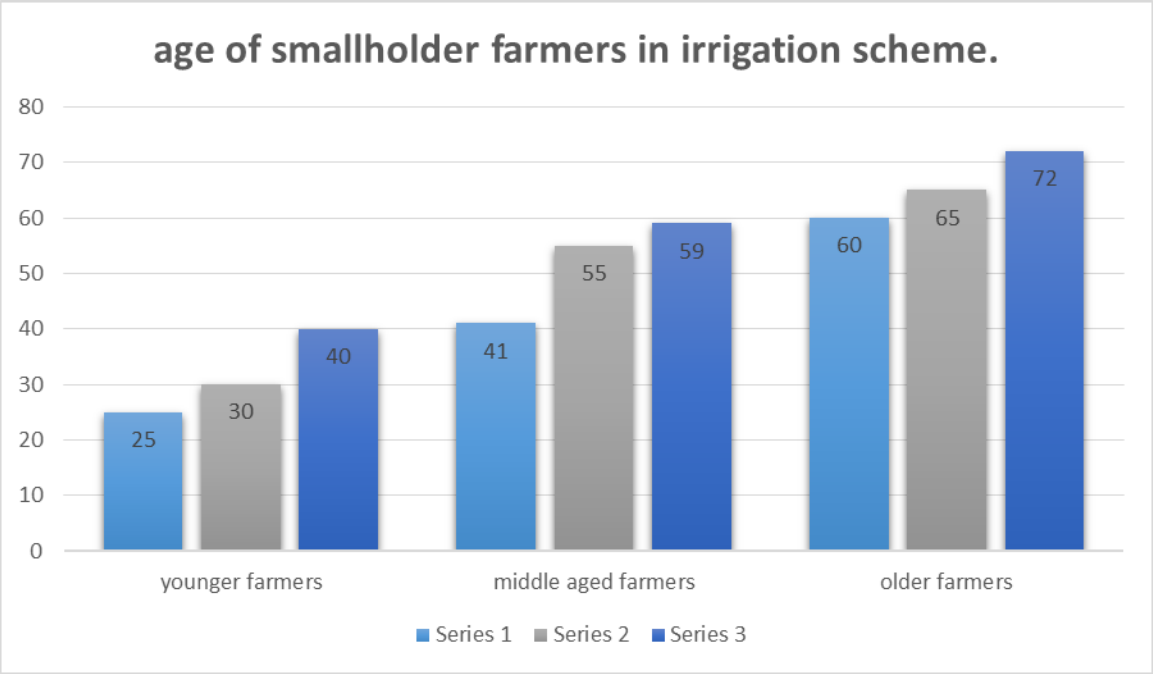

Fig5: range of age group under the survey.

4.1.4 Gender inclusivity

The research study indicated that the majority of farmers (63%) are male, a significant proportion of farmers (37%) are female. Men make up a larger share of the farming community, but women are still a substantial part of the group. There may be gender-specific challenges or opportunities that need to be addressed in supporting farmers. This is shown in(Fig6) below:

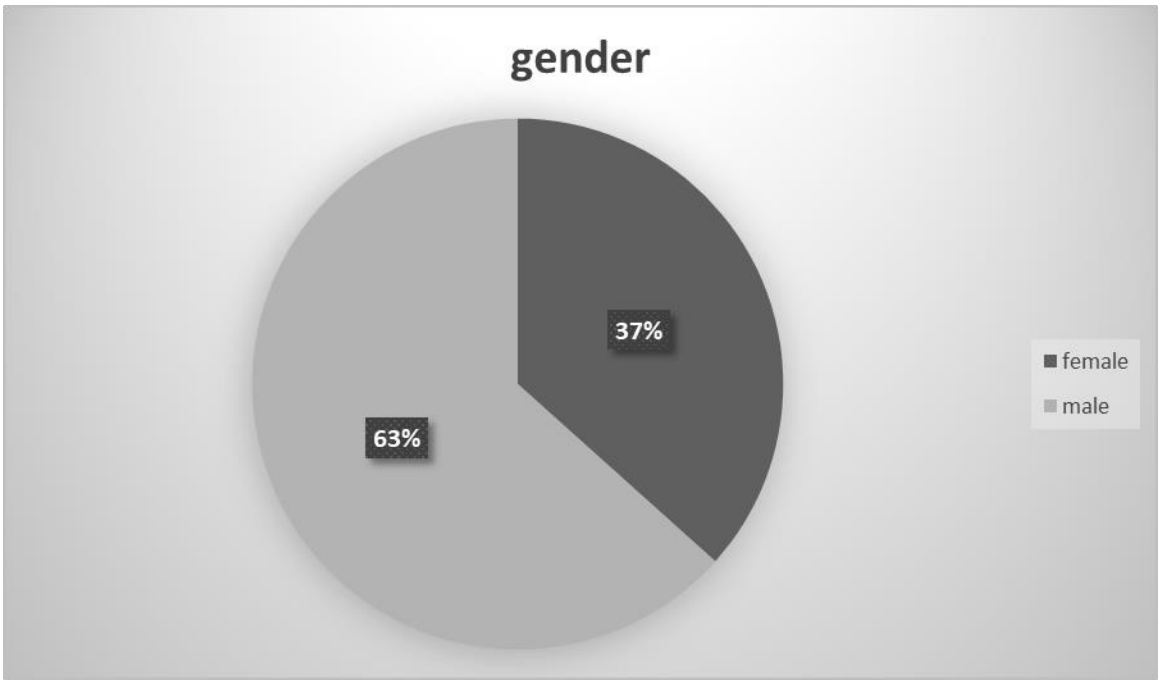

Fig6: the selected gender under the study.

4.2 BARRIERS AND OPPORTUNITIES ASSOCIATED WITH SMALLHOLDER FARMERS ON PARTICIPATING IN IRRIGATION SCHEMES.

The researcher applied linear regression to provide a comprehensive understanding of the barriers and opportunities associated with smallholder participation in irrigation schemes. The results indicate barriers such as age, distance, household size and farm size. Opportunities include livestock ownership, market access, farm equipment, income and credit.

Barriers

Table 2 in this study, reveals that distance to the irrigation scheme (OR=0.274, $p<0.05$) and limited education (OR=0.33, $p<0.05$) are significant barriers associated with smallholder farmers' participation in irrigation schemes, consistent with previous findings (Kadigi et al., 2012; Nkhoma, 2011). Distance to the irrigation scheme is a significant barrier to participation, as it increases transportation costs and reduces accessibility to the scheme (Kadigi et al., 2012). Limited education is also a significant barrier, as it limits farmers' understanding of irrigation technologies, management practices, and their ability to adapt to changing conditions (Nkhoma,

2011). Specifically, the odds of participating in irrigation schemes decrease by 72.6% for each kilometer increase in distance and by 67% for each year increase in education.

Opportunities.

On the other hand, extension services (OR=19.18, $p<0.05$), larger farm size (OR=12.20, $p<0.05$), access to credit (OR=1.849, $p<0.05$), are significant opportunities that can enhance participation.

Building on previous findings (Inocencio et al., 2007; Rosegrant & Perez, 1997). The finding that Credit is an opportunity for increasing irrigation scheme participation, with an Exp(B) value of 1.85, is supported by previous research. Studies have consistently shown that access to credit is a significant factor in farmers' decision to adopt irrigation technologies (Kumar et al., 2018; Mishra et al., 2019), enabling them to overcome financial barriers and invest in irrigation infrastructure (Ghimire et al., 2017). Similar research has found that a one-unit increase in credit score or access to credit leads to an increase in irrigation scheme participation (Sahoo et al., 2020), and a review of agricultural credit research found a positive correlation between credit access and agricultural productivity, including irrigation investments (Oluwatayo et al., 2020). These studies validate the positive association between credit and irrigation scheme participation, strengthening the argument and providing context for the results.

The analysis reveals that extension services and larger farm sizes significantly influence smallholder farmers' participation in irrigation schemes. Specifically, farmers receiving extension services are approximately 19 times more likely to participate (OR=19.18, $p<0,05$), underscorimg the critical role of knowledge amd support in enhancing irrigation adoption.

Similarly, larger farm size sizes increase participation by about 12 times (OR=12,20, $p<0,05$), suggesting economies of scale in irrigation investment, These findings align with previous research demonstrating the positive impact of extension services on farmers' productivity and technology adoption (Kassie et al., 2018; Singh et al., 2019). Additionally, studies have consistently shown that larger farm sizes are associated with higher irrigation technology adoption rate (Kumar et al., 2017; Dhakal et al., 2019). This research results emphasize the importance of targeted interventions, such as strengthening extension services and promoting

efficient land management practices, to enhance smallholder farmers' participation in irrigation schemes and improve their overall livelihoods.

Factors	B	Standard error	Wald chi square test	sig	Odds ratio
Education level	**-3.41**	**3.04**	**1.25**	**0.26**	**0.03**
Distance to the scheme	**-1.30**	**1.73**	**0.56**	**0.45**	**0.27**
Access to extension services	**2.95**	**3.00**	**0.967**	**0.33**	**19.18**
Access to credit	**0.619**	**2.452**	**0.063**	**0.802**	**1.849**

table2: barriers and opportunities associated with smallholder participation in irrigation.

4.3 ANALYZING THE DECISIONS OF SMALLHOLDER FARMERS IN PARTICIPATING AND NON PARTICIPATE IN IRRIGATION SCHEMES.

In investigating smallholder farmers' decision to participate and non participate in the irrigation scheme, the researcher applied binary logistic model. The model summary (Table 3), indicates a good fit, with a relatively low -2 Log Likelihood value of 15.91, suggesting that the observed values are well-predicted by the model. The Cox and Snell R Square value of 0.51 reveals that approximately 51% of the variance in the decision to participate in irrigation schemes is predictable from the independent variables, while the Nagelkerke R Square value of 0.86 indicates that about 86% of the variance is predictable when considering the number of predictors and sample size. Overall, the model effectively explains a substantial proportion of the variation in the outcome variable, confirming that the independent variables, such as credit and extension services, are strong and relevant predictors of farmers' decisions to participate in irrigation schemes.

-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
15.91a	0.51	0.86

table3: summary of the binary logistic analysis of participation and non participates

Based on the model summary statistics, the significant vatiables influencing smallholder farmers' decision to participate in irrigation schemes are; access to credit, availability of water, household income, farm size, and extension services. These variables have a statistically significant relationship with the decision to participate in irrigation schemes, meaning that changes in these variables are likely to influence the outcome. The other variables, namely; household size, marital status , farm animals and distance may not have a significant impact on the decision to participate in irrigation schemes.

Under (Table 4) below; extension services (19.18): The odds of participating in irrigation schemes are 19.18 times higher for smallholder farmers who receive extension services compared to those who do not. This means that receiving extension services increases the likelihood of participation by about 1918%. The positive effect indicates that farmers who receive support and guidance through extension services are more likely to participate in irrigation schemes as extension services can provide information, training, and resources to help farmers adopt new technologies like irrigation systems. This finding is consistent with previous research that was carried by Geddafa, T. (2021). According to Geddafa, T. (2021), access to extension services is a significant factor influencing farmers' participation in smallholder irrigation schemes. The study found that farmers who have access to extension services are more likely to participate in irrigation schemes, as it enables them to receive valuable information, guidance, and support.

Credit (1.85): Smallholder farmers with access to credit have odds of participating in irrigation schemes that are 1.85 times higher than those without access. This means that access to credit increases the likelihood of participation by about 85%. The finding that credit is a significant

variable in the decision to participate in irrigation schemes is supported by previous research, which has consistently shown that access to credit is a critical factor in farmers' decision to adopt irrigation technologies (Kumar et al., 2018). Studies have identified credit constraints as a major barrier to irrigation investment among smallholder farmers (Mishra et al., 2019), and have found that access to credit increases the likelihood of irrigation adoption (Ghimire et al., 2017). Additionally, research has demonstrated a positive correlation between credit access and irrigation investment, as well as agricultural productivity (Oluwatayo et al., 2020).

The results show that farm size has a positive and significant effect on the decision to participate in irrigation schemes, with a coefficient of 12.20, indicating that for every unit increase in farm size, the odds of participating in irrigation schemes increase by a factor of 12.20. This finding is consistent with previous research, which has shown that larger farms are more likely to adopt irrigation technologies due to economies of scale and better access to resources (Kumar et al., 2018). Studies have also found that farm size is a significant determinant of irrigation adoption, with larger farms being more likely to participate in irrigation schemes (Mwangi et al., 2017), and that smallholder farmers face barriers to entry in irrigation schemes, including limited access to credit, technology, and markets (FAO, 2017). Additionally, irrigation adoption has been linked to farm size, with larger farms being more likely to adopt irrigation technologies to improve productivity and income (Mujeri et al., 2017).

The finding of Exp(B) = 3.25 for household income indicates that higher-income households are more likely to participate in irrigation schemes, with a unit increase in household income increasing the odds of participation by a factor of 3.25. This suggests that household income is a significant determinant of irrigation adoption, consistent with previous research (Lefore et al., 2019; Mujeri et al., 2017). Higher-income households are better able to overcome financial constraints and access credit, technology, and other resources that facilitate irrigation adoption (Kumar et al., 2018). This finding supports the notion that access to irrigation is often limited by financial constraints, and that households with higher incomes are more likely to participate in irrigation schemes (FAO, 2017). Overall, the result highlights the importance of household income in the decision to participate in irrigation schemes, with higher-income households being more likely to adopt irrigation technologies to improve productivity and income.

The finding of Exp(B) = 1.86 for water access indicates that having access to water increases the odds of participating in irrigation schemes by a factor of 1.86, suggesting that water access is a significant determinant of irrigation adoption. This is consistent with previous research, which has shown that access to water is a critical factor in irrigation adoption (Mwangi et al., 2017). Studies have found that farmers who have access to water are more likely to adopt irrigation technologies, as it reduces the risk of crop failure and increases crop yields (Kumar et al., 2018). Additionally, access to water has been shown to be a key driver of irrigation adoption, particularly in areas where water scarcity is a major constraint (Lefore et al., 2019). This finding supports the notion that water access is essential for irrigation adoption, and that farmers who have access to water are more likely to participate in irrigation schemes to improve their agricultural productivity and income.

Variable	**B**	**standard error**	**wald**	**degree of freedom**	**sig**	**Exp(B)**
Credit	**0.612**	**2.45**	**0.06**	**1**	**0.80**	**1.85**
Water access	**0.62**	**2.41**	**0.07**	**1**	**0.80**	**1.86**
Extension service	**2.95**	**3.00**	**0.97**	**1**	**0.33**	**19.18**
Farm size	**2.50**	**1.13**	**4.91**	**1**	**0.03**	**12.20**
Household income	**1.18**	**2.57**	**0.21**	**1**	**0.65**	**3.25**

table4: decision 0f smallholder farmers to participate in irrigation schemes

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4.4 IMPACT OF SMALLHOLDER IRRIGATION SCHEMES ON INCOME.

The regression analysis reveals a statistically significant positive relationship between smallholder farmers' participation in irrigation schemes and their income, suggesting that participation in irrigation schemes is associated with an increase of 0.64 units in income, holding all other factors constant. This relationship is strongly significant, with a p-value of 0.00, indicating that the association is unlikely to be due to chance. The findings of this study (Table 5), are consistent with other research that has investigated the impact of irrigation schemes on smallholder farmers' income, such as Mhembwe et al. (2019) who found that small-scale rural irrigation schemes can significantly transform the lives of rural farmers through earning increased reliable income from farming, and Muzerengi and Mapuranga (2017) who noted that small-scale irrigation schemes in many less developed countries, particularly in Africa, were initiated mainly to boost agricultural production and reduce farmers' dependency on unpredictable rainfall. Moreover, examples of successful irrigation schemes, such as the Chitora irrigation scheme in Mutoko district, Zimbabwe, have demonstrated the potential of irrigation schemes to reduce food insecurity, malnutrition, and poverty, and promote economic empowerment of local people, as highlighted by Hussain and Hanjra (2014).

Model	**unstandardized coefficients**		**standardized**	**t**	**p-value**
coefficients					
B	**Std Error**	**Beta**			
Income	**0.21**	**0.10**		**2.17**	**0.03**
Participation	**0.64**	**0.11**	**0.55**	**5.90**	**0.00**

table5: impact of participation on income.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.0 INTRODUCTION

Smallholder farmers' participation in irrigation schemes is crucial for improving agricultural productivity, food security, and livelihoods in Mashonaland Central Province, Zimbabwe. However, various barriers and opportunities exist that influence their participation. By addressing the barriers and seizing the opportunities, this chapter provides insights into the ways to promote inclusive and sustainable irrigation development that benefits smallholder farmers and contributes to agricultural transformation in Mashonaland Central Province, Zimbabwe.

5.1 MAIN FINDINGS OF THE STUDY

- Factors influencing participation include access to credit, farm size, extension service, distance and educational levels
- Smallholder farmers face various challenges in participating in irrigation schemes, including limited access to credit; long distance from home to the scheme, restriction to extension services, lack of training, and inadequate water for irrigation to invest in irrigation infrastructure and technology.
- Benefits of irrigation include increased crop yields, improved food security, and increased income.

5.2 RECOMMENDATIONS

5.2.1 Policy and Regulations Reforms.

To address the barriers and challenges faced by smallholder farmers in accessing irrigation schemes, the following policy and regulatory reforms are recommeneded:

- Prioritize smallholder farmers' access to irrigation infrasture.

Smallholder farmers face challenges in accessing irrigation infrastructure, which limits their productivity. To address this, the government should allocate more resources for example finding equipment to build irrigation systems that benefit smallholder farmers. This includes building new irrigation schemes or upgrading existing ones to serve smallholder farmers. The

goal is to increase smallholder farmers' access to reliable water sources, improving their crop yields and livelihoods.

- The government needs to review and revise policies such as the Zimbabwe National Water Policy (2019) to ensure smallholder farmers have priority access to irrigation infrastructure. The revised Zimbabwe National Water Policy (2019) will ensure that at least 50% of irrigation infrastructure development funds are allocated to smallholder farmer projects.

- Develop inclusive regulatory frameworks.

The current regulatory framework does not adequately address the needs of smallholder farmers. The government should update laws and regulations to ensure fair water distribution and access for smallholder farmers. This could include establishing water user associations or cooperatives that represent smallholder farmers' interests. The goal is to ensure smallholder farmers have a voice in water management decisions and receive a fair share of water resources.

- The Zimbabwe Water Act (1998) should be revised to include a section that promotes equitable water distribution for example water allocations shall be based on equitable principles, prioritizing smallholder farmers' needs during times of water scarcity.

- Establish farmer-friendly institutions.

Smallholder farmers require support services to improve their productivity. The government should establish institutions that provide support services to smallholder farmers, such as training, extension services and credit facilities. This institutions should be accessible, affordable, and responsive to smallholder farmers' needs. The goal is to enhance smallholder farmers' productivity and livelihoods through capacity building and support. The Agricultural Marketing Authority (AMA) Act (2019) should be revised to establish a farmer-friendly institution that provides training and credit facilities to at least 500 smalholder farmers annually.

5.2.2 Capacity Building and Training Programs.

Capacity building and training programs refer to initiatives designed to enhance the skills, knowledge, and abilities of individuals or organizations to perform their tasks more effectively.

In the context of smallholder farmers, capacity-building and training programs aim to improve their agricultural productivity, efficiency, and sustainability.

- Agricultural extension services.

The government should provide one-on-one training and advice by agricultural experts to farmers on their forms. These services include guidance on crop selection, soil preparation, fertilizer application, pest management and irrigation techniques. This will help farmers to identify and solve problems, hence improving crop yields and quality.

- Workshops and seminars.

The government and other sectors should provide farmers with group training sessions where farmers learn from experts and share experiences with other farmers. Farmers should have workshops on topics like sustainable agriculture, climate-resilient farming, and market access.

- Training on technology adoption.

The government and other sectors should educate farmers on the use of precision agriculture tools, such as drones for crop monitoring and spraying, and mobile apps for farm management and market access. This will hence help farmers improve efficiency, productivity, and decision-making.

- Business skills training.

Teaching farmers essential business skills such as marketing and sales strategies, record keeping and accounting, financial management and budgeting, entrepreneurship and innovation. This helps farmers to manage their farms as business, improving profitability and sustainability.

- Leadership and governance training.

Building capacity for farmer organizations and cooperatives, including leadership and management skills, governance and decision-making processes, communication and conflict resolution, strategic planning and visioning. This helps farmer organizations and cooperatives become more effective and sustainable.

5.3 SUMMARY

This study investigated factors influencing smallholder farmers' participation in irrigation schemes in Mashonaland Central Province, Zimbabwe. Employing a mixed-methods approach, combining surveys, interviews, and observational data, the research identified key factors affecting participation. Data collection involved a cross-sectional household-level survey, multistage sampling (82 households, 68 participants, 14 non-participants), and secondary data from AGRITEX and ARDA.

The findings revealed that age, farm size, income, distance to the scheme, access to credit, and extension services significantly influence participation. Notably, receiving extension services increases the likelihood of participation by 19.18%, while farm size positively affects participation (odds increase by a factor of 12.20). However, smallholder farmers face barriers, including limited water access, lack of credit, inadequate technical knowledge, ineffective extension services, and challenges in accessing markets, managing water use, and adapting to climate change.

To address these challenges, the study recommends providing affordable credit and financing options, offering training and capacity-building programs, improving access to water and irrigation technologies, enhancing extension services and farmer support, promoting market access and value chain development, and developing climate-resilient irrigation schemes. Additionally, involving smallholder farmers in planning and management and promoting gender equity and social inclusion are crucial for effective and sustainable irrigation schemes.

The study's results have important implications for policy and intervention strategies aimed at promoting sustainable agricultural development in Zimbabwe. By understanding the complex factors influencing smallholder farmers' participation in irrigation schemes, stakeholders can design targeted interventions to improve productivity, income, and food security

5.4 CONCLUSION

In conclusion, the findingsa of this research demonstrate that smallholder farmers face significant barriers to participation, including limited access to credit, restricted access to extension services, and long distances to the irrigation scheme. However, despite these challenges, irrigation schemes have the potential to significantly improve the livelihoods of smallholder farmers and contribute to food security and poverty reduction.

By implementing the recommendations, smallholder farmers can be empowered to take full advantage of irrigation schemes, leading to improved agricultural productivity, food security, and poverty reduction. Ultimately, this research highlights the importance of prioritizing smallholder farmers' needs and concerns in irrigation scheme development and management. By doing so, we can build more sustainable, equitable, and productive irrigation systems that benefit both farmers and society as a whole.

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APPENDIX

IRRIGATION SCHEME PARTICIPATION QUESTIONNAIRE

AN INVESTIGATION ON THE SMALLHOLDER FARMERS PARTICIPATING IN IRRIGATION SCHEMES. THE CASE STUDY OF GULEK FARM WARD 21 MATEPATEPA BINDURA, MASHONALAND CENTRAL PROVINCE, ZIMBABWE.

I am a Bindura University student doing a bachelor's honours degree in Agricultural Economics and Management, researching and investigating smallholder farmers participating in irrigation schemes in Gulek Irrigation Scheme in Matepatepa District. The purpose of this questionnaire is to gather information about your experiences, perceptions, and practices related to irrigation schemes. Your responses will help us better understand the factors that influence smallholder farmers' participation in irrigation schemes and inform strategies to improve agricultural productivity and livelihoods in the region. Your participation is voluntary, and your responses will be kept confidential.

Date of interview……..…/……/2024

Name of Interviewer……..

Ward No……..

Name of respondent……

Section 1: Demographic Questions

Please tick in the space provided

1.1 Gender

Female	Male

1.2Age

18-25 years	
26-35 years	
36-45 years	
46-55 years	
56 years and above	

1.3 **education level**

primary	
secondary	
tertiary	
Others please specify	

Section 2: Farm information

2.1 Farm size (hectares)

1-3	

4-7	
8 and above	

2.2 Land ownership

Own the land	
Rent the land	
Other please specify	

2.3 Do you have access to credit?

Yes	
No	

2.4 Do you have access to the irrigation water?

Yes	
No	

2.5 Distance from home to the irrigation scheme.

Below 1 km	
2-4km	
4km and above	

Section 3: Extension services

3.1 Do you have access to or receive extension services in the past 12 months?

Yes	
No	

3.2 If yes, what type of services did you receive? (check all that apply)

Training	
Demonstrations	

Advisory services	
Other please specify	

Section 4: Household income.

What is your household annual income?	What percentage of your household income comes from farming?

Section 5: Participation in irrigation scheme.

5.1 Do you participate in an irrigation scheme?

Yes	
No	

5.2 If yes what motivated you to participate? (check all that apply)

Increased crop yields	
Improved crop quality	
Increased income	
Reduced drought risk	
Other (please specify)	

5.3 what benefits have you experienced as a result of participation in the irrigation scheme? (check all that apply)

Increased crop yields	

Improved crop quality	
Increased income	
Reduced drought risk	
Other (please specify)	

5.4 Has participation in the irrigation scheme increased your income?

Yes	
No	

5.5 what challenges have you faced as a result of participating in the irrigation scheme? (Check all that apply).

High operation and maintenance costs	
Limited access to water	
Conflicts with other water users	
Other (please specify)	

Section 6: Support for Irrigation Schemes

6.1 Have you received any support for your irrigation scheme?

Yes	

No	

6.2 If yes, what type of support have you received? (check all that apply)

Financial assistance	
Technical assistance	
Training	
Equipment and infrastructure provision	
Market access support	
Other (please specify)	

6.3 From which sources have you received support? (check all that apply)

Government	
NGOs	
Private companies	
Farmer organizations	

Other (please specify)	

Section 7: Recommendations

1. What recommendations do you have for improving the irrigation scheme?.....

.....

.....

2. What support services or training would you like to receive to improve your irrigation scheme

experience?.....

.....

.....

3. Do you have any suggestions for how to improve the overall management and sustainability of the irrigation scheme?.....

.....

....

Thank you for your participation and contributions to the study.