AN INVESTIGATION OF FARMERS' LEVEL OF PARTICIPATION IN REVITALIZED SMALLHOLDER IRRIGATION SCHEMES IN THE KWAZULU-NATAL PROVINCE, SOUTH AFRICA

by

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ABSTRACT

Agricultural irrigation development should be considered an essential cornerstone for food security, economic growth, and adaptation to climate change. Effective irrigation management contributes substantially to many Sustainable Development Goals (SDGs). Nevertheless, current irrigation schemes in Sub Saharan Africa perform below expectations, resulting in unreliable, inadequate, and inequitable access to irrigation water. Due to this, Sub-Saharan Africa is hindered from reaching its developmental goals in the irrigation sector. Various researchers identified five major limitations of African irrigation schemes, i.e., high capital costs, exaggerated and overestimated gains, a lack of understanding of the social reality, the absence of management skills and responsible human resources, and the neglect of operations and maintenance. Furthermore, most studies on African irrigation schemes also identified an overly centralised and bureaucratic management system as a major limitation. Thus, management transfer became a key strategy. Management transfer can be categorized differently according to the mode of implementation and phases, such as irrigation management transfer (IMT), participatory irrigation management (PIM), turnover or responsibility transfer.

In South Africa, PIM/IMT policies were adopted and referred to as Revitalisation of Smallholder Irrigation Schemes (RESIS), which aimed at rehabilitating irrigation infrastructure and providing farmers with access to input and output markets, training, financial support and assists with establishment of functional institutions within irrigation schemes. However, most countries, including South Africa, lack effective policy implementation strategies that encourage farmer participation to maintain irrigation schemes after government support is withdrawn. The main aim of the study was to investigate factors affecting farmers' level of participation during the decision-making, implementation, benefit sharing, and evaluation stages of PIM/IMT related programmes such as the RESIS in South Africa, and their effect on farmers' access to water for irrigation in selected revitalised smallholder irrigation scheme in KwaZulu-Natal (KZN) Province, South Africa.

The study described demographic and socioeconomic factors of farmers in Makhathini, NdumoB, Tugela Ferry, and Mooi River irrigation schemes using descriptive statistics, an analysis of variance (ANOVA), and a Chi-square test. Multiple Linear and Probit Regression models were used to determine the effect of selected socioeconomic and demographic factors, RESIS knowledge, the RESIS programme and its implementers, and access to irrigation on farmers' level of participation and farmers' access to water in four revitalised smallholder irrigation schemes, respectively.

Results indicated that the average age of farmers across four irrigation schemes is 54.38 years. Household heads own 4.66ha of land on average, but farmers in Makhathini and NdumoB have significantly larger plots than farmers in Mooi River and Tugela Ferry. Farmers in different irrigation schemes have statistically significant differences in education and marital status. Despite this, more than half of farmers were married. RESIS was known to more than half of the farmers in the four irrigation schemes. Furthermore, farmers expressed positive attitudes towards training and institutional arrangements, but were dissatisfied with their access to markets, financial support, and irrigation infrastructure. Farmers in Tugela Ferry were pleased with their irrigation infrastructure, but other irrigation schemes were not. Farmers in Makhathini were happier with market access than farmers in other irrigation schemes. Farmers were generally pleased with the participatory approaches, efficiency, effectiveness, and fairness of RESIS implementers. The overall Farmer Participation Index (FPI) in four irrigation schemes was around 50%, indicating that more farmers were not participating. Over 50% of farmers did not have adequate, timely, or equitable access to water across four irrigation schemes. With the exception of gender, all variables regressed against farmer participation were statistically significant.

Age, education level, marital status, household and plot sizes, farmers' access to irrigation water, farmers' knowledge of RESIS and RESIS market access, financial support, institutional support, rehabilitated irrigation infrastructure and training, and RESIS implementers' fairness and participatory approach, efficiency, and effectiveness were found to have statistically significant effects on farmers' participation in various stages of the RESIS programme. Farmers' attitudes towards access to rehabilitated irrigation infrastructure, markets, financial support, training, the effectiveness of RESIS Implementers, and farmer participation during RESIS decision-making stages all had a statistically significant impact on their likelihood of accessing water for irrigation in four revitalised irrigation schemes.

The implementation plans for the RESIS programme should not be viewed as one size fits all because demographic and socioeconomic factors may vary from irrigation scheme to irrigation scheme. Consequently, the study recommends determining a suitable project implementation plan for each scheme that will encourage farmers to participate throughout all phases of RESIS.

DECLARATION 1 – PLAGIARISM

I, ……., declare that

1. The research reported in this thesis, except where otherwise indicated, is my original research.

2. This thesis has not been submitted for any degree or examination at any other university.

3. This thesis does not contain other persons' data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other persons.

4. This thesis does not contain other persons' writing, unless specifically acknowledged as being sourced from other researchers. Where other written sources have been quoted, then:
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Signed…… …… Date…….

Matome Freddy Rabothata

We hereby agree to the submission of this thesis for examination:

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DECLARATION 2 – PUBLICATIONS AND CONFERENCES

PUBLICATION

The following manuscripts form part of the research presented in this thesis.

Manuscript 1

Rabothata MF, Mudhara M, Senzanje A, Kolanisi U. Determinants of farmers' participation in the revitalization of selected smallholder irrigation schemes in the KwaZulu-Natal Province, South Africa (Out for review: Development in Practice)

Manuscript 2

Rabothata MF, Mudhara M, Senzanje A, Kolanisi U. Farmer attitudes affect access to irrigation water in selected revitalised smallholder irrigation schemes in South Africa (Submitted: Agrekon).

Manuscript 3

Rabothata MF, Mudhara M, Senzanje A, Kolanisi U. Determinants of farmers' level of participation in the implementation phase of the Revitalization programme of selected smallholder irrigation schemes, South Africa (Submitted: South African Journal of Agricultural Extension).

Manuscript 4

Rabothata MF, Mudhara M, Senzanje A, Kolanisi U. Farmers' participation in agricultural development projects: Review (In preparation: African Development Review)

Manuscript 5

Rabothata MF, Mudhara M, Senzanje A, Kolanisi U. Assessing factors affecting farmers' level of participation in the evaluation of the revitalization programme, South Africa (In preparation: African Development Review)

CONFERENCE PAPERS

The following manuscripts form part of the research presented in this thesis.

Rabothata MF, Mudhara M, Senzanje A, Kolanisi U. Determinants of farmers' level of participation in the revitalization programme of selected smallholder irrigation schemes in the KwaZulu-Natal Province, South Africa. Paper was presented at the SANCID Symposium 2023, in Tzannen, Limpopo Province, South Africa on the 21-23 February 2023.

DEDICATION

I dedicate this thesis to my wife (Nshalati), my sons (Mahlatse and Vulombe) and my daughters (Kamogelo, Hangwani and Thabiso).

I also drew inspiration from my late grandmother, Maite MmaMini Mancha Rabothata, who was an educator as well.

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CHAPTER 1: INTRODUCTION

This chapter provides a background to the research problem, and justification, as well as the objectives, research questions, and hypotheses of the study. A description of the thesis structure is also provided in this chapter.

1.1. Background

The global food security challenges of the mid-20th century called for additional intensification of agricultural production (Subramanian, 2015; Flachs, 2016; Conway, 2019). The Green Revolution (also known as Third Agricultural Revolution) was introduced to increase agricultural production primarily in India, Mexico, Philippines, Pakistan and other developing countries through the transfer of the latest agricultural technologies (Cleaver, 1972; Jain, 2010; Conway, 2019). Irrigation expansion was a consequence of the Green Revolution, with Asia experiencing a 2.5 percent annual increase in land under irrigation (Byerlee, 1992; Subramanian, 2015). The era saw most countries in Asia and Latin-America doubling annual cereal production and becoming food self-sufficient (Nelson *et al*., 2019; Somvanshi *et al*., 2020). There was already evidence that poverty challenges were not being addressed uniformly globally, with African countries falling behind (Otsuka and Kalirajan, 2006). A lack of human and institutional capacity, insufficient seed varieties, and inadequate national policies contributed to the failure to transfer latest agricultural production technologies in most Sub-Saharan African countries (Toenniessen *et al*., 2008; Muzari *et al*., 2012). Accordingly, the irrigation expansion in Sub-Saharan African countries was below expectations. At present, only 5-7 percent of Sub Saharan cultivated lands are under agricultural water management. This is low compared to Asia, where 43 percent of the land is under agricultural water management (Food and Agriculture Organization (FAO), 2011; Xie *et al*., 2021). A further drawback in irrigation potential exploitation in Sub Saharan Africa is that, despite the size of equipped irrigated land in Sub Saharan Africa being 7.1 million ha, only 5.2 million ha are actually irrigated (Cleaver, 1993; World Bank, 2012). The full exploitation of equipped irrigated land is hindered by an ineffective enabling environment, due primarily to unfavourable policies, ineffective institutions, insecure access to water and land (Machethe *et al*., 2004; Namara *et al*., 2011; Fanadzo, 2012; Ofosa *et al*., 2014). This under exploitation of irrigation potential in Sub Saharan Africa was already associated with low agricultural yields, globally. Nonetheless, Sub Saharan African irrigated land was expected to increase up to 100 percent by 2020 from 2010's baseline (Kadigi *et al*., 2019; FAO, 2020). On the other hand, compared to South Asia (1.2%) and Latin America (0.9%),

Sub-Saharan Africa's population is growing at 2.7% a year (Statista, 2021). For a growing population, it is imperative that agricultural production increases. Agricultural irrigation development should be considered an essential cornerstone for food security, economic growth, and adaptation to climate change. Effective irrigation management contributes substantially to many Sustainable Development Goals (SDGs). Nevertheless, current irrigation schemes in Sub Saharan Africa perform below expectations, resulting in unreliable, inadequate, and inequitable access to water (Merrey *et al*., 2018). Due to this, Sub-Saharan Africa is hindered from reaching its developmental goals in the irrigation sector (Woodhous *et al*., 2016; El Shaikh *et al*., 2018; Shah *et al.,* 2020).

In response to some of the emerging challenges during the 1970s, policy makers revisited some of the options to improve irrigation development (World Bank, 1982; Timmer, 1988; Inocencio *et al*., 2003). Challenges included a growing population, a decrease in government budgets for irrigation projects, increased competition among water users (agriculture, domestic, and industrial), poor water management, poor irrigation system operation and maintenance, and concerns regarding the environment (Molden *et al*., 2007; Turral *et al*., 2010). Governments financed, constructed, operated and maintained most irrigation schemes, with farmers left out of the management process (Mandri-Perrott and Bisbey, 2016; Malano and Van Hofwegen, 2018; Bjornlund *et al*., 2020). In the 1980s, the challenges associated with irrigation schemes in Africa intensified (Matlon and Spencer, 1984; Bjornlund *et al*., 2020). Various researchers (Higginbottom *et al*., 2021; Carter, 1989; Fanadzo and Ncube, 2018; Bjornlund and Pittock, 2017; Bjornlund *et al*., 2020) identified five major limitations of African irrigation schemes, i.e., high capital costs, exaggerated and overestimated gains, a lack of understanding of the social reality, the absence of management skills and responsible human resources, and the neglect of operations and maintenance. Furthermore, most studies on African irrigation schemes also identified an overly centralised and bureaucratic management system as a major limitation (Ofosu *et al*. 2014; Higginbottom *et al.*, 2021). A more integrated community-based management mechanism resulted from this recognition. Thus, management transfer became a key strategy (Shah *et al*., 2002; Senanayake *et al*., 2015; Scheumann *et al*., 2017; Kadigi *et al*., 2019; Cambaza *et al*., 2020). Management transfer can be categorized differently according to the mode of implementation and phases, such as irrigation management transfer (IMT), participatory irrigation management (PIM), turnover or responsibility transfer (Mukherji *et al*., 2009; Senanayake *et al*., 2015; Woodhouse et al., 2017). It is common for these terminologies to be used interchangeably even though their definitions differ (FAO, 1999; Senanayake *et al*., 2015; Khadra *et al*. 2017). FAO (2007) defined the philosophy of participatory management as “increased ownership, decision-making authority, and active

participation in the operation and maintenance of irrigation systems would create or force a binding commitment from water users to be more effective and responsible towards their obligations" (as cited by Pék, 2021).

In South Africa, PIM/IMT policies were adopted and referred to as Revitalisation of Smallholder Irrigation Schemes (RESIS), which aimed at rehabilitating irrigation infrastructure and providing farmers with access to input and output markets, training, financial support and assists with establishment of functional institutions within irrigation schemes (DAFF, 2015; Christian, 2017; Dennison, 2017; Dlangalala, 2018; Mudhara and Senzanje, 2020).

Reinders *et al*., (2010) defined irrigation scheme as "an agricultural project involving multiple holdings that depend on a shared distribution system for access to irrigation water and, in some cases, on a shared water storage or diversion facility". Van Averbeke *et al* (2011) specifically define the term 'smallholder irrigation scheme" in the context of South Africa as "irrigation scheme that was constructed specifically for occupation and use by Black farmers". Smallholder irrigation schemes are critical to rural livelihood, particularly in arid regions, where crop production depends on irrigation due to erratic rainfall and high evaporative demand (Fanadzo and Ncube, 2018; Serote *et al*., 2021). In South Africa Smallholder Irrigation Schemes (SIS) were established after recognizing the importance of smallholder farmers to the local communities. The smallholder irrigation schemes, onstitute an essential way to meet food security, create jobs, and alleviate poverty, particularly in rural areas (Van Averbeke, 2012 and Sinyolo *et al*. 2014).

Since the inception as a democratic state, the South African government has made significant investments in the RESIS programme in communal areas (Van Averbeke *et al*., 2011). The ultimate goal in these schemes is to reduce poverty by providing job opportunities and food security in the local communities (Sinyolo *et al*., 2014). Although South African government still invests heavily in smallholder irrigation schemes, many of them are still rendered inefficient or fall apart when state support is withdrawn (Van Averbeke *et al*., 2011). From 2016/17 to 2019/20, the South African government invested about R64.4 billion in agriculture, rural development, and land reform (National Treasury, 2023). Although there are no dedicated funds for the RESIS program, most government agencies have used various funding mechanisms to assist irrigation farmers (DALRRD, 2015). Initially, the former Department of Agriculture, Forestry, and Fisheries (DAFF) and Provincial Departments of Agriculture were expected to fund and drive the RESIS programme through Conditional Grants such as the Comprehensive Agricultural Support Programme (CASP) and Ilima/Letsema funds, as well as Equity Funds (funds allocated to

provinces by the Treasury) (DAFF, 2015). Additionally, the former Department of Land Reform and Rural Development (DLRRD) contributed funds to the RESIS program through the Rural Infrastructure Development Fund. The Department of Water and Sanitation (DWS) also assisted in the rehabilitation of bulk irrigation infrastructure like dams and canals (DWS, 2017). The Department of Agriculture was thus tasked with rehabilitating the infield irrigation infrastructure (DALRRD, 2012).

Even though different government departments participated in the RESIS programme, it was the Department of Agriculture (at provincial levels) that was responsible for its implementation. By merging DAFF and DLRRD, the Department of Agriculture, Land Reform, and Rural Development (DALRRD) was envisioned to improve coordination and implementation of various programmes such as the RESIS. The extent to which beneficiaries are involved in the revitalization process from the beginning determines their sense of ownership over the new and rehabilitated infrastructure. Irrigating farmers or beneficiaries of RESIS programme should be included in all decision-making processes. Therefore, RESIS programme should be driven by demand. The selection of an irrigation system, in particular, should be made in consultation with beneficiaries (Dennison and Manona, 2007). Dennison and Manona (2007) reported that revitalized schemes with high levels of farmer participation have performed better in comparison to supply-driven schemes with low levels of farmer participation. In accordance with the 'Continental Irrigation and Agricultural Water Development Framework for Africa,' governments and implementation agencies should not manage the processes of identification, design, supervision of construction, and farmer organization, but instead should focus on facilitating the process based on demand (AU-SAFGRAD, 2018, p. 22). As the name suggests, demand-driven development involves individuals requesting government assistance without being influenced by external forces. In this case, the project is likely to receive high levels of farmer participation from beginning to end, which could allow the project to succeed and be sustainable long after government support has been withdrawn (McIntosh and Zler, 2013; de Bont *et al*., 2019; de Bont and Veldwisch, 2020).

In addition, Kabeer and Sulaiman (2015) recommend four steps to improving service delivery by mobilizing voices. The first step is for implementing agencies to provide information about the services they will offer and to whom they will be provided. For ultimate beneficiaries to participate effectively, a second step may require additional training. Thirdly, farmer participation could be influenced by incentives (difference between cost and benefit). Furthermore, farmers could hold implementing agencies or government departments accountable for their actions by expressing their opinions and perceptions.

The level of farmer participation in revitalized schemes has been the subject of several studies. These studies (Kgosiemang and Oladele, 2012; Botlhoko and Oladele, 2013; Nxumalo and Oladele, 2013) investigated factors influencing farmer participation in agricultural projects and concluded that household size, program effectiveness, constraints and effectiveness of departments, age, gender, entrepreneurship, and household income are determinants of farmer participation in general. Muchara *et al*. (2014) explored the factors influencing farmer participation in collective activities to improve the management of previously government-funded schemes. Water scarcity and low farmer literacy had a negative impact on collective activities, according to the study (Muchara *et al*., 2014). Fawole and Tijani (2013) investigated farmers' awareness and participation in extension activities including research, extension services, and input supply services, and found a positive relationship between respondents' awareness and participation in extension activities. Isaac (2016) also investigated household participation and decision making in smallholder irrigation practice focusing on the Shiloh irrigation scheme in the Eastern Cape province, South Africa. Seven variables correlated positively with household participation and decision making. These factors included farm experience, distance from a road, farm assets, access to extension services, and market information. It can be concluded that irrigation farmers' characteristics (socioeconomic and demographic factors) and the irrigation scheme's biophysical characteristics could influence the level of farmer participation in irrigation reform policies such as the RESIS.

A review of the literature indicates no studies on the effects of farmers' awareness (knowledge) and attitudes on their level of participation during implementation of PIM/IMT policies such as the RESIS in South Africa. In addition to study the effect of farmers' RESIS knowledge and attitudes, the study explores the effect of socioeconomic and demographic factors on farmer's level of participation during RESIS decision-making, implementation, benefit sharing and evaluation stages, as well as their impacts on the performance of revitalised smallholder irrigation schemes based on access to water for irrigation.

1.2. Problem statement

Many governments across Africa have adopted smallholder irrigation schemes to eradicate poverty and improve food security (Gebrehiwot *et al*., 2015; Fanadzo and Ncube, 2018; Mhembwe *et al*., 2019; Mujuru and Obi, 2020). PIM/IMT policies adopted in Sub-Saharan Africa are also seen as promising by farmers and governments because they encourage farmer participation throughout the implementation process, including during decision-making. Nonetheless, performance of most rehabilitated irrigation schemes falls short of expectations. There are few successful and sustainable smallholder irrigation schemes in

Africa (Mutambara *et al*., 2016; Hanafi *et al*., 2020). Smallholder irrigation schemes are vital for rural communities, and different development agencies have invested heavily in this sector (Kortenhorst *et al*., 2002; World Bank, 2008; Mwendera and Chilonda, 2013). However, most countries, including South Africa, lack effective policy implementation strategies that encourage farmer participation to maintain irrigation schemes after government support is withdrawn (Huang, 2010; Ghazouani *et al*., 2012; Ricks 2015; Yami, 2013; Moss and Hamidov 2016; Wang and Wu 2018; Gany *et al*. 2018). These irrigation policy reforms presented a wide range of challenges when converting them into action. South Africa spends millions of rands annually on the RESIS programme as part of PIM/IMT policies, but little is achieved. Many PIM/IMT policy studies reviewed lacked rigorous analysis of farmer participation in decision-making (Owusu-Sekyere *et al*. 2020; Braimah *et al*., 2014). A lack or varying level of farmer participation during certain stages of these initiatives could be a contributing factor to the failure of the revitalised smallholder irrigation schemes in South Africa. Participation is viewed as a fundamental human right, where people should be involved in every development project that affects them (Dugard, 2015; Uphoff, 2019). Despite the importance of farmer participation in any development program, it is not fully practiced (Usadolo and Caldwel, 2016; Khadra *et al*., 2017; Crase, 2020). Some PIM/IMT implementing agencies or government departments view such exercises as time-consuming, which may delay the implementation of the programme (Dennison Manona, 2007; Harrison and Mdee, 2018; Ali, 2020). The main aim of the study was to investigate factors affecting farmers' level of participation during the decision-making, implementation, benefit sharing, and evaluation stages of PIM/IMT related programmes such as the RESIS in South Africa, and their effect on farmers' access to water for irrigation in selected revitalised smallholder irrigation scheme in KwaZulu-Natal (KZN) Province, South Africa.

1.3. Importance of the study

There is limited knowledge on the effect of the RESIS programme, farmers' attitudes, programme implementers, and farmers' awareness on the degree of farmer participation during the RESIS stages (decision making, implementation, benefits sharing, and evaluation). The current study will benefit the government departments (DWS, DALRRD and PDAs), agencies, contractors and engineers responsible for implementing the RESIS programme. The study findings will also help in the development of a guideline for the implementation of the RESIS programme which will encourage farmer participation during RESIS decision making, implementation, benefit sharing and evaluation stages. Furthermore, the study will highlight constraints to farmer participation during the RESIS programme that must be addressed for smallholder irrigation schemes to remain sustainable after implementation.

1.4. Objectives and hypotheses

1.4.1. Overall objective

To investigate the level of farmers' participation in the revitalization processes of selected revitalized smallholder irrigation schemes in the KZN Province.

1.4.2. Specific objectives

- To determine farmers' level of RESIS programme awareness in four revitalised smallholder irrigation schemes;
- To analyse farmers' attitudes toward the RESIS programme and Implementers (government officials, agencies, and contractors) in four revitalised smallholder irrigation schemes;
- To assess farmers' level of participation during revitalization of four smallholder irrigation schemes and the determinants;
- To determine the effect of selected variables (demographics, attitude, knowledge, and farmers' level of participation) on farmers' access to water for irrigation in four revitalised smallholder irrigation schemes.

1.4.3. Research Questions

This study seeks to answer the following pertinent questions:

- What are socio-economic and demographic factors of farmers in four revitalised smallholder irrigation schemes?
- What is farmers' RESIS programme awareness in four revitalised smallholder irrigation schemes?
- What is the farmers' attitudes toward the RESIS programme and Implementers (government officials, agencies, and contractors) in four revitalised smallholder irrigation schemes?
- What is the farmers' level of participation during the revitalization of four smallholder irrigation schemes?
- What is the farmers' access of water for irrigation in four irrigation schemes?
- What is the effect of selected variables (demographics, attitude, and knowledge) on farmers' level of participation during revitalization of four smallholder irrigation schemes?

- What is the effect of selected variables (demographics, attitude, knowledge and farmers' level of participation) on farmers' access to water for irrigation in four revitalised smallholder irrigation schemes?

1.4.4. Hypotheses:

- Socio-economic and demographic factors of farmers do not differ statistically significantly across four revitalised smallholder irrigation schemes.
- Farmers' levels of RESIS programme awareness or knowledge do not differ statistically significantly across four revitalised smallholder irrigation schemes.
- Farmers' attitudes toward the RESIS programme and Implementers (government officials, agencies, and contractors) do not differ statistically significantly across four revitalised smallholder irrigation schemes.
- Farmers' levels of participation during the revitalization do not differ statistically significantly across four smallholder irrigation schemes.
- Farmers' access to water for irrigation in four irrigation schemes do not differ statistically significantly across four irrigation schemes.
- Selected variables (demographics, attitude, and knowledge) do not affect farmers' level of participation during RESIS stages statistically significantly across four smallholder irrigation schemes.
- Selected variables (demographics, attitude, knowledge and farmers' level of participation) do not statistically significantly affect farmers' access to water for irrigation statistically significantly across four revitalised smallholder irrigation schemes.

1.5. Thesis Outline

The study is divided into six chapters based on the objectives. The concept of participation in the implementation of IMT/PIM related policies globally, as well as the objectives, research questions, and hypotheses of the study, were presented in Chapter 1. In Chapter 2, a literature review was presented looking at research works conducted on the participation of farmers in PIM/IMT related projects globally and identifying any research gaps. Within the context of PIM/ITM related programmes, Chapter 2 also examines the concept of farmer participation in more detail based on specific contexts and dimensions. Chapter 3 describes the methods followed to conduct the study, including the study areas, methods for sampling participants, and descriptive and inferential statistics used to present the results for each objective. Results presented in Chapter 4 are both descriptive and inferential to answer the

research questions outlined above. Chapter 5 presents discussions of results presented in Chapter 4 based on literature review in Chapter 2. Based on the results and discussions in Chapter 4 and 5, Chapter 6 concludes the study and provides policymakers with recommendations.

CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

The implementation of irrigation reform policies such as Irrigation Management Transfer (IMT) and Participatory Irrigation Management (IMT) has been widespread since the 1980s (Angelakis *et al*., 2020; Pék, 2021). Originally, these reforms were inspired by a broader set of 'participatory approaches' to development projects in the late 1970s and early 1980s (Cernea, 1985; Cleaver, 1999; Kanyamuna and Zulu, 2022) and were labelled as 'participatory irrigation development' and 'participatory irrigation management' (Groenfeldt and Svendsen, 2000; Kulkarni and Tyagi, 2012). As a result of these policies, water users were empowered to become active participants in decision making and given the ability to define how their irrigation systems should be managed to improve agricultural production by increasing their responsibility, accountability, and transparency (Coward, 1986; Uphoff, 1986; Akuriba *et al*., 2020). During the 1980s and 1990s, international organizations promoted liberalizing economic reforms that incorporated some of these ideas. These reforms stressed decentralization and marketization in water and irrigation management as well as the transfer of operation and maintenance responsibilities to lower levels of government and organized water users (Suhardiman and Giordano, 2014). This process was generally known as IMT.

In different countries, IMT and PIM were named and introduced differently (Mukherji *et al*., 2009). This was the case in South Africa when the Revitalization of Smallholder Irrigation Schemes (RESIS) programme was introduced in the late 1990s (DALRRD, 2022). Originally, the programme was called Rehabilitation of irrigation schemes with a focus on modernizing irrigation infrastructure. Most development practitioners criticized this approach for ignoring the software components of the programme (social, institutional, training, etc.) and paying too much attention to the hardware (irrigation infrastructures). It was later renamed the RESIS to focus on farmers' access to training, financial support, input and output markets. Despite this, the majority of revitalized smallholder schemes failed to meet the expectations of development practitioners (Dennison and Manona, 2007).

It was evident according to Deerkor (2019) that partnerships, development, and successful programmes could not be realized without effective participation by farmers. Hence irrigation reform policies such as PIM and IMT could also fail if farmer participation is not prioritized. Irrigation reform projects could only be considered participatory if farmers were involved throughout all stages (decision making, implementation, benefit sharing, and evaluation)

(Poddar *et al.*, 2011). This chapter review literature on farmer participation during different phases of agricultural development projects, specifically PIM/IMT related projects.

2.2. Literature review approach

In this literature review chapter, a conceptual analysis of the dimensions of farmer participation in agricultural development projects was undertaken. A particular focus of this chapter was to use Cohen and Uphoff (1980)'s framework for characterization of farmer participation in rural agricultural development with special focus to IMT/PIM related projects (Fig. 2.1). To identify research gap, dimensions of farmer participation in agricultural development projects were reviewed mainly from articles, books, and reports published recently.

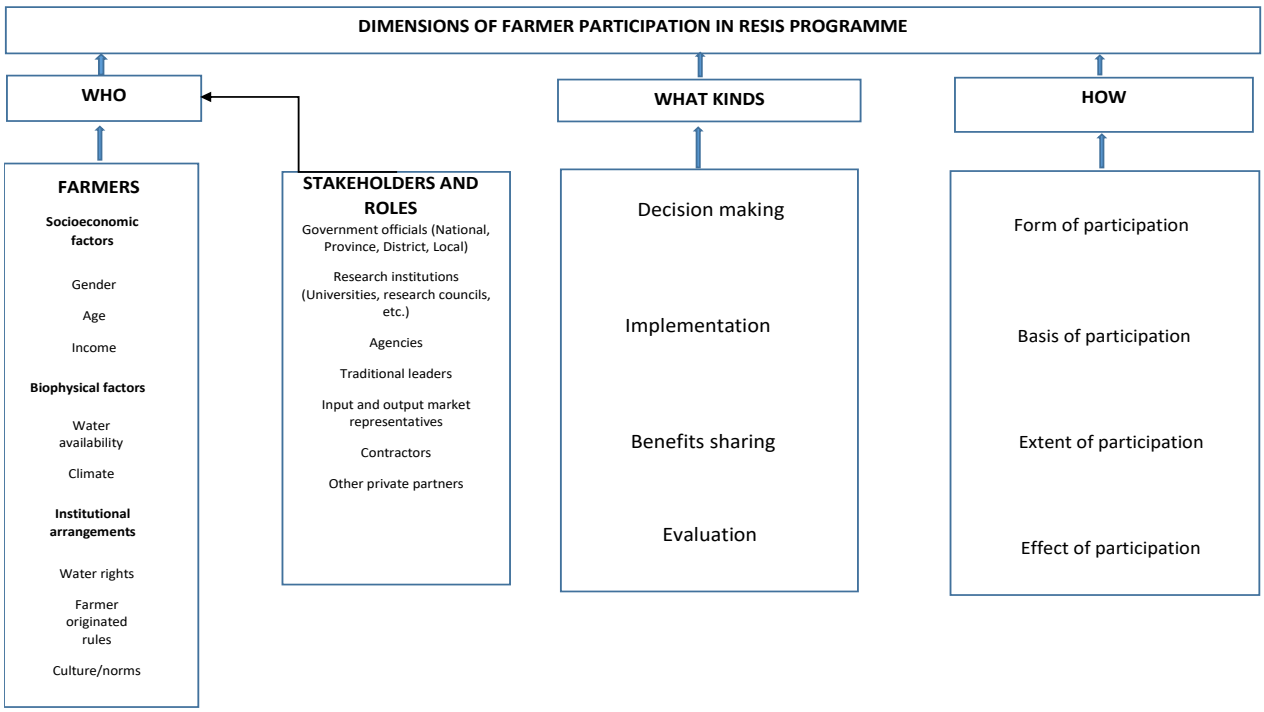

***Figure 2.1: Framework for characterising and analysing participation in PIM/IMT related programmes.**

*Modified from Cohen and Uphoff (1980)

2.3. The concept of participation

Participation as a concept has a wide range of definitions and interpretations. Participation can be defined, for instance, as a method of sensitizing beneficiaries to programmes related

to development (Pék *et al*., 2019). The reviewed literatures (Aref, 2011; Snyder *et al*., 2014; Parlin, 2019; Nahayo, 2017; Lusk and Parlin, 2019), on the other hand, have advocated community participation as a method of involving people in the decision making process of development projects. Further, participation can also be defined as the process of organizing a group to advocate for the rights of disadvantaged individuals in order to control resources, access to services, and bargaining power (Chifamba, 2013). Participation can also be seen as the process of involving people in the planning, implementation, and sharing of the benefits of rural development projects (Pavlis *et al*., 2016; De Loe, *et al*., 2015).

Participation as a concept can range from political to developmental, depending on the discipline. Accordingly, a proper definition should be able to make a distinction between political and development participation. The term "participation in politics" refers to people who engage in activities to influence public policy, either directly or indirectly (Uhlaner, 2015). Elections, political campaigns, donations to a candidate or cause, contacting representatives, petitions, protests, and working with others are some examples of these activities. On the other hand, development participation also known as participatory development refers to engagement of local populations in development projects (Cornwall, 2002). During the 1970s, participatory development was introduced as an integral part of the "basic needs approach" to development (Uphoff, 1977). Participatory development as a concept can also be defined differently depending on the perspective (Isgren, 2012). The "Social Movement Perspective" and the "Institutional Perspective" can both be used to define participatory development (Nyam *et al*., 2020). Social Movement Perspective of participation aims to mobilize and abolish unjust hierarchies of knowledge, power, and economic distribution (Steup *et al*., 2018). Participation in this perspective refers to an empowerment process where primary stakeholders or beneficiaries are empowered to deal with challenges that affect their lives (Tufte *et al*., 2009; Kusnanda *et al*., 2019). When primary stakeholders are capable of initiating the process and are willing to participate, empowerment participation happens. The result is a joint decision-making process about how and what should be accomplished. Despite the fact that outsiders are equal partners in development effort, primary stakeholders have a significant say in decisions that affect them. The main goal is to engage in consultation with beneficiaries is to identify and analyse critical issues, as well as to exchange knowledge and experiences in order to find solutions to the problems faced by primary stakeholder. Primary stakeholders should own and be in control of the decision making process (Kusnanda *et al*., 2019).

"Institutional Perspective" of participation, on the other hand, emphasizes that development projects should be designed and implemented with the input of relevant groups (Schneiberg,

2013). Farmers, who are the primary beneficiaries in this case, are relevant groups or stakeholders. This approach uses the input and opinions of relevant groups in a community to achieve a pre-established goal, which is defined by someone external to the community. An activist outside of the community who initiates a development project can divide a problem into stages, which facilitates determining whether participation is necessary and to what extent (Tufte and Mefalopulos 2009; Yapa *et al*., 2022). Research, Design, Implementation, and Evaluation are the four key stages of a development project from an institutional perspective (Uphoff, 1980; Yapa *et al*., 2022). The "institutional perspective" is also known as a project-based perspective (Tufte *et al*., 2009; Schneiberg, 2013).

It is important to distinguish between participatory development as an end in itself and participatory development as a means of empowering marginalized groups (Mohan, 2007; Mubita *et al*., 2017). Thus, participation is viewed as intrinsic, rather than purely instrumental (Osmani, 2008). Those who participate in the first form of participation may be asked for their opinions without being guaranteed that their opinions will be implemented, or decisions will be communicated afterward. In the second form of participatory development, the importance of fostering and enhancing the ability of people to participate in the development of their societies is stressed (Dreze and Sen, 2002).

In this study, farmer participation refers to extent, basis, form and effect of participation of farmers as primary stakeholders during the decision-making, implementation, benefit sharing, and evaluation phases of agricultural development projects. The focus of the following sections is on dimensions and contexts of farmer participation in agricultural development projects.

2.4. Farmers' participation: Dimensions

A comprehensive analysis of farmer participation in development projects has been provided by Cohen and Uphoff (1977). Through discussions of what, who, how, when, and where of participation, Cohen and Uphoff (1977) disaggregated and classified the maze of activities that fall under the category of farmer participation. The “What” part of the concept of farmer participation reviewed was based on four stages of the projects: decision making, implementation, benefit sharing, and evaluation. The 'Who' part of farmer participation refers to stakeholders or types of people involved in project tasks: (1) local residents, (2) local leaders, (3) government officials, and (4) foreign donors. Farmer Participation matrix was described in the 'how' part: (1) who initiated the idea? (2) what inducements or incentives are involved to encourage participation? (3) what is the structure? (3) what are the channels of participation? The 'when' and 'where' of participation refers to the contextual factors that

affect the likelihood of positively contributing to the project based on many project characteristics and aspects of the task environment (Cohen and Uphoff, 1977). These dimensions and contexts of participation were used to review literature on assessment of farmers' level of participation during stages of PIM/IMT related projects.

2.4.1. The 'What' dimension of farmers' participation

The assumption regarding farmer participation in agricultural projects was that it would vary from one stage to the next. Nonetheless, participation of farmers as primary stakeholders should be encouraged to occur throughout the phases of projects to ensure project sustainability (Oduor *et al*., 2018). Hence the 'what' dimension is useful approach to assess the level and extent of farmer participation during decision making, implementation, benefit sharing and evaluation stages of the development project (Cohen and Uphoff, 1977; Mishra, 2022). For instance, in most PIM/IMT programmes implementing agencies are mainly familiar with farmer participation during decision making, implementation, and benefits sharing stages (Khadra *et al*., 2018). Nonetheless, farmer participation at the evaluation stage is critical to the sustainability of irrigation schemes long after PIM/IMT programs have been implemented (Aref, 2007, Khadra *et al*., 2018). Evaluation stage provides a systematic approach to study whether a programme, intervention, or initiative is achieving its objectives. The purpose of an evaluation is to determine what works well and what needs improvement in a program or initiative (Khadra *et al*, 2018). In the context of PIM/IMT related projects, there is still a limited literature on farmer participation during monitoring and evaluation stages.

Farmer participation is typically encouraged throughout the PIM/IMT process, such as in the RESIS programme in case of South Africa (Denison and Manona, 2007). Yet intensity and level of farmer participation varies considerably across phases of the agricultural developmental programme (Geza, 2017). It is for this reason that more attention should be given to project phases where farmer participation is limited. Hence conducive environment should be created by removing the constraints that limit farmer participation (Havugimana, 2015).

Depending on the discipline, participation in decision making may also be defined differently (Mubita *et al.* 2017). Participation in decision making may be viewed as 'real' participation by scientists from a political background (Uhlaner, 2015). In contrast, those responsible for managing PIM/IMT related programmes may consider farmer participation during decision making about implementation of projects as the real form of participation (Denison and Manona, 2007). This is because decision making process is an essential part of the

implementation of PIM/IMT related projects. In the same way, economists could consider participation in the benefit sharing stage as the most important part of participation in PIM/IMT related projects (Oswald *et al*., 2018). The importance of participation in evaluation stage of projects is often overlooked, despite the fact that it is one of the most critical phases of the projects (Khadra *et al*., 2018).

Farmer participation in PIM/IMT projects is largely limited to input mobilization stages (decision-making and implementation phases). Development efforts, particularly those initiated externally, are typically decided by governments and donors. Thus, those who have access to resources are better placed to make decisions regarding project implementation (Clarkson *et al*., 2019). Participation in benefits and evaluation, on the other hand, is mainly concerned with outputs of PIM/IMT related projects. As Ostrom (1987) explains, incentives (differences between costs and benefits) can increase farmer participation. Besides repairing, re-designing, upgrading, and modernizing bulk irrigation infrastructure, access to training, input and output markets, access to the latest farming technologies increased productivity where PIM/IMT programs were adopted by irrigation schemes (Dennison and Manona, 2007; DALRRD, 2022). Consequently, most farmers may only participate or be interested in an output phase of the RESIS programme.

i) Farmer participation in decision making

With reference to PIM/IMT programmes, farmer participation in decision making process during initiation of the projects is normally referred to as decision making in project formulation (Dolage *et al*. 2015). In this kind of participation, farmers should be consulted when assessing options and making decisions that will affect them in the later stage (Bjornlund *et al*., 2019). As part of the development of the PIM/IMT project plans, farmers should also be consulted (Alam *et al*. 2012). Firstly, when initial decisions are taken about PIM/IMT projects, farmers should also be seen as active participants. Secondly, it is essential to view farmer participation in decision making as a continuous process throughout the implementation of PIM/IMT related projects. Finally, farmers would be expected to continue with decision making process about irrigation schemes long after the PIM/IMT programme has been implemented. In other words, farmers should be in position to continue to make decisions on management, operation, and maintenance of irrigation infrastructure. The decision making process should be seen an integral part of irrigation farming enterprises (Ricart *et al*. 2019).

Farmers should also participate at the feasibility stage when ideas are generated. The purpose of a feasibility study is to show how a proposed agribusiness would operate under

certain assumptions in the early stages of its development (Brockhouse and Wadsworth, 2016). Despite the fact that farmers are the primary stakeholders, irrigation schemes will require continued management, operation, and maintenance long after PIM/IMT projects have been implemented. Hence farmer representations in the main decision making committees or bodies of projects should be central. Farmers should also be involved in the decision making process, for instance, when choosing irrigation systems to be installed by contractors in irrigation schemes (Denison and Manona, 2007). Farmers should be informed of both the advantages and the disadvantages of the irrigation system so they can make an informed decision (Ricks, 2015; O'Shaughnessy *et al*., 2019). Despite access to market for the produce, decisions on what crops to plant could also be limited by local climatic conditions. Farmers should be involved in such decisions, and a feasibility study should be conducted to determine the possibility of a project succeeding based on farmers' socioeconomic factors and available natural resources (Ostrom, 1998; Takayama *et al*., 2018).

Farmer participation in decision making could also results in better project design. A participatory approach ensures that perceived needs of farmers as beneficiaries are met (Mwambi *et al*., 2020). In a way that outside planners cannot, beneficiaries are likely to shape the project to fit their specific needs. In the eyes of beneficiaries, a project should be truly worthwhile if they feel immediate responsibility and ownership. As a result, farmer participation could also promote further local development efforts. As villagers communicate with other villages and their kin, there are typically greater spread effects. As a result, local awareness, competence, and capacity are created where none previously existed (Wesselink *et al*., 2011; Steiner and Farmer, 2018).

Farmer participation in initial decision making is generally referred to as 'project identification'. Participation of farmers in the formulation of projects ensures that the needs of beneficiaries are incorporated into the project design. In light of this understanding, International Water Management Institute (IWMI) (2004) and, Afzal and Barbhuiya (2011) reported that high levels of farmer participation during the project identification stage have contributed significantly to increases in land under irrigation in smallholder irrigation schemes in Bangladesh, China, India, Indonesia, Pakistan, and Vietnam, which account for more than 51 percent of total land under irrigation globally. Chaudhry (2018) also argued that social organization is just as important as technical aspects of irrigation in the efficiency of water use. However, Ghosh and Kumar (2012) also found farmer participation during decision making stage resulted in high crop yields in Ghana and successful transfers of management responsibilities from government to smallholder irrigation farmer groups.

Meanwhile, in Zimbabwe, farmer participation was documented as a way to overcome challenges hindering project design and planning (Chifamba *et al*., 2013). A similar participatory approach was used by policy makers in Ethiopia to make smallholder irrigation schemes more sustainable (Wotie and Hanaraj, 2013). Project formulation is therefore a means of solving identified problems and it entails project identification and project planning. Farmer participation in project formulation where initial decisions are taken could also affect the sustainability of smallholder irrigation schemes (Imburgia *et al*.,2021)

Some socioeconomic factors, such as access to capital, may limit farmer participation during the initiation stage (Sharaunga and Mudhara, 2018; Okeyo *et al*. 2020). On the other hand, farmer participation in decision making should be viewed as an ongoing process. The objective of ongoing decision making process is to provide farmers who did not participate with the opportunity to participate in future phases of the PIM/IMT projects. The farmers, however, should also be expected to participate in the operational decisions. In some cases, block committee leaders are elected to form part of project steering committee that makes decisions to support the implementation of the agricultural projects. This was the case in South Africa where farmers were encouraged to establish schemes committees and elect leaders who would represent them during the revitalization process of selected irrigation schemes (Dennison and Manona, 2007). Hence, farmer participation in decision making process was considered an integral part of every phase of the RESIS programme.

According to Denison and Manona (2007), the RESIS programme in South Africa entails three stages: scoping of institutions and irrigation scheme status, participatory planning (feasibility), and implementing the intervention plan. A scoping of the status of irrigation schemes and institutions requires the establishment of project lead teams, which consist of experienced sociologists and irrigation development planners. In addition, the scoping stage involves exploring the objectives and desired outcomes of the relevant authorities (provincial and municipal) and scheme leadership who have control over resources.

Denison and Manona (2007) also indicate that at the participative planning stage, the community should be mobilized and information gathering exercise at farmer level should be carried out. A diagnosis tool is particularly useful for schemes which have some ongoing crop production as it gives farmers feedback on their production mix, and costs and through scenario planning that informs their choices. The aim should be to understand the current reality on the schemes in terms of the key elements of agricultural production from the perspective of those who currently have rights to the land. In agreement, this requires a substantial mobilization and consultation process right down to sub-scheme and groups of households. In addition, the general vision of how the different farmers might progress and

make sure that this is agreed by scheme leadership, plotholders and farmers should be reflected. Furthermore, issues relating to leasing of land, commercial agri-business partnerships, farmer training and support for household food production, including irrigation infrastructure and water harvesting are appreciated.

The implementation of the intervention plan according to Denison and Manona (2007) includes formalizing of existing land-allocation and land rights, promotion of food production on the homestead gardens, definition of marketing channels, sources of finance and cash flow measures, finalization of engineering rehabilitation and re-design to allow easier water management and allocation. Lastly, Initiation of the training programmes for 'smallholder farmers' who wish to proceed along a path of commercialization, complete with financial mechanisms and exploration of marketing/entrepreneurial initiatives.

ii) Farmer participation in implementation phase

There are three primary ways in which farmers can participate in the implementation of PIM/PIM related projects: (1) contributing resources; (2) assisting with administration and coordination; and (3) enlisting in the programme. As part of project implementation, farmers mobilize resources and incorporate their lay expertise to make project inputs into tangible outputs (Uphoff, 1980). According to Woodhouse *et al*. (2017), farmers could contribute labour, local construction materials, and supervise implementation activities during implementation. In order to determine the effect of labour contributions on sustainability, Adeniji (2011) examined smallholder irrigation farmers in three schemes in Adamawa, Nigeria. A cross-sectional survey design and a sample of 150 farmers were used to establish that farmers' labour contribution during project implementation did not affect their willingness to pay for irrigation water. Farmers' willingness to pay for water in the irrigation scheme upon completion of the project was not associated with their labour contributions during the implementation phase. In a study focusing on four irrigation projects in Iringa and Mbeya regions of Tanzania, Koopman *et al.* (2001) disagreed on the influence of farmer participation on project implementation when top-down approaches and bottom-up approaches were used. Their studies showed that farmers' willingness to pay for water was increased by 45% when bottom up approaches were adopted in contrast to top down approaches. In top down irrigation water projects, farmers did not contribute as much labour and were therefore not willing to pay for irrigation water. According to Marks *et al*. (2014), farmers develop a sense of ownership only if they participate in the project implementation process. In this sense, when farmers contribute their own labour, a sense of ownership is developed, whereas if they don't, they are less likely to feel any obligation, resulting in lower

water use which is proxy to lower level and extent of farmer participation. The literature on farmer participation during agricultural project implementation is still contradictory.

Another indicator of farmer participation at project implementation phase is their role in supervision of implementation activities. In a study by Marks *et al.* (2014) it was established that farmer involvement in supervision of implementation activities had influence on the increase of area of land under irrigation. As also indicated by Wandera *et al.* (2013), farmer participation in supervision during the project implementation phase increased sense of ownership. Marks and Davis (2012) similarly concurred with these findings. On the other hand, Marks and Davis (2012) used cross sectional design, Wandera *et al* (2013); Marks *et al* (2014) adopted descriptive survey design yet their findings were similar. In other words, when farmers participate in supervision of project implementation activities, they develop a sense of ownership.

For sustainable agriculture in the former rural areas in South Africa, farmer participation in the design of Farmer Support Programmes (FSPs) was of outmost importance (Dalrrd, 2022). Uphoff (2000) identified that for the success of any developmental plan, there had to be a widespread participation in the identification of problems and in the implementation of solutions. The widespread participation in identification of the problems could lead to greater participation of the beneficiaries as their problems would be solved. Walter (1997) also identified that there was a need to include farmers in the planning and reorient them about the programme as in most cases they were often seen as passive recipients in the policy planning. In his study on the participation of the farmers in the planning of programmes, Baker (1997) observed that a great contribution by farmers ensured the success of the FSPs. The participation of farmers could strengthen and improve the objectives of the programmes, as well as motivate farmers to participate in the programmes, thus improving the overall performance of the programme. The lack of farmers' participation in the planning phase was detrimental to the success of the agricultural programmes. Aref (2010) also maintains that the lack of participation of farmers in the planning of agricultural development projects could have led to non-participation of farmers which could have resulted in the omission of the main objective of programmes which could have assisted the very same farmers as beneficiaries. Subedi (2008), in Kavre District Nepal, found that allowing different groups to participate in the design of the programmes had a greater advantage to the government in identifying gaps and adopting strategies which could not only improve the participation of certain groups but could lead to the success of the programmes.

According to Cole (2007), the participation of the farmers is necessary to get support for the agricultural development programmes, however, the farmers often face barriers in their

participation. In rural areas, lack of knowledge and education was often a problem for the farmers to participate in the programmes as this lack constrained the farmers from fully participating in the development of the programmes. Another barrier was that the government often took the decisions by itself without involving the farmers in the planning of the programmes (Scheyvens, 2003). In planning the programmes, the government in South Africa often use a top-down approach, which was characterized as being more state-led, complex, having a high level of institutionalization, a modernist technological regime which sets quantifiable targets for rural development (Maroo *et al*., 2015). According to Elias *et al*. (2013) the top-down planning processes were said to be branded with the non-participation of farmers and had failed to lead to the development of small scale farmers in the Southern African countries. Aref (2011) found that the farmers did not play any role in the planning of the programmes because they were excluded from the design process. DAFF (2013) also stated that the farmers did not participate in the design of the programme, as the government departments were responsible for designing the programmes for the farmers based on the policy direction of governing party. However, according to Bagdi and Kurothe (2014), in India the farmers stated that they took part in the planning of the programme as they participated in the meeting and shared their views on the development of the programmes. According to Cristóvão *et al*. (1997), when the government planned these programmes, it looked at past circumstances which inhibited the development and barriers which were a stumbling block for farmers in the country and thus the government tried to correct those conditions. However, according to Ndou (2012), the programmes in South Africa failed due to the lack of considering local ethics, socio-economic and cultural characteristics of the targeted group by designers. This caused the designers to plan programmes which produced the same results of the previous programmes without any improvement or relevance to the farmers. Sibanda (2007) revealed that women in the rural areas in Zimbabwe did not participate in the planning and decision-making process of the agricultural programmes. Lack of knowledge and information about the programme development was the cause of disparity among the rural women farmers. Kongolo and Bamgose (2015) found that the rural women did not participate in the initiation of development processes due to illiteracy, lack of knowledge and discrimination. Kanji (2004) stated that women were less involved in the agricultural programme because the male famers were more dominant in community level meetings and so had positions in the communities. The communication of these programmes to the women was also another barrier affecting their activeness in the planning of the programmes. Sibanda (2011) stated that the women farmers had to be included in the planning of the programmes as they had different needs from men. The women farmers did not have access to land, credit and

market, their situation was worse than that of the men, and the programmes which were often implemented were not responsive to the women.

iii) Farmer participation in benefit sharing stage

There are three ways in which farmers can participate in benefit sharing stage of the irrigation reform projects (Narayanan, 2014). A farmer could either participate by benefiting materially, socially and personally. Reviewed literature agreed that participation in benefits falls under category of passive kinds of participation. Based on economic literature, this type of participation is always regarded as important. There is only one danger in focusing on this kind of participation, however, since it can sometimes be quite high and lead observers to overlook other important aspects of the project, such as decision-making, which have either not taken place or have been quite limited.

According to study conducted by Owusu-Sekyere *et al*. (2021), farmers participated in PIM/IMT programmes had significantly enhanced rice yield and income, which in turn improved the welfare of farmers to ensure farming households are food secure and escape poverty trap. However, it is worth mentioning that the increase in yield and income of participants of IMT were not only linked to more consistent or reliable water supply under IMT schemes, but also connected with investment in inputs, improved management practices and reduced post-harvest losses. In terms of policy and management decision making, the findings of the IMT scheme suggest that farmers with higher productivity are more likely to participate than those with below-average productivity. This implies that productive farmers have a comparative advantage in rice irrigation water productivity and net farm returns. Participation in IMT schemes can significantly improve yields and net farm returns for smallholder farmers. Agricultural water managers, development partners, governments, and policymakers should encourage smallholder farmers to participate in PIM/IMT programmes. A government subsidy can help farmers with below-average performance by lifting their performance. It is generally possible to divide the benefits of PIM/IMT programmes into outputs, intermediate outcomes, and long-term outcomes.

iv) Farmer participation in evaluation stage

Project evaluation refers to the process of systematically evaluating one development activities by involving various stakeholders, including farmers, researchers, government officials, and extension workers. Due to its emphasis on stakeholder involvement, participatory monitoring and evaluation is regarded as a valuable tool for ensuring the success and sustainability of development programmes and projects (also known as stakeholder evaluation, participatory evaluation or collaborative monitoring and evaluation)

(Bashir and Kyung, 2018). In fact, participatory evaluation remains characterized by active engagement of multiple stakeholders. Heck *et al*. (2011) argue that participatory approaches could enhance evaluation capacity, enhance credibility, and increase results acceptance, enhancing relationships between local stakeholders and managers. According to Heck *et al*. (2011), participatory evaluation can promote transformation by strengthening the analytical capabilities of all participants, while also encouraging mutual acknowledgment of differing perspectives. Participants are responsible for developing indicators for measuring change and progress towards objectives in participatory evaluation (Bashir and Kyung, 2018).

Various studies (Waithera and Wanyoike, 2015; Ocharo, 2020) have indeed indicated that monitoring and evaluation function significantly impact project performance. For example in Cuba, activities such as planning monitoring and evaluation planning before project initiation and performance, have been emphasized in order to have the required project results (Abarinda, 2019). The results indicated a significance correlation between follow up and estimation of project progress in Kenya (Phiri, 2015). In Ghana, Ocharo, (2020) study indicated monitoring and evaluation of projects are essentially related to success of construction projects. In Uganda, Abarinda (2019) research revealed that monitoring and evaluation had a significant correlation with project performance.

The study conducted in Nakuru, Kenya, by Winch *et al*., (2010) as cited by Umugwaneza *et al*. (2021) examined the relationship between project performance, and monitoring and evaluation considering agribusiness project results indicated a significant relationship between the dependent and the independent variables. The study concluded that monitoring and evaluation (M&E) plays a significant role through cost and budget management. A research study conducted in Rwanda by Sheillah (2020) found that possessing M&E did not guarantee project success. In contrast, Shukla (2015) found that M&E frameworks are significantly associated with the success of agricultural projects. Galukande-Kiganda and Nalumansi (2021) contend that project evaluation plans are usually developed in workplaces that are far from the locations where projects are situated and far from the people who are affected by project activities. Yet, this study failed to explain the extent to which project managers incorporate farmers into evaluation processes.

2.4.2. The 'Who' dimension of participation

The 'Who' dimension of farmer participation refers to categories of stakeholders who are involved or have interests on irrigation reform projects.

i) Stakeholders in PIM/IMT projects

The RESIS program in South Africa has four categories of participants: the public sector (government agencies and departments), actors involved in interventions (indirectly related to the public sector), irrigation scheme participants (users), and those not directly related to the scheme (private sector). In South Africa, RESIS is more prominently implemented by the Department of Water and Sanitation (DWS) and Provincial Departments of Agriculture (PDAs). PDAs closely collaborate with DALRRD in conducting most intervention activities. Although not the largest actor in the scheme, DALRRD plays a crucial role. In DALRRD, different actors play different roles, such as policy makers, environmentalists, water scientists, economists, soil scientists, irrigation specialists, etc. Additionally, extension officers are key players between the DALRRD and farmers. A government extension officer is a government representative who communicates directly with farmers near a scheme (DALRRD, 2022).

Farmers are the actors directly involved in the scheme or "ecosystem", which enables them to use irrigation and infrastructure. There are three types of farmers: registered land farmers, rejected land farmers, and dry land farmers. A separate actor group consists of the scheme's management committee (MC), which is comprised of elected representatives of the farmer community. Though not formally part of the scheme, the village community and tribal authorities, including the chief, do influence the scheme. As a result, this actor group can be linked with the more social issues in the village and have an indirect impact on the plan. In spite of the fact that they aren't members of the scheme, markets for farmers' products, hawkers, and input providers influence the scheme significantly. This actor group is in continual contact with farmers, which creates an indirect connection between the scheme and farmers (Dennison and Manona, 2007; DALRRD, 2022).

The stakeholder analysis was an important exercise to ensure the success of the project. Similarly, Ethiopia's Koga irrigation and watershed management project aimed to boost agricultural productivity and productivity among smallholder farmers in the Koga River Valley. There were several farming communities and government agencies affected by the project that had different opinions, interests, and concerns, so stakeholder analysis was required (Gebre *et al*., 2007). Among the stakeholders identified were farming groups, public sector organizations, and project implementers. The stakeholder analysis identified four categories of farmer stakeholders. There were four types of displaced people in the project: i) those who have been displaced and relocated, ii) those who are waiting to be displaced and relocated, iii) communities that expect to host relocatees, and iv) those living near the irrigation scheme but not directly affected by it (Gebre *et al*., 2007).

Different stakeholders in the irrigation reform projects in many countries play important roles that include suppliers of inputs, farmer cooperatives and cooperative unions, microfinance institutions that provide financing services to smallholder farmers. Government actors are considered the most influential actors in the network (Bryan *et al*., 2020). The participation quality of beneficiaries in the decision-making process is quite difficult to assess but it depends entirely on the participatory approach used (Reed *et al*., 2009). Lamers *et al*. (2010) and Menconi *et al*. (2017) also agreed that planning of the participatory approach process should be suitable to type of beneficiaries. In most cases, farmers are already aware of the goals of the projects and are only interested on exploring the opportunities only if they are given power to make decisions (Oteros Rozas *et al*., 2013). It will take further research to determine if the outcomes of participatory processes are considered holistic, encompassing diverse values, and effective in meeting the rationale and needs of participants. The lessons learned from previous platforms can be applied to future processes. A water management system has been transferred by the government to water users' associations (WUAs) in Tunisia since 1989, without the farmers being involved in the design of the WUAs. According to Hanafi *et al*. (2019), this transfer of irrigation management has led to deterioration of the institutional environment. It was unclear to what extent farmers could participate, given this complex relationship between them and the agriculture department.

ii) Determinants of farmer participation in PIM/IMT projects

Research on the effects of various social factors affecting farmer participation in collective action, in general, is abundant (Arun *et al*., 2012; Muchara *et al*., 2014; Sithole *et al*., 2014). There are several factors that affect farmers' willingness to participate in collective actions such as managing, operating and maintaining smallholder irrigation systems. These factors are social, economic, managerial, institutional, locational, and physical.

In terms of social factors, age was identified as one of the factors that positively affected farmers' participation in collective actions (Sheikh *et al*., 2014; Sharaunga and Mudhara, 2018; Sithole *et al*., 2014). It was also discovered in the same literature that older farmers were more likely to participate in collective actions than their younger counterparts. As a result, younger farmers have better job prospects, whereas older farmers have more time for farming. In contrast, other studies (Alam *et al*., 2012; Nhundu *et al*., 2015) found that younger farmers were more likely to participate in irrigation management activities. Furthermore, this may be related to the ability of younger farmers to work productively for longer periods of time compared to older farmers who are less active due to deteriorating health. In contrast, literature reviews (Muchara *et al*., 2014; Etwire *et al*., 2013) did not find

any statistically significant association between age and farmers' participation in collective actions. The effects of age on farmer participation in irrigation reform projects (PIM/IMT) could also vary depending on the irrigation scheme or phase of the project.

Another social factor that affects farmer participation in PIM/IMT activities was gender (Sserunkuuma *et al*., 2004). A significant low level of participation was also found in farms that were operated by females (Balasubramanya, 2019). However, several scholars (Botlhoko and Oladele 2013; Etwire *et al*. 2013; Muchara *et al.* 2014) found that farmer participation in irrigation collectives was not significantly affected by gender.

The size of the farmer's household, as part of social factors, has been shown to have a significant effect on their participation in collection actions of PIM/IMT activities (Alam *et al.,* 2012; Botlhoko and Oladele, 2013). According to Alam *et al*. (2012) and Sithole *et al*. (2014) household size correlates with the amount of food and items consumed daily. Basically, the larger the household, the greater the need for the household head to participate in irrigation projects. Alternatively, a larger household size may complement the work of the household heads on the farm (Martey *et. al*. 2014). Because family labor is available, household heads can share responsibilities and focus on other areas of development, including irrigation development. In a study by Alam *et al*. (2012) it was found that some family members could assist household heads in managing irrigation. According to Bhatta *et al*., (2017), household labor is abundant when appropriate technologies are used in intensifying farming.

In terms of social factors, many researchers (Etwire *et al*., 2013; Muchara *et al*., 2014; Nhundu, *et al*. 2015) agree that farmers who have spent more time in formal education are more likely to adopt the latest irrigation technologies and take part in irrigation management activities. Farmers with many years of formal education, however, are likely to experience reduced reliance on agriculture, since their opportunity costs of labor are higher. This results in lesser participation in collective actions (Sserunkuuma*, et al*. 2004). Based on Sserunkuuma, *et al*. (2004), educated farmers receive a broader range of incomes. Consequently, irrigation water fees were easier to pay, which made them more likely to participate in PIM/IMT activities. The association between farming experience and farmer participation in collective actions was found to be significantly negative (Sserunkuuma *et al*., 2004). So, depending on the kind of experience gained, farmer experience could influence farmer participation positively or negatively. In contrast, Bhatta, *et al*. (2010) concluded that farmer experience did not affect farmer participation in irrigation management decisions.

Some researchers (Sharaunga and Mudhara, 2018; Sserunkuuma, *et al*. 2004) found that land ownership has a significant effect on farmer participation in irrigation management.

Farmers may be less likely to participate in irrigation management activities if they lack security over land ownership. According to Sserunkuuma (2004), there was a strong link between farmers' participation in collective action and household dependency ratios (i.e., the number of dependents to the number of working adults). The level of satisfaction with irrigation infrastructure by farmers could also affect their participation in collective actions (Upasena and Abeygunawardena, 1992). It has been shown that farmer participation in irrigation management activities is positively influenced by positive attitudes toward irrigation scheme management, operation, and maintenance (Chandran and Chackacherry, 2004; Alam *et al*., 2012; Gholamrezai and Sepahvand, 2017). For example, when farmers have access to water for irrigation, they are more likely to support collective actions.

The size of land ownership is related to farmers' likelihood to participate in collective actions (Sithole *et al*., 2014; Muchara *et al*., 2014; Sharaunga and Mudhara, 2018). Consequently, farmers with large irrigated land areas are compelled to participate in collective actions because of their increased water needs for irrigation. Furthermore, other researchers (Alam *et al*., 2012; Sharaunga and Mudhara, 2018) have found that large land holdings may negatively affect farmer satisfaction because of insufficient water supplies. Thus, farmers with small plots of land are often able to irrigate their crops with adequate water, whereas farmers with larger plots of land could not receive adequate water supply. As a result, farmers may opt for dryland farming rather than irrigate their land extensively, resulting in lower yields. Consequently, farmers who make more money from cash crop cultivation are more likely to participate in PIM/IMT projects (Aheeyar, 2006).

Several researchers (Wang *et al*., 2014; Muchara *et al*., 2014; Nhundu *et al*., 2015), active participation in farming activities is associated with adults in the household employed in off farm activities. On the other hand, as Aheeyar (2006) points out that household income from off-farm activities could also play a significant and positive role in the participation of farmers. By having multiple sources of income, household could afford to mobilize more resources for irrigation infrastructure maintenance and operation. Moreover, farmers' willingness to pay for operation and maintenance was also affected by the operation and maintenance fee (Aheeyar *et al*. 2012). Contrary to this, Adekunale *et al*. (2015) found no significant correlation between farmers' level of participation in irrigation management activities, and fees for operations and maintenance of irrigation schemes.

According to various researchers (Sserunkuuma, 2004; Sithole *et al*., 2014; Adekunale *et al*., 2015), farmer participation in collective actions such as PIM/IMT is influenced by factors such as type of farming, cropping pattern, irrigation knowledge level, and farm management costs. Collective action participation is higher among farmers with a primary source of

income from farming than among those with a secondary source of income (Sithole *et al*., 2014). Types of crops cultivated could also urge farmers to participate in collective actions of irrigation schemes. For instance, some crops need adequate irrigation water to survive, such as cash crops. Therefore, cash crop farmers could be compelled to participate in collective action to improve irrigation water access (Sserunkuuma *et al*., 2009; Aheeyar, 2006; Miao *et al*., 2015). Based on these findings, it appears that the type of farming greatly influences the level of farmers' participation in collective actions.

A majority of institutional factors could negatively or positively influence farmers' level of participation in irrigation projects. Researchers (Alam *et al*., 2012; Muchara *et al*., 2014) found that farmers who acquired soil and water management training were more likely to participate in PIM/IMT projects. These scholars (Alam *et al*., 2012; Muchara *et al*., 2014) also concluded that farmer training could change farmers' perceptions and increase their knowledge of irrigation benefits. Therefore, farmers may be more aware of the importance of collective action when managing common resource pools, such as irrigation systems.

Agricultural extension officers provide farmers with technical support related to the latest farming technologies. Farmers' access to extension services can positively and significantly affect farmer participation in collective action, according to most scholars (Etwire *et al*., 2013; Nhundu *et al*., 2015). Due to access to extension services, farmers are better equipped to cope with the risks associated with farming. In contrast, other researchers (Sserunkuuma *et al*., 2004; Sithole *et al*., 2014) found no significant effect of extension services on farmers' participation.

Several countries, including South Africa, are using subsidies or grants as a way to support and uplift emerging farmers financially (DALRRD, 2022). Participation in collective action could be significantly affected by farmers' access to financial support. According to Miao *et al*. (2015), grants or subsidies improved farmers' compliance with irrigation management activities. Moreover, farmers can mobilize production inputs such as seeds, plants, and fertilizers through affiliation with farmer organizations. Furthermore, farmers are members of farming organizations because they want to benefit from collective bargaining (Arun *et al*., 2012). It can be concluded that farmers who belong to a certain farmer association will be more willing to participate in the collective activities of the irrigation schemes. In General, farmers organize themselves into three tiers for better problem-solving and decision-making (Jinapala *et al*., 2010). In some instances, farmers who were members of scheme block committees had better chances of participating in collective action related to irrigation management (Sharaunga and Mudhara, 2018).

Nhundu *et al.* (2015) found that access to credit led to farmers adopting new technologies and increasing their production. The likelihood of farmers participating in agricultural projects increases when institutions or projects guarantee access to credit (Etwire *et al*., 2013). According to Bhatta *et al*. (2010), farmers' participation was significantly influenced by timely canal water availability. Gomo *et al*. (2014) found that farmers in downstream blocks were significantly dissatisfied with irrigation services, and this could lead to low level of farmer participation. Farmer participation in PIM/IMT projects could be significantly affected by their location along the canal of the irrigation scheme. Plots in irrigation schemes are typically located in accordance with a canal's head, middle, and tail reaches. Yapa *et al*. (2022) report that farmers at the tail-end of canals were less likely to participate in collective action due to water shortages than those at the head and middle. Also, farmers' willingness to participate in organized structures was negatively affected by distance from the irrigation scheme's main canal. In contrast, Sheikh *et al*. (2016) found that frequent water shortages, farmers situated at the tail-end of the main canal are urged to engage in irrigation management activities. In accordance with Sharaunga and Mudhara (2018), middle-section farmers along main canals tend to maintain irrigation infrastructure less frequently than head-end and tail-end farmers. In their study, Alam *et al*. (2012) found that farmers who lived further from market centers have low level of participation in farming activities than farmers who lived closer to produce markets. People with low economic status are more likely to participate in PIM related projects.

Water adequacy is the most important physical factor affecting farmer participation. There are several other factors, including soil quality, the severity of water shortages, and groundwater use that could affect farmer participation. This is in line with Muchara *et al*. (2014), who found that irrigation water adequacy significantly influences farmers' participation. The availability of adequate irrigation water correlates with the area of land under irrigation (Arun *et al*. 2012). Furthermore, farmers' willingness to participate in irrigation management may be affected by the quality of soil suitable to cultivation under irrigation (Krishna, 2013; Sharaunga and Mudhara, 2018). In addition, farmers experiencing short-term water scarcity are more likely to take collective action to reduce crop losses and improve access to water (Muchara *et al*., 2014). When water scarcity persists over long periods, farmers are discouraged from participating actively in collective action (Muchara *et al*., 2014). According to Arun *et al*. (2012), farmers facing severe water shortages are unlikely to participate. It has been reported that the heavy use of groundwater by farmers and the improvement of groundwater quality negatively affect their participation in irrigation management (Sheikh *et al*., 2014). In a study conducted by Arun *et al*. (2012), it was found that tube-well owners did not participate in farmer organization activities. This is because

farmers with access to water on their plot do not have a motive to participate in collective actions.

The lack of knowledge about farm technology negatively impacts farmers' participation in irrigation management (Adekunale *et al*., 2015). It has been shown by Alam *et al*. (2012) and Sserunkuuma (2004) that farm management costs negatively affect farm participation. According to Sserunkuuma (2004), farmers' participation in irrigation activities decreased when operating and maintenance costs exceeded farm profits. Consequently, these farmers are discouraged from investing and expanding their farms (Alam *et al*., 2012). Thus, farmers are less likely to participate when the costs of irrigation farming are greater than the benefits (Sserunkuuma *et al*., 2004).

2.4.3. The 'How' dimension of farmer participation

As Upholf (1987) points out, the 'How' dimension can be evaluated qualitatively by identifying the factors that influence participation positively or negatively, as well as its patterns. On the other hand, the 'Who' and 'What' dimensions focus on the amount, distribution, and trends of participation. By assessing patterns of farmer participation during PIM/IMT projects, one could determine whether the initiative was based on top-down or bottom-up approach. Farmer participation in PIM/IMT projects should also be determined on whether it was voluntary or coerced. In addition, it is also important to assess farmers' level of participation in PIM/IMT projects over time depending on their channels and structures - whether they participate individually or collectively, whether they were organized in a formal or informal manner, and whether they were directly involved or indirectly involved. Participation should be considered in terms of its duration, scope, and whether it was once off, intermittent, or continuous, as well as whether it covered a wide or narrow range of activities. Final consideration is empowerment: the degree to which people are capable of participating in decision-making and implementing their plans.

To understand the different levels of farmers' participation in agricultural development projects and programs where IMT/PIM is implemented, Petty (1995) defines seven types of participation. It is necessary for farmers to participate in collective action and to fulfill their assigned duties. In order to promote water users' collective participation in irrigation management, Farmer Organizations (FOs) should be autonomous in devising their rules: they may hold internal meetings, collect water charges or maintenance fees, coordinate water delivery systems, maintain secondary and tertiary canals, resolve disputes within communities, and elect farmer representatives. (Bastakoti and Shivakoti 2012; Nagrah *et al*., 2016). According to various researchers (Arun *et al*., 2012; Muchara *et al*., 2014), collective

action can be classified into five broad categories: labour-based activities, financial-based activities, decision-making based on support, regulation and control, and dissemination of information. For a better assessment of farmers' participation, it is important to distinguish between different PIM activities.

i) The basis of farmer participation

Farmer participation in PIM/IMT projects may be motivated by outcome incentives in addition to attributes of farmers, physical characteristics, and irrigation scheme rules (Bastakoti and Shivakoti, 2012; Chun, 2014; Muchara *et al*., 2014). In addition, the participatory decision-making processes with appropriate incentives and accountability arrangements motivates farmers to act rationally in support of the irrigation development activities. The theories of collective action, which argues that individuals choose collective action when their individual actions fail to fulfil their needs and when they find contribution to collective goods beneficial (Brewer *et al*., 1999).

Based on the research works (Homans, 1958; Blau; 1964) the social exchange theory is concerned with the exchange of both tangible and non-tangible resources that occurs as a result of interaction between and among individuals. Social exchange theory posits that the relationship between individuals is determined by the perceived cost/benefit analysis of that relationship. The relationship between beneficiaries and the development agency during PIM/IMT phases is not an exception. For example, when beneficiaries realized that the cost of their participation is far outweighing the expected benefits, they could decide to cease participation in the program. While tangible benefits include items such as monetary rewards, whereas intangible benefits are innate qualities such as new knowledge and skills and self-confidence. Furthermore, social exchange also refers to relationships that entail unspecified future relationship (Blau, 1964). Although, there are no universal factors motivating beneficiaries' participation in the development process due to context-specific nature of individuals, communities and programs; beneficiaries are motivated into participation based on their individual convictions. Among other factors motivating stakeholders to participate in rural development projects in Northern Ghana, Boakye-Agyei (2009) found that tangible material benefits are one of the most important motivators. Similarly, Friedman & Craig (2004) found that positive cost-benefit analysis results could be a motivating factor for participation in development programs.

ii) The form of farmer participation

Another important distinction is between direct and indirect participation (Cohen and Uphoff, 1980). Farmers could participate directly in the implementation of irrigation projects through

provision of labour for construction or maintenance, general meetings, or during the decision making process and evaluation of irrigation system performance (Yami, 2013). Farmers could also participate indirectly by electing representatives to form part of decision making associations or committee in the schemes (Cechin *et al*. 2013).

Farmer organizers acting as teams of trained specialists have proven to be most effective in participatory irrigation projects. Wherever possible, existing organizational capacity should be built upon, as in Nepal, for example (Bastakoti and Shivakoti, 2012). If there is an inequitable distribution of assets and a very hierarchical social structure, it may not be realistic to expect fully democratic scheme organizations (Taylor and Van Grieken, 2015). In order to manage vested interests, different categories of farmers have different incentives, and this should be considered into the design of a project (for example, the definition of water rights), along with the resulting difficulties of achieving collective action (Fischer and Qaim, 2014).

Farmers are encouraged to organize themselves into Water User Associations (Ostrom, 2014). If possible, incentives should be given to farmers to organize themselves because water user associations are better way for farmers to participate in irrigation projects (Kerr *et al*., 2014). Improvements in irrigation services are the most important incentives, and a voice in management decisions can be heard through an organization that is accountable to its members (Azfar *et al*. 2014). Farmers are most likely to support, and develop organizational capacity, if they are involved from the beginning in decision-making about the irrigation scheme, if farmer organization has complete control over the irrigation scheme (Amede, 2015). It is essential, for example, that specialized staff be selected by and accountable to the farmer organizations, even if they have been trained by government agencies (Uphoff, 2019). To be successful, farmer organizations must interact constructively with government agencies and technical experts. This relationship works best when consistent rules and procedures are established, and supported by government regulation, for the turnover of responsibility to farmers throughout the project or sector. Building the necessary organizational capacity for this turnover involves training farmers for a variety of new functions, from basic literacy, accounting, how to hold meetings, and how to deal with agencies, to legal regulations, and possibly even computer applications, as well as water management and operation of equipment (Uphoff, 2019).

iii) The extent of farmer participation

Participation of farmers in PIM/IMT related projects could also be assessed by determining its extent (Delos Reyes and Schultz, 2021). Jones (1995) remarked that many development

projects in developing countries have failed because of a lack of genuine participation by beneficiaries. As a result of studying the multitude of participation programmes that existed during the 1960s, Arnstein (1969) concluded that most were not sufficient to allow local beneficiaries to change their goals and activities. From Arnstein's perspective, programmatic intentions could range from low "manipulation" of participants to "high" full control by community and service users through decision-making processes (Hardina, 2004). The table below shows the six main types or levels of participation. There are three groups of six rungs. At the top of the hierarchy is genuine participation. The next level of tokenism contains three levels that allow individuals to have a voice and be heard. Symbolic participation gives citizens some power, but it is still a kind of tokenism because traditional power holders have the capacity to make decisions (Arnstein, 1969). There is an appearance of a voice, but not a real one. Non-participation is symbolized by the two bottom rungs of the ladder. At this level, farmers are allowed to participate, but they have limited capacity to modify programmes to fit their particular needs, and ultimately maintaining the status quo in power relations (Arnstein, 1969; Aref *et al*., 2010).

Table 2.1: Levels and typology of farmer participation in the implementation of agricultural policy (adopted from Aref, 2011)

Levels	**Types**	**Characteristics**
Genuine Participation	Empowerment	Agricultural development can be directly achieved by farmers by contacting explorers
Symbolic participation	Partnership	Agricultural development is influenced to some degree by farmers
	Interaction	At this level, farmers are more involved. Farmers' rights are recognized and accepted at the local level
	Consultation	Farmers may contribute some funds to planners that will benefit their project
Non Participation	Informing	As Arnstein noted, developers often run projects without taking into account the opinions of farmers.
	Manipulation	Landowners and governments generally develop agriculture without consulting farmers.

iv) The effect of participation

It is imperative to assess the effect of farmer participation on the success of PIM/IMT projects (Senanayake *et al*., 2015; Ghosh *et al*., 2019). Many large scale irrigation systems

managed by government agencies perform poorly in terms of efficiency, equity, cost recovery, and accountability, which has spurred efforts to increase user participation (Yilak, 2013). Many of these problems have since been alleviated due to increased farmer participation, through water users' associations (Mukhtarov *et al*., 2015).

The performance of the irrigation system can be improved by increasing farmer participation (Gedara *et al*., 2012). There is a clear improvement in efficiency and service quality when farmers design and manage irrigation schemes (Knox *et al*., 2012). In addition, it is beneficial to use local knowledge when designing irrigation schemes (Ajani *et al*., 2013). Furthermore, farmers have access to incentives and means that minimize costs and improve services. The WUAs are able to reduce labour costs by paying lower wages than government agencies; they can provide closer supervision to workers than distant agency supervisors; and farmers with more ownership experience fewer breakages and loss of crop. The electricity requirement for pumping irrigation in Senegal, for example, was reduced by half. In the end, farmers were better off when water is delivered, and damaged irrigation systems were repaired so that they can increase their yields (Borgia *et al*., 2013). Farmers in the Philippines increased their net income by 50 percent during the dry season due to an increase in rice yields of 12 percent (Duhari, 2007). These were some of the benefits that resulted from implementation of the IMT and PIM policies through participatory approach.

The reduction in government staff and expenses resulting from farmer management and contributions of cash, labour, materials, and materials is one of the most notable effects (despite not being related to farmers' motivations for participating) (Kulkarnir *et al*., 2011; Khadra *et al*., 2019). User fees are more effectively collected by farmer associations than by government agencies. In most cases, farmers willingly pay more after the system is transferred to their control than the original user rate. Fees collected from farmers do not, however, motivate them to participate in agriculture. Direct benefits must be accrued to participants in order for them to participate (Crase, L., 2020; Pék, 2021).

The best way to make irrigation systems sustainable is to encourage farmers' willingness to support IMT and PIM policies and increase sense of ownership (Phali *et al*., 2020; Mudhara and Senzanje, 2020; Wang *et al*., 2021). When user fees are used to meet maintenance and operation costs instead of government subsidies, the irrigation system is more financially and physically sustainable (Kahimba *et al*., 2021; Ma'Mun *et al*., 2021; Jiang, 2023). Participatory approaches have been shown to result in more equitable organizational arrangements and water delivery. In participatory systems, tenants and small farmers are more involved than in non-participatory systems because the leadership's socioeconomic

status tends to be similar to the ordinary members (Radcliffe, 2021; García-Lorenzo et al., 2021).

Training and organizing farmers could have a significant impact on transforming them from beneficiaries to partners in irrigation development (Mapiye et al., 2021). By working with other government agencies dealing with rural issues, for instance, local officials can coordinate input supplies better. Organizing field staff, training farmers, and conducting socioeconomic research are some of the costs associated with user participation (Mohammedshum *et al*., 2023; Achichi *et al*., 2023). Nonetheless, these extra costs are generally offset by subsequent savings in building costs and higher loan repayment rates. In the absence of local institutions for cooperation, setting up a participatory approach and getting the project off the ground can be a bigger challenge. Building dams and delivery structures are easier to control than developing farmer organizations (Ricks and Doner, 2021). Participation reduces implementation time after the participatory approach is established (Chilima *et al*., 2021). Through effective participatory processes, most of the problems related to non-participatory irrigation projects can be avoided or resolved (for example, difficulties in negotiating rights of way or obstruction by farmers or local politicians) (Chilima *et al*., 2021; Enteshari and Safavi, 2021).

2.5. Farmer participation and attitudes

Farmers' attitudes towards PIM/IMT programmes and implementing agencies could also vary one irrigation scheme to another (Khanpae *et al*., 2020; Delos Reyes and Schultz, 2021; Obalola *et al*., 2021). PIM/IMT programme participants with a more favourable attitude may be more likely to participate in the planning, implementation, and maintenance phases. Farmers would be enthusiastic about IMT and PIM projects, but negative perceptions or attitudes toward the programme could have devastating consequences. Therefore, it is imperative to understand the effect of farmers' attitudes towards farmers' level of participation during implementation of the IMT and PIM programmes (Delos Reyes and Schultz, 2021).

Reddy (1987) found that most respondents had formed a more favourable attitude toward all three components of Watershed Development Program, including (i) SWC, (ii) improved dry farming technologies, and (iii) non-arable land development. Additionally, he found highly statistically significant differences between smallholder farmers and commercial big farmers' attitudes towards watershed management practices. All three components of watershed management had developed a more favourable attitude among commercial farmers than among smallholder farmers. Clearly, the tendency of farmer participation in PIM/IMT related

project could be heavily affected by an individual's behaviour. Participatory behaviour's, however, are determined by certain prerequisites (Taqipour *et al*. 2015). Afshar and Zarafshani (2010) recognizes the importance of analysing farmers' behaviour in various circumstances. The Theory of Planned Behaviour (TPB) of Ajzen has been thoroughly tested (Armitage and Conner 2001; Boudreau and Godin 2009). Originally proposed by Icek Ajzen in 1985, the theory of planned behaviour (TPB) extends the theory of reasoned action (TRA) (Ajzen, Fishbein, 1980; Fishbein & Ajzen 1975). According to TPB, human behaviour can be explained and predicted by how beliefs and attitudes affect behaviour (Ajzen 1991), and we postulate that attitude determines behaviour when three conceptually independent constructs determine attitude: attitude, subjective norm, and perceived behavioural control.

Salient beliefs are the specific viewpoints that constitute behavioural, normative, and control beliefs, determining all constructs (attitude, subjective norm, perceived behavioural control, etc.). Additionally, the underlying TPB variables are defined by specific salient beliefs. Beliefs fall into three categories: behavioural beliefs (attitude toward actions), normative beliefs (subjective standards), and control beliefs.

2.6. Farmer participation and awareness of PIM/IMT projects

The main element to the proper functioning of RESIS related programmes is that all parties should have access to information - farmers, irrigation scheme officials, field staff, the government and other ministries, the press and media, as well as the general public. The RESIS programme should be transparent in its objectives and operations in order to be effective, and good communication practices are essential for this to be the case. As part of the IMT Public Awareness Campaign, Barker and Molle, (2004) developed this Public Awareness Campaign proposal which includes a comprehensive strategy and set of communication tools to educate all targeted audiences on how to participate in and support IMT initiatives. The campaign was designed to: 1) provide support for the development of IMT by developing a comprehensive, wide-scale communications outreach program aimed at involving everyone who is required to participate and be involved, 2) increase awareness of IMT among the key target audiences and, ultimately, the people living around the project sites, 3) develop educational tools that will enable the project implementers to effectively and efficiently convey IMT ideas to target audiences, especially a core group of irrigation extension agents and Communications Unit task managers, 4) develop a method for distributing and disseminating information that allows it to be applied in various ways depending on the audience and the information at hand, 5) define an initiative to increase public awareness of water conservation issues by collaborating with other government

departments and the "engaged" public, 6) and develop a regular conference schedule, workshops, and seminars that invite everyone to keep learning about IMT and getting involved (Winrock International, 2001).

There must be a very effective PIM/IMT awareness campaign targeting those directly affected by the programme: the farmers themselves. RESIS participants should be taught that they will benefit from participation both now and in the future. To be effective, they must understand RESIS policies, the costs, benefits, and responsibilities of both themselves and the government. Following familiarization and acceptance, they can implement the policy confidently. Following familiarization and acceptance, they can implement the policy confidently (Winrock International, 2001).

Communication of RESIS programmes to farmers should take into consideration their individual characteristics, so that all responsibilities and messages are clearly communicated to them. These farmers have special requirements that set them apart from other targets. The types of farm activities, the size of the operation, and their educational background directly affect the needs of these farmers. It will be necessary to tailor and frame messages for them as well as the tools used to deliver the messages in such a way as to capture their attention and transfer information effectively (Winrock International, 2001).

It should also be noted that there are subgroups within this target group. When framing messages and doing outreach, the RESIS related programmes should make every effort to take into account the special needs of each subgroup of farmers. There may not be a practical way to create a significant amount of specialized materials that address the diverse needs of these groups within the short-term. Through the materials to be used for the entire target group, this can be accomplished on a basic level or in subtle ways (Winrock International, 2001).

These issues, however, should be addressed in greater detail as the program moves toward the medium-term, so that messages can be tailored more effectively and better communication can be provided. The following characteristics of a farmer group should be taken into account for the Public Awareness Campaign: Educated or non-educated, large or small farmers, owners or tenants, improved or unimproved lands, male or female, old or new lands (Winrock International, 2001).

2.7. Assessment of farmers' participation in PIM/IMT projects

Many of the scholars (Alam *et al*., 2012; Nhundu, *et al*., 2015) explored the cross-sectional survey research design methods where structures questionnaire and personal interviews were conducted to determine effect of farmer participation in PIM/IMT related projects. In most cases, multistage random sampling procedure was adopted since it is the most famous method to sample farmers in irrigation schemes (Arun *et al*., 2012; Etwire *et al*., 2013; Sharaunga and Mudhara 2018). Additionally, in most cases, preference was given to Logit, Probit, Tobit and Multiple regression models as suitable inferential statistical approach to determine and assess the direction and degree of each factors affecting farmers' participation (Chandran and Chackacherry, 2004; Botlhoko and Oladele 2013; Luo *et al*., 2018).

In terms of statistical analysis, farmer participation was considered to be dependent variables with other factors as independent variables. Nonetheless, most researchers considered farmer participation as a discreet choice or dummy dependent variable (Botlhoko and Oladele, 2013; Etwire, *et al*., 2013; Nhundu *et al*., 2015; Sharaunga and Mudhara, 2018; Sithole, *et al*., 2014). On the other hand, most research works (Alam *et al*., 2012; Muchara *et al*., 2014; Sheikh *et al*., 2014) are based on identifying the number of farming activities and measuring them using the Participation Index (PI). Take for instance, Alam, (2012) managed to develop PI based on the average difference between farmers who were willing to participate in PIM/IMT projects and those not willing to participate. In this case, farmers were grouped into those willing to participate in water allocation, field canal maintenance, revenue collection, dispute resolution, and revenue collection at both the distributary and field canal levels using a three-point scale. Nonetheless, this kind of measurement was associated with level of uncertainty (Alam, 2012).

Muchara *et al*. (2014) used PCA to reduce dimensions, Tobit regression to assess factors influencing participation, and ordered Probit regression to measure level of farmer participation in collective actions of smallholder irrigation schemes. An ordered Probit regression model was used to account for the ordered nature of farmer participation levels as a dependent variable.

2.8. The knowledge gap

A review of the literature indicates that vast studies have been conducted on farmer participation in collective action related to irrigation schemes in countries such as South Africa, Ghana, Zimbabwe, India, Pakistan, Tajikistan, Iran, China, Swaziland, and Uganda,

using cross section surveys. Researchers have mostly focused on the effect of socioeconomic factors on farmer participation, but few have examined the effect of farmers' attitudes toward IMT and PIM projects. Additionally, there has been little research on how farmers' awareness of IMT/PIM projects affects their participation.

It is worth noting that even studies with similar results may differ in the direction and significance of the same factor. There was probably a variation in degrees of certainty because different methods were used. There were some studies that examined how farmer attitudes and awareness of PIM/IMT projects affected farmer participation, but the results were not conclusive because some factors were not evaluated individually but were used to develop a Participation Index collectively. As an example, consider how income affects farmer participation in management, operation, and maintenance. According to most of the studies, higher income could be associated with higher levels of farmer participation in collective action, but high farming expenditures might reverse this gain. A focus on and comparison of household incomes may miss the effect of farming expenditures on farmer participation. There is no doubt that farmers participate in farming activities if the benefits outweigh the costs.

Furthermore, as previously demonstrated, the proposed determinants have some limitations, since the factors affecting farmers’ level of participation during the PIM/IMT may vary from one irrigation scheme to another. Furthermore, a factor that enables farmers to participate in one irrigation scheme could also prevent them from participating in a different irrigation scheme at the same time.

In South Africa, irrigation schemes are fraught with problems, but no household level study has been conducted to assess attitudes and awareness about farmers' participation in PIM/IMT related programmes. A number of contributions are made to the field of PIM/IMT by this study. A detailed and sufficient description of the conceptual framework and methodologies is provided in this study so that future research can be replicated. The framework can be used to identify combinations of factors that affect farmers' participation in PIM/IMT projects, and to compare their relationships. The proposed determinants and measures can provide a basis for further research in South Africa and other developing countries.

2.9. Conceptual Framework: Assessment of farmers' level of participation in PIM/IMT projects

Based on the reviewed literature, level of participation in RESIS programme (as dependent variable) could be affected by selected demographic and socioeconomic factors such as age, gender, marital status, household farm income, etc. as independent variables (Figure 2.2). These factors could behave as enabling or disabling environmental in the schemes to encourage or discourage required level of farmer participation in the schemes. The framework also includes other independent variable such as awareness or knowledge and attitude towards RESIS programme and implementers (implementing agencies, government officials and engineers). According to the conceptual framework below, socio-demographic factors and farmers' awareness as well as attitude towards RESIS programme and implementers, could have significant effect on farmers' level of participation in RESIS programme and access to water for irrigation by farmers in revitalized smallholder irrigation schemes.

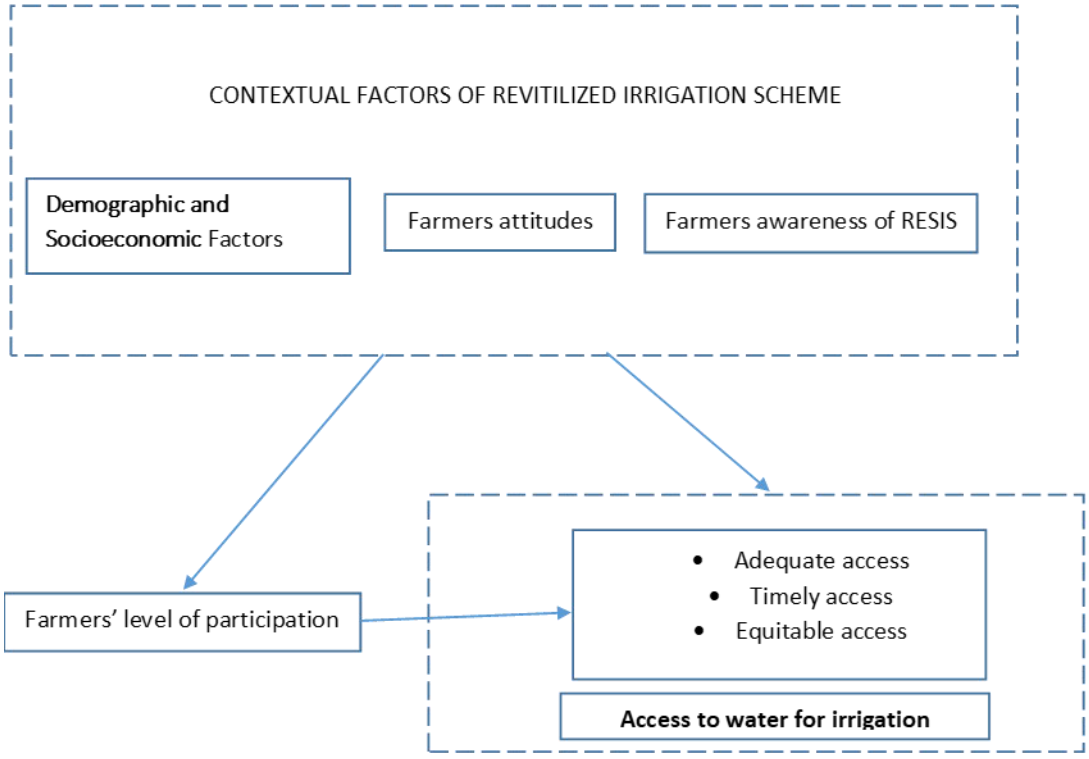

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Figure 2.2: The conceptual framework towards investigating farmers' level of participation and access to water in revitalized smallholder irrigation schemes in the KwaZulu-Natal Province.

2.10. Summary

The framework developed by Cohen and Uphoff (1980) to define farmer participation in rural agricultural development served as the basis for the literature review. It is evident from the framework that participation is defined as a multifaceted concept that allows for the analysis and promotion of several different but related activities. The literature review also revealed a distinction between political and developmental participation. Participation in politics may lead to development, but political participation alone is not sufficient for development participation. Participation in agricultural projects was also discovered to be not just an end in itself, but it is more than a means. Depending on the stakeholder, participation may mean different things as an end or a means. Farmers may view their participation in agricultural projects as a means of gaining access to resources (financial, markets, irrigation infrastructure, etc.) as project beneficiaries. The review of the literature also shows that farmer participation in agricultural projects may not have the same effect on project success if it is not contextualised with regard to the kinds of participation, the context, and types of stakeholders. Therefore, the conditions under which farmers participate in the agricultural project at different stages may depend on socioeconomic, demographic, and attitude factors. Despite the various farmers' level of participation, decisions are made at every stage of the agricultural project. Benefit sharing and evaluation are viewed as output stages, while decision making, and implementation are considered input stages. Therefore, it is critical to outline the kids of participation and the conditions under which a farmer must participate in agricultural projects to yield the intended results. While most studies have focused on the effect of socioeconomic factors on farmer participation, few have examined the attitudes of farmers towards IMT and PIM projects. Additionally, not much research has been done on how farmers' awareness or knowledge affects their participation in IMT/PIM projects. The conceptual framework and methodology are sufficiently well described in this work to allow for their replication in other research studies. The framework can be used to evaluate and pinpoint combinations of variables that affect farmers' participation in PIM/IMT initiatives.

CHAPTER 3: RESEARCH METHODOLOGY

3.1. Introduction

This section describes the methods used to determine if socioeconomic factors, farmers' attitudes towards RESIS programme and implementers, and farmers' level of RESIS awareness statistically significantly affect farmers' level of participation in the revitalization process and access to water for irrigation of selected revitalised smallholder irrigation schemes in the KZN Province, South Africa.

3.2. Research design

In this study, a cross-sectional research design was used. A quantitative research method was used with a survey questionnaire as a data collection tool.

3.3. Study area

Four irrigation schemes (Tugela Ferry, Mooi River, Makhathini Flats, and Ndumo B) in the KwaZulu-Natal Province (South Africa) were purposively selected to address research questions. The following criteria were used to select irrigation schemes that were part of the revitalization program in the past five years: a mixture of gravity and pumped irrigation systems, irrigation schemes supported by agencies (e.g., Mjindi in the Makhathini Irrigation Scheme), and schemes exclusively operated by elected scheme management committees (Ndumo B, Tugela Ferry and Mooi River). Furthermore, after the revitalization program was implemented, the scheme should have been operational for at least a year.

3.3.1. Tugela Ferry Irrigation Scheme

The scheme was constructed in 1889 to early 1900 and is situated near to the town of Tugela Ferry in KwaZulu-Natal. Plots measuring 1000 m^2 (0.1ha) were originally allocated to households based on the traditional methods of allocating land in the KwaZulu traditional authorities. The Scheme was originally designed and constructed as a gravity-fed flood irrigation scheme which is situated on valley-bottom alluvial soils along the Tugela River. The bulk infrastructure consists of a weir on the Tugela River which feeds a main canal along the south bank of the river and a syphon across the river to a main canal serving blocks of irrigable soils on the north bank. The total length of main canal is about 31 km.

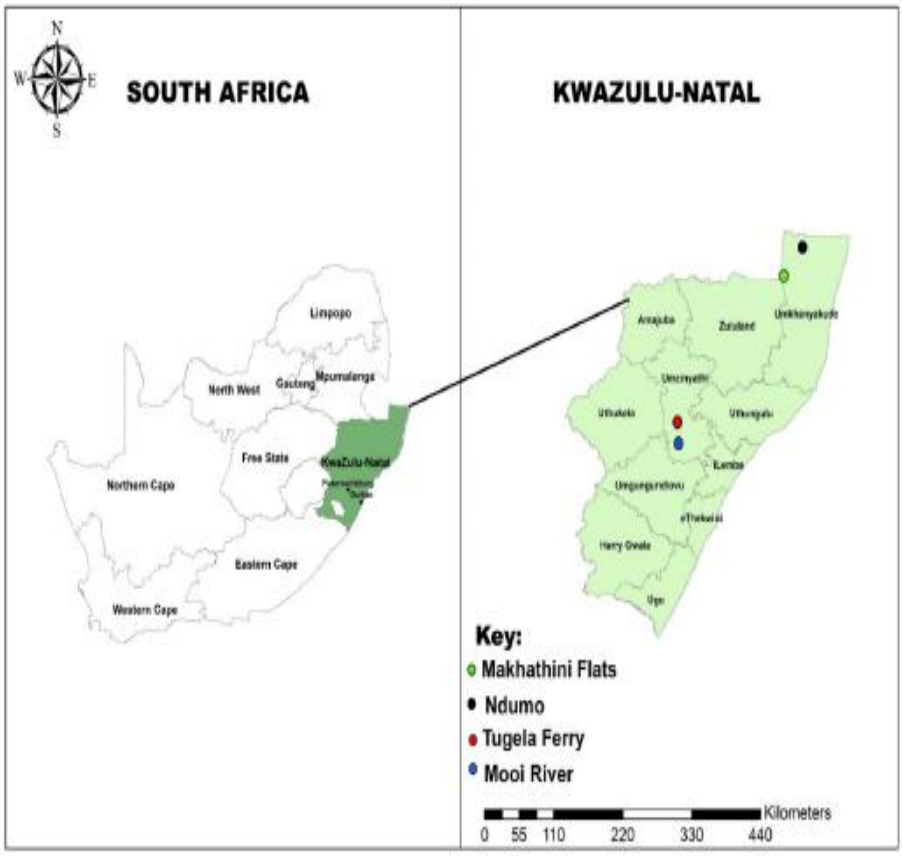

Figure 3.1: The location of the selected irrigation scheme in the KwaZulu-Natal Province (Mudhara and Senzanje, 2020)

The Scheme is 726 ha in extent with nine discrete irrigation blocks. The irrigation scheme is divided into nine blocks (1, 2, 3, 4A, 4B, 5, 6, 7A and 7B) with Blocks 1-4B on the south bank of the Tugela River and Blocks 5-7B on the north bank of the river. Originally all nine blocks received their irrigation water from the main canal on the south bank, a syphon across the river to the north side feeding a second main canal to the end of Block 7B. All nine Blocks were served by secondary canals running at right angles to the main canal into the lands and from which irrigation water was led into individual plots by furrow irrigation.

Over the past 10 years, a rehabilitation of bulk scheme infrastructure has been underway. This has involved firstly the installation of buried mainline pipes from the main canal into Blocks 1, 2 and 3 and flexible hoses at each plot for controlled flood (furrow) irrigation in these three Blocks. Secondly the installation of pump stations at Blocks 4a, 4b, 5, 6, 7a and 7b for pumping irrigation water directly from the Tugela River.

The nine blocks of the irrigation scheme fall under three traditional authorities namely the Mthembu, maBaso, and Ngubane Traditional Authorities. Block one to four fall under the Mthembu Traditional Authority under the Sijozini, Mbabane and Malomeni communities.

Block five and six fall under the Mabaso chieftaincy and Block seven falls under the Ngubane TA in the Ezingulubeni community. The scheme falls within five municipal wards, namely ward 3, 4, 5, 6 and 14.

The Scheme was selected based on DALRRD officials that RESIS projects were undertaken with relation to rehabilitation of irrigation infrastructure, provision of farmer training, inputs and outputs markets, institutional arrangements as well as financial access. In addition, scheme was selected because it was fully operational under both gravity and pumped irrigation system.

3.3.2. Mooi River Irrigation Scheme

The Tugela Ferry Irrigation Scheme is also next to the Mooi River Irrigation Scheme. It covers over 600 ha and has over 380 active farmers (KwaZulu Natal Department of Agriculture and Land Reforn - KZN-DARD, 2021). It is within a 30-km radius of a larger smallholder irrigation scheme, Tugela Ferry Irrigation Scheme. In terms of management and distribution of water, the scheme is divided into 15 blocks of different sizes. A scheme management committee oversees the allocation of water within each block. Plots of less than 0.4 ha are included in both the Tugela Ferry and Mooi River irrigation schemes (Gomo *et al*., 2014). The Mooi River Irrigation Scheme was also being revitalised with the help of the government departments, including the Department of Agriculture, Land Reform, and Rural Development. This scheme was also selected based on the reasons as the Tugela Ferry irrigation scheme and the fact that these schemes were divided into smaller plots compared to other schemes (Makhathini and NdumoB).

3.3.3. Makhathini Irrigation Scheme

The Makhathini Irrigation Scheme is located in the north-eastern part of KwaZulu-Natal Province, and it covers the floodplains on both sides of the Pongola River, from just below the Jozini Dam to the confluence of the Pongola and Usuthu Rivers on the Mozambican frontier. The scheme is located in the Umkhanyakude District of the Jozini Local Municipality, near Jozini Town. The irrigation scheme is comprised of 10 hectare plots of the total land size 4,572 hectares and no expansion took place so far (KZN-DARD, 2020).

According to KZN-DARD (2020) the Makhathini irrigation scheme is composed of two categories of beneficiaries: individual farmers and cooperatives. There are 312 individual farmers operating in the scheme whereas 786 farmers were grouped into 10 cooperatives. Accordingly, there are 818 plot holders, with an average size of 10 hectares. The Makhathini Irrigation Scheme is one of the economic development schemes in the UMkhanyakude District, as well as a component of the Makhathini Master Plan. The scheme had been

undergoing a revitalization phase implemented by Mjindi Farming (Pty) Ltd. The entity (Mjindi) ceased to operate by March 2020 and all functions were transferred to the caretaker Agribusiness Development Agency (ADA). The entity was mandated to provide the irrigation water and farmer advisory services, in pursuit of developing farmers in Makhathini Irrigation Scheme.

The Makhathini irrigation scheme, unlike Mooi River and Tugela Ferry, use pumped irrigation system and rely heavily on electricity to pump water from overnight dams and bulk canals to the plots. In addition, this scheme was still undergoing revitalization process.

3.3.4. Ndumo B Irrigation Scheme

The 446 hectare Ndumo B Irrigation Scheme is located approximately 10 kilometers south of the Ndumo Game Reserve and 5 kilometers from the small town of Ndumo. It's in a very rural Zulu community that falls under the Nyawo Traditional Authority's jurisdiction and is bordered to the east by the Tembe Traditional Authority and to the north by the Mathenjwa Traditional Authority. The Scheme, which receives its water from the Pongola River, is accessed through a gravel road (D1851). The Scheme is located in ward 17 of the local municipality.

NdumoB Phase 1, which covers about 179 hectares, was developed 10 years ago and consists of 13 farmers with plots averaging 10 hectares. The DALRRD funded revitalization of NdumoB Phase 2 (total of 267, adjacent to Phase 1) in 2012. Phase 2 was divided into 27 plots, each of which is 10 hectares in size and was farmed as a commercial unit. Pump stations are located on the banks of Pongola River and irrigation water is pumped directly to the sprinkler irrigation systems on the blocks. A sophisticated pressure regulation system in the scheme has been implemented, involving the gradual transition or exclusion of pumps based on pumping demand. Farmers in Phase 2 were registered and begun operating in September 2015.

Just like Makhathini Irrigation Scheme, the scheme was selected because it went through revitalization process, fully under pumped irrigation system and was still operative.

3.4. Target population and sampling frame

3.4.1. Target Population

Population refers to all irrigating farmers from the four selected smallholder irrigation schemes in the KZN Province who were active during revitalization process. These farmers are the beneficiaries of government-owned schemes that were handed over to them after revitalization process. The Makhathini, NdumoB, Tugela Ferry, and Mooi River Irrigation

Schemes had a confirmed total of 2124 registered irrigating farmers that considered for this study (Table 3.1).

3.4.2. Sample and sampling procedure

Purposive sampling was used in this study to select the irrigation schemes based on predetermined criteria. Following that, a random sampling of irrigation farmers within each irrigation scheme was performed. Irrigating farmers from each scheme comprise the sampling unit for this study. Using the list of irrigating farmers given by each scheme, random sampling procedure was used. The sample size for each scheme was calculated using the formula below:

$$S = \frac{N}{1+N\,(e)^2} \quad \text{.....(1)}$$

Where S is the sample size, N is the population size, and e is the degree of precision or error, the recommended e for social science research is 5% since it gives a 95 percent confidence interval. However, if resources are not limited, investigators or researchers can use a larger e (for example, 10%). (Naing *et al*., 2006). As a result, e = 10% was used in this study. The number of irrigating farmers sampled per scheme along the canal is shown in Table 3.1 (divided into three strata). Additional farmers were also interviewed in addition to the calculated sample size in order to increase precision level given specified combinations of population size and confidence level.

Table 3.1: Number of farmers sampled from selected irrigation schemes

Irrigation Schemes	Population	Sample size per scheme	
		Calculated	Interviewed
Makhathini	778	85	111
Ndumo B	49	-	49*
Mooi River	380	74	75
Tugela Ferry	771	88	110
Total	**2124**		**345**

Note: All NdumoB farmers were interviewed

The sample size for the interviews was selected from four schemes calculated using the formula above. This sample size is acceptable, particularly in light of Bailey (1994)'s suggestion that around 30 cases appear to be the bare minimum for studies requiring statistical data analysis using statistical analysis software such as the Statistical Package for

the Social Sciences (SPSS). Other statisticians (Muller and Benignus, 1992; Lenth, 2001; O'Brien and Castelloe, 2007) on the other hand, believe that the census method should be used for populations of fewer than 100 people. As a result, all irrigation farmers in Ndumo B irrigation scheme were interviewed.

3.5. Instrumentation, scales, and measurement

The main aim of the study was to determine factors affecting the level of farmer participation during the RESIS phases of selected smallholder irrigation schemes in the KZN Province. The supervisors at the University of KwaZulu Natal and University of Zululand were pivotal in developing, evaluation, and approval of a questionnaire. Personal interviews with a questionnaire were used to collect data. Personal interviews with a questionnaire, according to Miller (1983), have more benefits than other approaches. It allows the researcher to obtain a high percentage of return, the information is more likely to be accurate, scoring and testing instruments can be used, and additional information about the respondents' personal characteristics can be collected, and the researcher can normally monitor which individual or persons answer the questions. The interviews were conducted by trained enumerators from selected schemes who were fluent in the local language.

Quantitative data was collected using a closed-ended questionnaire consisting of five sections: (1) socio-economic and demographic factors, (2) farmers' awareness of the RESIS Programme, (3) farmers' participation levels in RESIS programme stages, (4) farmers' attitudes toward the RESIS Programme, and (5) attitudes toward RESIS implementing officials as well as their access to water for irrigation. To have a better understanding of the study's instrumentation, figure 1 (in chapter 2) presents the study's conceptual framework and description of variables.

3.5.1. Description of the study variables

Table 3.2 describes variables and levels of measurements based on the study objectives.

i) Farmers' level of participation

In this study, farmers' participation levels in RESIS stages (FPID-decision making, FPII-implementation, FPIB-benefit sharing and evaluation) were assessed as both independent and dependent variables. Multiple Linear Regression models were used to determine the effects of independent variables (demographic and socioeconomic factors, RESIS knowledge, farmers' attitudes towards RESIS programme and its implementers) on participation levels in four RESIS stages. According to Pèk *et al*. (2019), farmers' level of participation during decision making could have positive and significant effect on productivity and ultimately success of irrigation schemes. It was expected that high levels of farmer

participation during different stages of revitalization would have a significant positive effect on farmers' access to irrigation water in this study.

Table 3.2: Description of variables in the study

Variable Description	Level of Measurement
Farmer Participation Index of RESIS stages (FPID-decision making, FPII-implementation, FPIB-benefit FPIE-sharing and evaluation)	Continuous variables (%)
Farmer has adequate, equitable and timely access to water	0=No 1=Yes
Age	years
Size of the household	Number of persons per household
Gender	0=Female 1=Male
Educational level of the household head	0=non-formal education, 1=Primary education (Grade 1-6), 3=Secondary education (Grade 7-12), 4= Tertiary education (Certificate/Diploma/Degree)
Size of the household farm/plot	Number of hectares
Marital status of the household head	Singe=0 Married=1
Farmers' knowledge of the RESIS Programme	1=Yes 0=No
Attitudes of farmers toward RESIS irrigation infrastructure services	Likert scale of 1 to 5*
Attitudes of farmers toward RESIS output market services	Likert scale of 1 to 5
Attitudes of farmers toward RESIS financial support services	Likert scale of 1 to 5
Attitudes of farmers toward RESIS training services	Likert scale of 1 to 5
Attitudes of farmers toward RESIS institutional arrangement support	Likert scale of 1 to 5
RESIS implementers have participatory approach during RESIS process	Likert scale of 1 to 5
RESIS implementers are efficient and effective	Likert scale of 1 to 5
RESIS implementers fairness	Likert scale of 1 to 5

*__Note__: Likert scale of 1 to 5 refers to=1-Strongly disagree, 2=Disagree, 3=Neutral, 4=agree and 5=Strongly agree

i) Farmers’ access to water for irrigation

As with farmers' participation level, farmers' water access level was either a dependent or independent variable. Adekunle *et al*. (2015) argue that farmers only participate in dryland farming because of a lack of water for irrigation. Water availability on time, equitably, and adequately would motivate farmers to participate in irrigation farming. Therefore, access to irrigation water was expected to have a positive statistically significant effect on farmers' participation during different stages of RESIS.

ii) Farmers’ knowledge of the RESIS programme

Mabe *et al*. (2021) assessed household food insecurity levels using an endogenous switching regression treatment effects model with ordered outcomes. The study found that households that were aware of SDG2 were more food secure than their counterparts. As an independent variable in this study, farmers' knowledge of the RESIS programme was considered a positive factor affecting their participation and access to irrigation water. In addition, if farmers are aware of the RESIS programme, they could be more likely to participate in irrigation schemes' collective activities. Therefore, farmers’ access to irrigation water was proxy to RESIS programme success. The study expects RESIS knowledge or awareness to positively statistically affect farmers' levels of participation and access to water for irrigation in four revitalised smallholder irrigation schemes.

iii) Farmers’ attitudes towards the RESIS programme

RESIS services such as access to functional irrigation infrastructure, input and output markets, financial support, training and robust institutions may have a positive impact on farmers’ participation during RESIS stages and access to irrigation water as a proxy for the programme's success.

iv) Farmers’ attitudes toward RESIS implementers

Good resource governance emphasizes participation, transparency, fairness, efficiency, and effectiveness (Akuriba *et al*., 2020). Participatory approach will also be applied to RESIS program implementation by RESIS implementers. Irrigation resource sustainability requires cooperation between water users, particularly at the community level. It is the purpose of this section to examine the influence of farmers' attitudes on their level of satisfaction with RESIS implementers' adherence to good governance or Batho Pele Principles. Batho Pele means "People First" and can be summed up by this slogan: "We belong, we care, we serve.". Batho Pele encourages public servants to deliver excellent services through continuous improvement (DPSA, 2023). Using good governance indicators, the South African government promotes adherence to Batho Pele Principles. It is possible that farmers' level of participation as well as their access to irrigation water could be affected by their positive

attitudes towards participation, efficiency and effectiveness, and transparency and fairness of implementers during the RESIS stages. It was expected that the effect would be positive. Farmers who are positive about the adherence of RESIS implementers to Batho Pele Principles and good governance will be more likely to participate in the RESIS stages and ultimately succeed in the programme because they will have access to water for irrigation in revitalised irrigation schemes.

3.5.2. Statistical analysis procedures of the study objectives

Table 3.3 summarizes statistical procedures followed to test hypothesis and answer research questions for each research objectives. In this section, statistical procedure for each study objective were described.

Table 3.3: Summary of statistical analyses methods used to attain each research objective

Objectives	Statistical analysis method
• To describe socio-economic and demographic factors of farmers in four revitalised smallholder irrigation schemes	Descriptive statistics, χ2 tests, ANOVA F-tests, Scheffe's test
• To determine farmers' knowledge of RESIS programme in four revitalised smallholder irrigation schemes	Descriptive statistics and χ2 tests
• To analyse farmers' attitudes toward the RESIS programme and Implementers (government officials, agencies, and contractors in four revitalised smallholder irrigation schemes	Cronbach's alpha (internal consistency), descriptive statistics, χ2 tests, ANOVA F-tests, Scheffe's test,
• To assess farmers' level of participation of the farmers during revitalization of four smallholder irrigation schemes	Descriptive statistics and χ2 tests
• To determine the effect of selected variables (demographics, attitude, and knowledge) on farmers' level of participation during revitalization of four smallholder irrigation schemes.	Ordered Probit Model (OPM)
• To determine the effect of selected variables (demographics, attitude, knowledge and farmers' level of participation) on farmers' access to water for irrigation in four revitalised smallholder irrigation schemes	Probit Model (PM)

Objective 1: To describe socio-economic and demographic factors of farmers in four revitalised smallholder irrigation schemes.

This section tested the hypothesis that there is no statistically significant difference between the socioeconomic factors of farmers in the selected four smallholder irrigation schemes. To achieve this, collected data on age, marital status, household size, gender, education level and household land size of farmers in four irrigation schemes were subjected to descriptive (means, standard deviation, tables, frequencies and percentages) and inferential (Chi-square and ANOVA) statistical analyses using a combination of STATA 17.0, IBM SPSS and MS Excel programmes. The Chi-square was used to determine if the relationships between categorical data (marital status, gender, and education level) of farmers across four irrigation schemes were statistically difference. On the other hand, the ANOVA was used to test statistical significance difference between means of continues variables (age, size of household and land) of farmer across four irrigation schemes.

Objective 2: To determine farmers' RESIS programme awareness in four revitalised smallholder irrigation schemes.

This section provides a statistical procedure used to test the hypothesis that there was no statistical significance difference in farmers' awareness of the RESIS programme across four irrigation schemes in the KZN Province. The binary data collected using questionnaire were based on the general awareness of the RESIS programme activities (rehabilitation of irrigation infrastructures, provision of input and output markets and training). The data on farmers' level of RESIS awareness were subjected to descriptive (tables) and inferential (Chi-square) statistics.

Objective 3: To analyse farmers' attitudes toward the RESIS programme and its Implementers (government officials, agencies, and contractors) in four revitalised smallholder irrigation schemes.

In this section, the study tested the hypothesis that the farmers' attitudes towards RESIS programme and its implementers were statistically significantly different across four irrigation schemes. A close-ended questionnaire consisted of 61 items developed and grouped into RESIS objectives (farmers' access to operational irrigation infrastructure, input and output markets, financial support, training and institutional arrangements) and RESIS implementers' adherence to good governance principles, fairness and transparenc was deployed to measure farmers' attitude toward RESIS programme (31 items) and implementers (30 items), respectively. The questionnaire as an instrument utilized a five-point Likert scale. The scale constituted: 1 - strongly disagree; 2 - disagree; 3 - neutral; 4 - agree; and 5 - strongly agree. According to the business plan of the DALRRD (2022), the main objectives of the RESIS programme include farmers' access to operational irrigation infrastructure, production inputs, input and output markets, financial support, training. It was

assumed that the revitalized irrigation scheme would achieve all these objectives. Furthermore, all good governance principles were also assumed to be adhered to by RESIS program implementers. It is imperative that RESIS implementers follow all good governance principles, such as participation, transparency, accountability, capacity development, efficiency, and effectiveness, in order to implement RESIS successfully. Participation in RESIS programme should be encouraged through inclusive decision making, which involves all farmers. It is important to encourage transparency and cooperation within RESIS implementers by using democratic principles, holding adequate meetings, and allowing members to be open at these meetings. Through democratic principles, resources are used efficiently and fairly, improving productivity and increasing social capital. The implementation of RESIS programme will require informed interventions in the form of capacity building (Akuriba *et al*., 2020).

Likert-scale surveys are recommended for studies where one survey item cannot adequately capture a concept being assessed, such as farmer attitudes (Gliem and Gliem, 2003; Sullivan and Artino Jr, 2013). Developed by Rensis Likert in the 1930s, the Likert scale has become a standard method of rating opinions (Coolican, 2009; Adah *et al*., 2016). To compute farmers' attitudes towards RESIS and its implementers The five point Likert Scale was used as follows: Strongly Agree -5, Agree (A)-4, Neutral – 3, Disagree-, 2 Strongly Disagree -1. For each item, the mean response was calculated using the formula below:

$$\bar{x} = (\sum FX)/N \quad \text{.....(2)}$$

Where:

$\bar{x}$ = means response,

$\sum$ = summation,

F = number of respondents choosing a particular scale point,

X = numerical value of the scale point; and

N = total number of respondents to the item.

Based on the mean weights, the decision was made whether farmers are positive or negative about RESIS and its implementers. An attitude value of 3 [(5+4+3 + 2 + 1) ÷ 5 = 3] or more indicates a positive attitude towards that particular item among farmers in SISs. A continuous value should be rounded to the nearest discreet value for easy interpretation.

Data was subjected to descriptive (means, standard deviation, and tabulation) and inferential (ANOVA and Scheffe) statistics. To determine internal consistency of the scale, results of the farmers' attitudes towards RESIS programme and its implementers were subjected to Cronbach's alpha tests. This is prerequisite for data collected using Likert scale and can only be subjected to parametric analysis if its Cronbach alpha value exceeds 0.7.

Objective 4: To assess farmers' level of participation during revitalization across four smallholder irrigation schemes.

This section provides statistical analyse procedures used to test the hypothesis that farmers' level of participation did not differ statistically significantly across four selected smallholder irrigation schemes. The Arnstein's Ladder of Citizen Participation theory approach was used by various scholars (Okoth and Mbugua, 2018; Ndlovu, 2021; Zondi, 2021) to critically analyse type and level of farmer participation in various agricultural projects. A similar approach was used in this study to assess farmer participation during different phases of the RESIS programme. Table 3.4 indicated the modified version of Arnstein's ladder of participation in the democratic process used in this study was developed by Aref *et al*. (2010). According to Aref *et al.* (2010) six types of participation are grouped into three levels: non-participation (1 - manipulation, 2-information), symbolic participation (3 - consultation, 4-interaction, 5 - partnership) and genuine participation (6-empowerment). Farmers' level of participation in RESIS stages was determined based on the characteristics of types of participation (Table 1). With reference to manipulation participation, farmers were not consulted regarding RESIS implementation. However, informing participation indicates that farmers were only informed about RESIS, but their inputs were not taken into account during RESIS stages. In symbolic participation level, RESIS implementers only consulted farmers if contributions were required from farmers (consultation), farmers are also active during RESIS meetings and their rights are acknowledged and observed (interaction), and farmers also have some control over the RESIS programme (partnership). Genuine participation occurs when farmers contact RESIS implementers and ask for their intervention with farmers directly involved in irrigation scheme revitalization (empowerment). The collected data was subjected to descriptive (tables and histograms) and inferential (Chi-square) statistics to determine if statistically significant difference exists between level of farmer participation in four selected smallholder irrigation schemes.

Table 3.4: Assessment of farmers' level and type of participation during different stages of RESIS programme

Level	Types of participation	Characteristics
3. Genuine Participation (High)	Empowerment	RESIS decisions should be approved by farmers, who are the primary stakeholders.
2. Symbolic Participation (Average)	Partnership	Farmers have varying degrees of control in the RESIS process.
	Interaction	Farmer inputs were received by RESIS implementers without any guarantees that their inputs would be considered.
	Consultation	Farmers were only consulted about RESIS before decisions are taken and their inputs not taken into consideration
1. Non-participation (Low)	Informing	RESIS decisions were only informed to farmers without farmer participation
	Manipulation	Farmers were not consulted about RESIS process and decisions were made without their knowledge

The level of farmer participation (0=non-participation, 1=symbolic participation, and 2=genuine participation) was based on the type of participation during different stages of the RESIS program. Level 0 of farmers' participation consists of manipulation and informing, while level 1 consists of consultation, interaction, and partnership. In the final level of participation (level 2), only empowerment was considered genuine participation. Farmer Participation Index FPI_{scheme} measures farmer participation in RESIS stages by calculating the ratio between 'actual participation' (rated level of farmer participation) and 'possible participation' (maximum level of farmer participation) expressed as a percentage. Mathematically, can be expressed as follows (Hasan, *et al*. 2006):

$$FPI_{scheme} = \frac{1}{3} + \left(\frac{FPa_{non}}{FP_p} + \frac{FPa_{symb}}{FP_p} + \frac{FPa_{genuine}}{FP_p}\right) \times 100 \quad (3)$$

Where,

FP_p =farmers' possible level of participation (genuine participation, level 3) during RESIS stages.

FPa_{non}= Farmers' actual level of participation (non-participation, level 0) based on two types of participation (Manipulation and Informing) during RESIS stages.

FPa_{symb} = Farmers' actual level of participation (symbolic participation, level 2) based on three types of participation (consultation, interaction and partnership) during RESIS stages.

$FPa_{genuine}$ = Farmers' actual level of participation (genuine participation) based on a type of participation (Empowerment) during RESIS stages.

As a result, FPI could vary from 0 to 100, with 0 indicating no participation and 100 indicating full participation.

Objective 5: To determine farmers' level of water access in four irrigation schemes.

This section provides statistical analysis procedures to test the hypothesis that farmers in four irrigation schemes do not differ statistically significantly in access to water for irrigation after implementation of the RESIS programme. Farmers' water access for irrigation was based on three key criteria: adequate, timely, and equitable water distribution in the scheme. For access to water for irrigation, farmers were expected to answer 'yes' to all indicators of access to water. Farmers' water access data was subjected to descriptive (tables and histograms) and inferential (Chi-square) statistics to determine if statistically significant difference exists with farmers' access to water for irrigation in four selected smallholder irrigation schemes.

Objective 6: To determine the effect of selected variables (demographics, attitude, and knowledge) on farmers' level of participation during revitalization of four smallholder irrigation schemes.

As part of this objective, the Multiple Regression Model was used to identify the various factors that influenced the farmers' level of participation during the different stages of RESIS in four irrigation schemes. An explanatory model involves multiple independent variables predicting the dependent variable. Multiple Linear Regression Models take the following form:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots \dots + \beta_n X_n + U \qquad (4)$$

In this model, Y represents the Farmer Participation Index (FPI) across four irrigation schemes during various phases of the RESIS programme and α indicates the value of the dependent variable when the independent variables are zero. Each β estimate shows how the average change in Y relates to a unit of change in X, while controlling other explanatory variables in the model.

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In this Multiple Linear Regression Model, age, gender, education level and household land size were included as independent variables to represent demographic factors hypothesised to have effect on farmers' participation level during RESIS stages based on reviewed literatures (Sheikh, *et al*., 2014; Alam, *et al*., 2012; Muchara *et al*., 2014; Botlhoko and Oladele 2013; Phali, 2020; Sharaunga and Mudhara, 2018). For effects of farmers attitudes towards the RESIS programme and its implementers, were included as independent variables. Finally, RESIS knowledge on farmers' level of participation was also included as independent variables in the model.

Objective 7: To determine the effect of selected variables (demographics, attitude, knowledge and level of participation) on farmers' access to water for irrigation in revitalized four smallholder irrigation schemes.

It was assumed that respondents would either have access to water for irrigation in specific irrigation scheme (1) or not (0) as the dependent variable in the regression analysis. Although linear probability models (LPMs) can be used to explain a binary dependent variable, there are several concerns with the approach (Maddala, 1983). To begin with, this model allows probabilities below 0 and above 1 to be estimated. In addition, the approach does not provide a way for the error term to be modelled using non-linear distributions, and the error term does not satisfy the homoskedasticity assumption of OLS. The use of regressions such as the logit or probit model is an alternative to LPM. There have been similar studies on level of participation in agricultural projects (Cheteni 2016; Yakubu *et al*. 2019) which have applied probit models; however, the results of logit and probit models are the same. Consequently, researchers are often left to choose between Logit and Probit models.

By using a binary dependent variable, the probit model fits a maximum likelihood model. The model assumes that the probability of a positive outcome is determined by the standard normal cumulative distribution function (CDF) (Gujarati 2021). Under the assumption of normality, the probability that observable farmers' access to water for irrigation in selected

irrigation scheme, I * i, is less than a threshold level, I_i , can be calculated from the standard CDF and is as follows:

$$Pi = P(Y = 1|X) = P(I * i \leq I_i) = P(Z_i \leq \beta_0 + \beta_i X_i) = F(\beta_0 + \beta_i X_i) \quad \ldots\ldots(5)$$

where P(Y = 1|X) is the probability that farmer has access to water for irrigation in selected irrigation scheme given the value(s) of the explanatory variable(s), X. Z_i is the standard normal variable, and F is the standard normal CDF. The estimation of the utility index ($\beta_0 + \beta_i X_i$) and the βs is complicated; however, the use of maximum likelihood estimators allows the researcher to estimate these variables. The study used the Probit Model to determine whether the independent variables (socio-demographics, awareness of RESIS programme, attitudes toward RESIS programme and its implementers) had an influence on the likelihood a farmer to access water for irrigation in the selected revitalized smallholder irrigation schemes.

CHAPTER 4: RESULTS

4.1. Introduction

The chapter presents the results in accordance with the study's objectives. Socio-economic and demographic factors, RESIS awareness, attitude toward RESIS and its implementers, farmers' level of RESIS participation and access to water for irrigation are presented using descriptive statistics. Lastly, the results of Multiple Linear Regression and Probit Regression Models are presented to estimate the effects of selected variables (socio-economic and demographic factors, RESIS awareness, attitude toward RESIS and its Implementers) on farmers' level of participation and access to water for irrigation in four selected revitalized smallholder irrigation schemes, respectively.

4.2. Farmers' demographic and socioeconomic factors

In this study, descriptive and inferential results of socio-economic and demographic factors (age, household and farm sizes, gender, marital status, and education levels) of farmers from four revitalized smallholder irrigation schemes are presented (Table 4.1 and 4.2).

4.2.1. Age of the household head

Table 4.1 indicated that majority of farmers across four irrigation schemes had average age of 54.38 years. These average ages of farmers from the four revitalized irrigation schemes were compared to each other using ANOVA F-tests. Results showed that there was no statistically significant.

4.2.2. Size of the household farm

As indicated on Table 4.1 farmers across four irrigation schemes owned plot sizes of 4.66 ha on average. The average size of the farms in Makhathini and NdumoB irrigation schemes was 10.21 and 8.08 ha, respectively. In contrast, average sizes of the farms in Mooi River and Tugela Ferry irrigation schemes were 0.35ha and 0.51 ha, respectively. These differences of household farm size across four revitalized irrigation schemes were statistically significant ($p<0.01$).

4.2.3. Size of the household

The average size of the households across four revitalised smallholder irrigation schemes were 8.04. In addition, F-tests found no statistically significant difference in size of households across the irrigation schemes.

Table 4.1: Continuous socioeconomic and demographic variables description

Description of variables	Mean (Std. dev)				All schemes (n=345)	F test (Sig)
	Mooi River (n=75)	Tugela Ferry (n=110)	Makhathini (n=111)	NdumoB (n=49)	Mean (Std. dev)	
Age of household head	55.07[a] (14.72)	53.64[a] (13.20)	54.86[a] (15.09)	53.92[a] (11.69)	54.38 (13.94)	NS
Size of the plot	0.51[a] (0.56)	0.35[a] (0.19)	10.21[b] (3.85)	8.08[b] (1.15)	4.66 (5.13)	***
Size of the household	8.39[a] (3.34)	8.35[a] (3.31)	7.37[a] (3.85)	8.37[a] (2.58)	8.04 (3.43)	NS

Notes: NS represents no statistically significant difference; ***, ** and * means statistically significant at 1%, 5% and 10% levels, respectively**.**

Source: Survey data (2021)

4.2.4. Gender of the household head

Table 4.2. present gender distribution across the schemes. Overall, there were more women (54.49%) than men (45.51%) across four irrigation schemes. Table 4.2 also indicated that the highest percentages of female-headed households were in Mooi River (70.67%) and Tugela Ferry (81.82%). In contrast, Makhathini (74.77%) and NdumoB (65.35%) had the highest percentages of male-headed households. This gender difference between farmers in four irrigation schemes was highly significant ($p<0.01$) according to the $\chi 2$ tests. In another words, there were gender inequalities among farmers across the schemes.

4.2.5. Education level

Table 4.2 also provided results of education level of respondents across the four irrigation schemes. Farmers in all schemes had the overall of 40% primary education level. Farmers in Mooi River and NdumoB had 60% and 51.02% of access to primary education, respectively. Nonetheless, the results of the χ^2 tests conducted reveal that the difference between education levels of farmers across four irrigation schemes was highly statistically significant ($p<0.01$).

Table 4.2: Description of demographic and socioeconomic variables

Variable Name		Irrigation Schemes				All schemes (n=345)	χ2 tests
		Mooi River (n=75)	Tugela Ferry (n=110)	Makhathini (n=111)	NdumoB (n=49)		
Educational level of the farmers	Non-formal education	25.33	40.00	13.51	10.20	24.06	***
	Primary education	60.00	26.36	35.14	51.02	40.00	
	Secondary education	14.67	30.91	26.13	38.78	26.96	
	Tertiary education	0.00	2.73	25.23	0.00	8.99	
Marital status of the household head	Single	44.00	67.30	37.80	38.80	48.70	***
	Married	56.00	32.70	62.20	61.20	51.30	
Gender of the household head	Female	70.67	81.82	25.23	34.65	54.49	***
	Male	29.33	18.18	74.77	65.35	45.51	

Notes: ***The difference in socioeconomic factors of farmers in four irrigation schemes were statistically significant ($p<0.01$) according to the χ2 tests

Source: Survey data (2021)

4.2.6. Marital status

Table 4.2 also indicate farmers' marital status in the four irrigation schemes. A total of 48.70% of farmers in revitalised irrigation schemes are single, while 51.30% are married. Comparison of farmers marital status at scheme level, indicate that NdumoB (37.80%) and Makhathini (38.80%) had lowest percentages of single farmers whereas farmers in Tugela Ferry were mostly married heads (67.30%). The χ^2 tests reveal that the difference between marital status of farmers across the four irrigation schemes was statistically significant ($p<0.01$).

4.3. Farmers' level of awareness of revitalization of programme

This section presents results of the level of farmer's awareness of the RESIS programme across the four revitalised SISs.

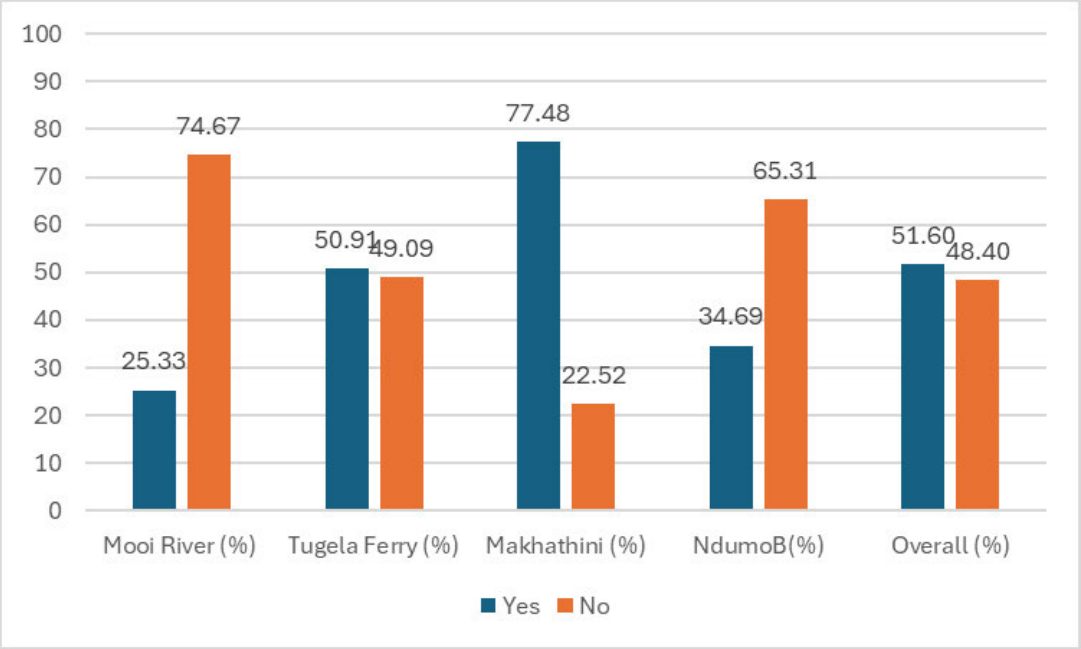

Figure 4.1: Farmers' level of RESIS programme awareness in selected irrigation schemes

Source: Survey data (2021)

According to Figure 4.1, 51.60% farmers across the four irrigation schemes were aware of the RESIS programme. At scheme level, 25.33% of farmers in Mooi River were aware of the RESIS programme. However, most farmers in NdumoB (65.31%) were not aware of the RESIS programme either. The opposite was true for Makhathini, where 77.48% of the farmers knew about the RESIS programme. According to the χ^2 test, farmers across the four revitalised smallholder irrigation schemes statistically significantly differed ($p<0.01$) in their knowledge of the RESIS programme.

4.4. Farmers' attitudes towards revitalization programme and implementers

A survey results of farmers' attitudes towards RESIS and its implementers across four revitalised smallholder irrigation schemes are presented in this section.

4.4.1. Reliability of instrument

According to Table 4.3 Cronbach alpha values below 0.7 indicate that only one aspect of the variable was assessed. In another words, Table 4.3. shows Cronbach alpha value of above 0.7, indicating that items included to measure farmers' attitudes toward RESIS programme, and its implementers were related and measure the variables under consideration.

Table 4.3: Cronbach alpha test of farmers' attitude scales

Description	Number of Items	Average Interim Covariance	Scale Reliability Coefficient (α)
Rehabilitated irrigation infrastructure	5	1.268	0.930
Access to output markets access	5	1.094	0.8996
Access to financial support	5	0.572	0.7715
Access to training and extension services	5	0.791	0.9020
Assistance with institutional arrangements	6	0.714	0.890
Implementers encourage farmers to participate in RESIS	5	0.688	0.874
Implementers were efficient in use of resources	5	0.645	0.928
Implementers were fair in allocation of RESIS benefits	5	0.542	0.897

Note: α ≥ 0.7 is reliable

Source: Survey data (2021)

4.4.2. Farmers' attitudes toward the RESIS programme

Table 4.4. indicated results of the Likert scale questions were used to assess attitudes of farmers toward the RESIS programme, specifically attitudes toward six objectives of the RESIS programme: access to working irrigation infrastructure, output markets, financial support, training and extension services, and helping with institutional arrangements.

i) Farmers' attitudes toward RESIS rehabilitated irrigation infrastructure

Based on Table 4.4, farmers in Tugela Ferry (3.392) and Mooi River (2.708) irrigation schemes had positive attitude toward access to functional irrigation infrastructure. Makhathini and NdumoB had negative attitudes toward access to functional irrigation infrastructure, scoring means of 1.67 and 1.97, respectively. In multiple comparisons using Scheffe's procedure, it was found that the means of farmer attitudes at Mooi River, and Tugela Ferry were statistically different, whereas the farmer attitude means at Makhathini and NdumoB were not statistically significantly different. The results indicate that the Tugela

Ferry irrigation scheme has statistically higher farmer attitude score towards access to functional irrigation infrastructure compared to other irrigation schemes statistically. There is an obvious difference between farmers in the NdumoB and Makhathini irrigation schemes who completely rely on pumped irrigation systems, and those in Mooi River and Tugela Ferry who have a combination of gravitated and pumped irrigation systems.

Table 4.4: Attitudes of the farmers toward the RESIS programme

Description of variables	Irrigation schemes Mean and Std. dev				
	Mooi River (n=75)	Tugela Ferry (n=110)	Makhathini (n=111)	NdumoB (n=49)	Overall (n=345)
Rehabilitated irrigation infrastructure	2.708[a] (0.569)	3.392[b] (0.796)	1.671[c] (0.605)	1.979[c] (0.678)	2.489 (0.988)
Access to output markets	2.224[a] (0.944)	1.912[a] (0.977)	3.230[b] (1.034)	2.240[a] (0.723)	2.451 (1.102)
Access to financial support	2.384[a] (1.084)	1.738[b] (0.716)	2.172[a] (0.764)	2.036[ab] (0.752)	2.060 (0.861)
Access to training and extension services	3.765[a] (0.672)	3.723[a] (1.141)	2.906[b] (0.728)	3.000[b] (0.501)	3.366 (0.936)
Access functional institutional arrangements	3.167[a] (0.643)	3.855[b] (1.079)	3.404[a] (0.724)	3.539[ab] (0.532)	3.515 (0.856)

Note: different letters within the same row represent significant differences at 5% level of significance.

[x] Pooled score for items on a 5-point scale.

Source: survey 2021

ii) Farmers' attitudes toward assistance with access to markets by RESIS programme

Table 4.4. indicate that farmers in the Makhathini scheme had a positive attitude ($\bar{x}$=3.230) toward access to markets. Mooi River ($\bar{x}$=2.224), NdumoB ($\bar{x}$=2.240) and Tugela Ferry ($\bar{x}$=1.912) had negative attitudes toward access to markets. The Scheffe tests indicated that there was no significant difference ($p<0.05$) between Mooi River, Tugela Ferry, and NdumoB, with the exception of the Makhathini. The results indicate that only farmers in the Makhathini were highly statistically significantly positive towards market opportunities provided through RESIS programme.

iii) Farmers' attitudes toward assistance with access to financial support through RESIS programme

According to Table 4.4, farmers' attitudes toward access to financial support were generally negative ($\bar{x}$=2.060) across four irrigation schemes. Scheffé tests did not find any significant differences between farmers' attitudes in Mooi River, Makhathini and NdumoB, but NdumoB farmers' attitude were not significantly different ($p<0.224$) from Tugela Ferry. These results indicate that farmers in all irrigation schemes were not satisfied with financial support ($\bar{x}$=2.060) from government through RESIS programme.

iv) Farmers' attitudes toward assistance with access to training provided through RESIS programme

In terms of attitudes of farmers toward access to training, Table 4.4 indicate that all farmers were positive towards training provided through the RESIS programme. There was no statistically significant difference in farmer attitudes toward access to training between Mooi River and Tugela Ferry. Accordingly, there was also no significant difference in the farmer attitude means of Makhathini and NdumoB. In accordance with this, all farmers were satisfied with training provided by government through RESIS programme compared to farmers in Makhathini and NdumoB.

v) Farmers' attitudes toward RESIS establishment of stable institutions

According to Table 4.4, farmers in all irrigation schemes indicated positive attitude toward access to stable institutional support. After conducting multiple comparisons of means between Mooi River, Makhathini, and NdumoB; there were no significant different statistically. However, farmer attitudes in NdumoB did not differ statistically significantly from farmer attitudes in Tugela Ferry.

4.4.3. Farmers' attitudes toward the RESIS Implementers

Table 4.5 presents the results of attitudes of farmers toward RESIS Implementers (government officials/contractors/engineers) in four irrigation schemes (Makhathini, NdumoB, Mooi River and Tugela Ferry). Batho Pele Principles were employed to assess farmer attitudes towards RESIS implementers. RESIS implementation principles included encouraging farmers to participate at all levels, ensuring RESIS resources were used efficiently and effectively, and ensuring fair distribution of RESIS benefits.

Table 4.5: Attitudes of the farmers toward RESIS implementers

Variable Name[x]	**Mooi River (n=75)**	**Tugela Ferry (n=110)**	**Makhathini (n=111)**	**NdumoB (n=49)**	**Overall (n=345)**
	Mean (Std. dev)	**Mean (Std. dev)**	**Mean (Std. dev)**	**Mean (Std. dev)**	**Mean**
Participatory approach as RESIS implementation principle	2.258^{a} (1.029)	2.887^{b} (0.980)	2.718^{c} (0.676)	2.375^{ac} (0.572)	**2.623 (0.887)**
Effectiveness and Efficiency as RESIS implementation principles	2.629^{a} (0.719)	3.153^{b} (0.907)	2.392^{a} (0.530)	3.599^{c} (0.567)	**2.858 (0.833)**
Fairness as RESIS implementation principle	3.714^{a} (0.598)	4.245^{b} (0.592)	3.347^{c} (0.517)	3.951^{a} (0.629)	**3.799 (0.680)**

Note: different letters within the same row represent significant differences at 5% level of significance.
[x] Pooled score for items on a 5-point scale

Source: survey 2021

i) Farmers' attitudes toward RESIS implementers promoting farmers participation in RESIS activities

According to Table 4.5, farmers in Makhathini ($\bar{x}$=2.718) and Tugela Ferry ($\bar{x}$=2.887) had indicated positive attitudes toward the role of implementers to encourage them to participate in the RESIS programme. A statistically significant difference was observed between the mean scores of Mooi River, Tugela Ferry, and Makhathini. Nevertheless, the mean of NdumoB was not statistically significantly different from that of Mooi River or Makhathini. The results indicated that farmers in Mooi River ($\bar{x}$=2.258) and NdumoB ($\bar{x}$=2.375) had negative attitudes towards opportunities given by RESIS Implementers to participate in the RESIS programme.

ii) Farmers' attitudes toward RESIS implementers' efficiency and effectiveness

The Table 4.5 indicated that farmers in Mooi River ($\bar{x}$=2.629), Tugela Ferry ($\bar{x}$=3.153) and NdumoB ($\bar{x}$=3.599) had a positive attitude toward RESIS implementers' efficiency and effectiveness, demonstrating that farmers were happy with the effectiveness and efficiency of RESIS Implementers during the implementation of the RESIS programme. Nonetheless, the farmers in Makhathini ($\bar{x}$=2.392), on the other hand, had indicated negative attitudes toward RESIS implementers' efficiency and effectiveness. Comparing the farmer attitude means of Mooi River, Tugela Ferry, and NdumoB, there was statistically significant difference between them. Farmer attitudes toward RESIS implementers' efficiency and effectiveness differ significantly between irrigation schemes, but not between Makhathini and Mooi River.

iii) Farmers' attitudes toward RESIS implementers' fairness in allocation benefits to farmers

Table 4.5 indicated that farmers in all irrigation schemes had positive attitudes towards fairness in allocation benefits to farmers as a sign of being satisfied with the allocation of benefits to the RESIS programme beneficiaries. In Scheffe's multiple comparisons, farmers' attitude means towards fairness in allocation benefits to farmers statistically differed significantly across four irrigation schemes except for Mooi River and NdumoB schemes. The results indicate that farmers in all schemes were happy with fairness of RESIS benefits allocation by implementers.

4.5. Farmers' level of participation in RESIS programme

This chapter determine differences in farmers' type and level of participation during different stages of the RESIS programme in Makhathini, NdumoB, Tugela Ferry, and Mooi River irrigation schemes. Furthermore, results on types of farmer participation in respective irrigation schemes during RESIS phases are presented. This is followed by results on farmers' participation indexes based on various types and levels of farmer participation across four revitalised irrigation schemes during RESIS stages.

4.5.1. Farmers' typology of participation in RESIS programme

Table 4.6 indicated that more farmers (40.90%) across four irrigation schemes had experienced consultation type of participation during decision making stage of the RESIS. At scheme level, most farmers in Makhathini (48.65%) and Mooi River (64.00%) had experienced consultation type of participation during decision making stage of the RESIS. Generally, most farmers were only consulted after decisions related to the RESIS programme were taken. Statistically types of farmer participation during decision making stage of the RESIS programme differed significantly ($p<0.01$) across four irrigation schemes.

Table 4.6 (A): Levels and types of participation of farmers in Mooi River, Tugela Ferry, Makhathini and NdumoB irrigation schemes

RESIS stages	Level of participation	Types of participation	Number of farmers in irrigation schemes (%)					χ2 test
			Mooi River (n=75)	Tugela Ferry (n=110)	Makhathini (n=111)	NdumoB (n=49)	All Schemes (n=345)	
Decision making	Non	1 - Manipulation	17.33	11.82	27.03	4.08	**16.70**	***
		2- Informing	18.67	45.45	9.01	10.20	**22.80**	
	Symbolic	3- Consultation	64.00	25.45	48.65	24.49	**40.90**	
		4- Interaction	0.00	4.55	9.01	16.33	**6.60**	
		5- Partnership	0.00	8.18	2.70	14.29	**5.50**	
	Genuine	6- Empowerment	0.00	4.55	3.60	30.61	**6.90**	

Implementation stage	Non	1 - Manipulation	4.00	1.80	2.70	4.10	**2.90**	***
		2- Informing	17.30	31.80	7.20	24.50	**19.60**	
	Symbolic	3- Consultation	41.30	32.70	80.20	22.40	**48.10**	
		4- Interaction	29.30	10.00	3.60	12.20	**12.40**	
		5- Partnership	4.00	18.20	2.70	14.30	**9.5**	
	Genuine	6- Empowerment	4.00	5.50	3.60	22.40	**6.9**	

Note: ***Farmers' levels of participation differ statistically significantly confirmed by χ2 test at all levels of significance across four irrigation schemes

Source: survey 2021

Table 4.6 (B): Levels and types of participation of farmers in Mooi River, Tugela Ferry, Makhathini and NdumoB irrigation schemes

RESIS stages	Level of participation	Types of participation	Number of farmers in irrigation schemes (%)					χ2 test
			Mooi River (n=75)	Tugela Ferry (n=110)	Makhathini	Mooi River (n=75)	Tugela Ferry (n=110)	
Benefits sharing stage	Non	1 - Manipulation	0.00	2.70	2.70	4.10	**2.30**	***
		2- Informing	9.30	32.70	10.80	6.10	**16.70**	
	Symbolic	3- Consultation	26.70	13.60	52.30	36.70	**32.00**	
		4- Interaction	29.30	22.70	27.90	16.30	**24.80**	
		5- Partnership	9.30	19.10	2.70	18.40	**11.50**	

	Genuine	6-Empowerment	25.30	9.10	3.60	18.40	**12.10**	
Evaluation stage	Non	1 - Manipulation	4.00	18.20	3.60	79.60	**19.00**	***
		2-Informing	53.30	30.90	29.70	20.40	**33.70**	
	Symbolic	3-Consultation	42.70	20.90	55.90	0.00	**33.70**	
		4-Interaction	0.00	10.00	5.40	0.00	**4.90**	
		5-Partnership	0.00	17.30	1.80	0.00	**6.10**	
	Genuine	6-Empowerment	0.00	2.70	3.60	0.00	**2.00**	

**Note: ***Farmers' levels of participation differ statistically significantly confirmed by χ2 test at all levels of significance across four irrigation schemes

Source: survey 2021

According to Tables 4.6 A and B most farmers (48.10%) experienced consultation type of participation during the implementation stage of the RESIS programme. At scheme level, most farmers (80.20%) in the Makhathini irrigation scheme indicated to have experienced consultation type of participation compared to other schemes. In another words, most of the farmers in Makhathini compared to other schemes were only consulted with regard to the implementation of the RESIS projects. It was also confirmed by χ2 test results that types of farmer participation during the implementation stage of the RESIS programme had statistically differed ($p<0.01$) across four revitalised irrigation schemes.

The Tables 4.6 A and B also indicate that most farmers (32.0%) across the four irrigation schemes had experienced consultation type participation during benefits sharing. This was due to majority of farmers (80.20%) in the Makhathini irrigation scheme who indicated to have experienced consultation-type participation during benefits sharing stage of the RESIS. The χ2 tests carried out also indicated the statistically significant difference ($p<0.01$) in types of farmer participation during benefits sharing of the RESIS stage across four revitalised smallholder irrigation schemes.

As shown in Tables 4.6 A and B that during the evaluation stages of four revitalised irrigation schemes, most farmers had experienced both informing (33.70%) and consultation (33.70%) types of farmer participation. More farmers in Makhathini (55.90%) had experienced the

consultation type of farmer participation as opposed to more farmers in Mooi River (53.30%) who experienced the informing type of farmer participation during evaluation stage of the RESIS programme. Statistically farmers' type of participation had differed significantly ($p<0.01$) across four irrigation schemes during the evaluation stages of the RESIS programme.

4.5.2. Farmer participation Index

Overall, Tugela Ferry farmers had the lowest farmer participation index (FPI) statistically compared to Mooi River and NdumoB, whereas there was statistically significant ($p<0.01$) difference between Makhathini and Tugela Ferry participation indices (Table 4.7). In terms of comparison at scheme level, farmers at NdumoB were statistically significantly ($p<0.01$) had higher participation index compared to the rest of the schemes. On the other hand, there were no statistically significant difference between participation indices of farmers across four irrigation schemes during implementation and decision-making stages of the RESIS programme. However, farmers in Mooi River had the significant highest participation index statistically ($p<0.01$) compared to the rest of irrigation schemes during the benefit sharing stages.

Table 4.7: Participation Indices based on farmer's types of participation

Irrigation Schemes	Farmer Participation Index (%) during RESIS stages				
	Decision making	**Implementation**	**Benefit sharing**	**Evaluation**	**Overall Schemes**
Mooi River (n=75)	41.11^{a}	54.00^{a}	69.11^{c}	39.77^{b}	51.00^{a}
Tugela Ferry (n=110)	44.24^{a}	54.54^{a}	58.33^{ab}	47.57^{c}	51.17^{a}
Makhathini (n=111)	43.69^{a}	51.20^{a}	54.65^{a}	47.14^{c}	49.17^{a}
NdumoB (n=49)	69.72^{b}	62.58^{b}	65.64^{bc}	20.06^{a}	54.50^{a}
Overall FPI	**49.69**	**55.58**	**61.93**	**38.63**	**51.46**

Note: FPI is Farmer Participation Index. Same letters in the columns represent significant differences at 5% level of significance during RESIS stages across four irrigation schemes.

Source: survey 2021

4.6. Farmers' access to water for irrigation

This section presents descriptive results on farmers' level of water access in the four irrigation schemes (Table 4.8). These results were presented into four categories, i.e., adequate, timely and equitable access to water as well as averall access to water. General access to water refers to number of farmers who met all water access criteria (adequate, timely and equitable access).

4.6.1. Adequate access to water by irrigating farmers

There is an overall access to adequate water for irrigation of 82.32% in four revitalised smallholder irrigation schemes (Table 4.8). In comparison, NdumoB farmers have access to 91.84% of water for irrigation, while Mooi River farmers have access to 74.67%. Chi square tests showed no statistically significant difference in access to adequate water for irrigation across four revitalised smallholder irrigation schemes. Thus, all farmers across four revitalised smallholder irrigation schemes have access to adequate irrigation water.

4.6.2. Equitable access to water by irrigating farmers

There is equitable access to water for irrigation among irrigating farmers (79.13%) in four revitalised smallholder irrigation schemes (Table 4.8). At the scheme level, Chi square tests indicated no statistically significant differences between four revitalised smallholder irrigation schemes on farmers' equitable access to irrigation water.

Table 4.8: Farmers' level of water access for irrigation in four revitalised smallholder irrigation schemes

WATERACCESS	**Irrigation scheme**						χ^2 tests
		Mooi River % (n=75)	**Tugela Ferry % (n=110)**	**Makhathini % (n=111)**	**NdumoB % (n=49)**	**Overall % (N=345)**	
Adequate access to water by farmers	no	25.33	14.55	19.82	8.16	17.68	NS
	yes	74.67	85.45	80.18	91.84	82.32	
Equitable access	no	29.33	16.36	21.62	16.33	20.87	NS
	yes	70.67	83.64	78.38	83.67	79.13	
Timely access	no	25.33	10.91	60.36	67.35	37.97	***
	yes	74.67	89.09	39.64	32.65	62.03	
Overall access	no	38.67	28.18	63.06	67.35	47.25	***

to water	yes	61.33	71.82	36.94	32.65	52.75	

Note: *** means significant at all levels. NS represents no significant difference.

Source: survey 2021

4.6.3. Timely access to water by irrigating farmers

The majority of farmers (62.03%) across four revitalised irrigation schemes have timely access to irrigation water (Table 4.8). At the scheme level, NdumoB (39.64%) and Makhathini (32.65%) have the lowest percentages of farmers with timely distributed irrigation water compared to Tugela Ferry (74.67%) and Mooi River (89.09%). There is a statistically significant difference ($p<0.01$) in farmers' access to timely distributed water across four revitalised smallholder irrigation schemes based on the Chi square test.

4.6.4. Overall water access by irrigating farmers

There is generally access to water for irrigation among farmers (52.75%) in four revitalised irrigation schemes (Table 4.8). NdumoB (67.35%) and Makhathini (63.06%) irrigation schemes had the least access to water compared to Tugela Ferry (71.82%) and Mooi River (61.33%). According to Chi-square tests, there was a statistically significant ($p<0.01$) difference in water access for irrigation between four revitalised smallholder irrigation schemes.

4.7. Determinants of farmers' level of participation in RESIS programme

This section is to present results on the effect of selected variables (demographic and socioeconomic factors, RESIS knowledge and attitudes) on level of participation of farmers during different stages of revitalization at Mooi River, Tugela Ferry, Makhathini and NdumoB. For this study, the multiple Linear Regression Model was applied to determine if the selected socioeconomic factors, farmers' RESIS knowledge and attitudes have statistically significant effect on farmers' level of participation during different stages of RESIS programme.

4.7.1. Description of variables

Using the multilinear regression model, four models were estimated from calculated Farmer Participation Index (FPI) derived from types and level of participation during RESIS stages as dependent variables.

Table 4.9: The results of the final the Variance Inflation Factor (VIF) was used to detect the multicollinearity problems

Variable VIF	VIF	1/VIF
Age	2.64	0.379201
Plot size	2.30	0.434315
Irrigation Infrastructure	2.17	0.460123
Institutional support	2.16	0.462197
Education level	2.14	0.466550
fairness	2.01	0.496448
training	1.99	0.503638
Household size	1.77	0.565020
Market access	1.60	0.626432
participatory approaches	1.51	0.662592
effectiveness and efficiency	1.49	0.670852
Gender	1.41	0.711260
RESIS Knowledge	1.32	0.757188
Access to water	1.29	0.777101
Financial support	1.26	0.795051
Marital status	1.11	0.902310
Mean VIF	**1.76**	

Source: Survey Data (2021)

The Breusch–Pagan/Cook–Weisberg test was used to test heteroskedasticity in the model (with assumptions that normal error terms exist), and on the other hand, the Variance Inflation Factor (VIF) was used to detect the multicollinearity problems (Marwati *et al*., 2020). The results of VIF tests and Multilinear Regression Model are shown in Tables 4.9 and 4.10, respectively. According to most reviewed literature (Akpan *et al*., 2013; Mkuna, 2022) a VIF less than 10 is acceptable. Therefore, the mean VIF of 1.76 indicates that there are no multicollinearity problems. Results suggest that effects of independent variables on dependent variables vary considerably in direction and significance levels.

4.7.2. Multiple Linear Regression results

i) Effects of selected socioeconomic and demographic factors on farmers' level of participation in the RESIS programme

According to Table 4.10, gender was the only demographic factor that was not statistically significantly affecting farmers' level of participation during RESIS stages across four irrigation schemes. However, the rest of selected socioeconomic and demographic factors

had affected farmers' level of participation at different directions and levels of significances. Age had statistically significantly ($p<0.10$) affected farmers' level of participation during the RESIS evaluation stage. On the other hand, the size of the household statistically significantly ($p<0.01$) and positively affecting farmers' level of participation, specifically during the decision-making stage of the RESIS programme. On the other hand, marital status significantly affecting farmers' level of participation positively during implementation ($p<0.05$) and benefit sharing ($p<0.05$) stages, and negatively during evaluation ($p<0.10$) stages of the RESIS programme. The education level of the household head was statistically significantly ($p<0.10$) and positively affecting farmers' level of participation during the RESIS evaluation stages. The size of the land in the household was statistically significantly ($p<0.05$) and positively affecting farmers' level of participation during decision making stages of the RESIS programme.

ii) Effect of farmers' knowledge of RESIS programme

Table 4.10 also indicates the effect of farmers general knowledge of the RESIS programme on farmers' level of participation during RESIS stages. The effect of farmers' knowledge of the RESIS programme was statistically significantly ($p<0.10$) and negatively affecting farmers' level of participation during the decision making stage.

Table 4.10: Determinants of farmer participation across four RESIS programme stages in the Makhathini, Mooi River, NdumoB and Tugela Ferry

Descriptions of the variables	Independent Variables	RESIS STAGES			
		Decision Making	Implementation	Benefit sharing	Evaluation
Socioeconomic and demographic factors	Age	-0.028 (0.021)	-0.018 (0.019)	-0.001 (0.021)	0.029* (0.018)
	Household size	0.144** (0.070)	-0.029 (0.064)	0.043 (0.070)	-0.022 (0.061)
	Gender	-0.062 (0.430)	0.102 (0.398)	0.042 (0.434)	-0.147 (0.374)
	Marital status	0.396 (0.266)	0.575** (0.246)	0.609** (0.268)	-0.445* (0.231)
	Education level	0.097 (0.197)	-0.239 (0.182)	0.095 (0.199)	0.282* (0.171)
	Plot size	0.203*** (0.053)	0.049 (0.049)	-0.063 (0.054)	-0.012 (0.046)
General Knowledge of the RESIS objectives	RESIS Knowledge	-0.882** (0.419)	0.459 (0.388)	-0.112 (0.423)	0.152 (0.365)
Farmers' attitudes towards the	Irrigation infrastructure	0.338 (0.262)	0.034 (0.243)	-0.567** (0.265)	0.883*** (0.228)

RESIS programme	Market access	0.363* (0.206)	0.024 (0.191)	0.106 (0.208)	0.911*** (0.179)
	Financial support access	0.043 (0.246)	0.569*** (0.228)	0.661*** (0.248)	-0.621*** (0.214)
	Training access	0.3713 (0.270)	0.177 (0.250)	0.667*** (0.273)	0.459** (0.235)
	Institutional support access	-0.213 (0.310)	-0.539* (0.287)	-1.041*** (0.313)	-0.069 (0.270)
Farmers' attitudes toward RESIS implementers	Participatory approach	-0.928*** (0.250)	0.018 (0.231)	0.303 (0.252)	0.623*** (0.218)
	Effectiveness and efficiency	1.162*** (0.267)	0.362 (0.247)	-0.027 (0.270)	-1.156*** (0.232)
	Fairness	0.515 (0.377)	1.294*** (0.350)	1.691*** (0.381)	-0.042 (0.329)
Overall water access (equity, adequate and timeliness)	Access to water for irrigation	1.013** (0.455)	0.767* (0.422)	-0.239 (0.460)	0.306 (0.396)
Y Intercept	_cons	1.008 (1.906)	2.595 (1.767)	3.128 (1.927)	3.135 (1.660)
Summary of the model	Number of obs.	345			
	F(16, 328)	5.87	3.15	3.68	5.61
	Prob > F	0.000	0.000	0.000	0.000
	R-squared	0.2226	0.1333	0.1522	0.2149
	Root MSE	3.3533	3.1085	3.39	2.9218

Note: ***, **, *; significant at 1%, 5% and 10%, respectively. Values in parentheses indicate standard deviation
Source: Survey Data (2021)

iii) Farmers' attitudes toward RESIS programme

As indicated in Table 4.10, farmers' attitudes toward RESIS services: rehabilitation, refurbishment, and construction of irrigation infrastructures, farmers' access to markets, training, financial support, and functional institutions had significant varied effects on farmers' level of participation during RESIS stages. With reference to access to rehabilitation of irrigation infrastructures, farmers' attitudes were statistically significantly affecting farmers' level of participation negatively during benefit sharing ($p<0.05$) and positively during evaluation ($p<0.01$) stages. Farmers' access to markets was found to be statistically significantly and positively affecting farmers' level of participation during decision making ($p<0.10$) and evaluation ($p<0.01$) stages. Attitudes of farmers toward farmers' access to financial support were statistically significantly affecting farmers' level of participation positively during implementation ($p<0.05$) and benefit sharing ($p<0.01$) stages, and negatively during evaluation ($p<0.01$) stages. Attitudes of farmers toward training provided through RESIS were statistically significantly affecting farmers' level of participation during benefit sharing ($p<0.05$) and evaluation ($p<0.01$) stages, positively. Finally, farmers' attitudes toward functional institutional support statistically significantly affected farmers' level of

participation negatively during RESIS implementation ($p<0.10$) and benefit sharing ($p<0.01$) stages.

iv) Farmers attitudes toward RESIS Implementers

The effect of RESIS implementers' participatory approach on farmers' level of participation was statistically significant negative during decision making ($p<0.01$) stage and positively during evaluation ($p<0.01$) stage (Table 4.10). Farmers' attitudes toward RESIS implementers' effectiveness and efficiency were statistically significant positive during decision making ($p<0.01$) stage and negative during the evaluation ($p<0.01$) stage. Attitudes of farmers toward RESIS implementers' fairness were statistically significantly ($p<0.01$) affecting farmers' level of participation positively during RESIS implementation and benefit sharing stages.

v) Effect of farmer's access to water on farmers' level of participation during RESIS stages

Farmers' access to water in terms of adequacy, reliability and equitable was statistically significantly affecting farmers' level of participation only during the RESIS decision making ($p<0.05$) and implementation ($p<0.10$) stages (Table 4.10).

4.8. Determinants of farmers' access to water for irrigation

In this section, the study determines the effect of selected demographic and socioeconomic factors, knowledge of the RESIS programme, attitudes of farmers toward the RESIS programme and its implementers, as well as the effect of levels of farmers' participation on water access for irrigation. The Binary Probit Regression Model was used to determine the likelihood of selected variables (as independent variables) that a given farmers in four irrigation schemes would have access to water for irrigation (as the dependent variable).

4.8.1. Probit Model variables

Independent variables: Gender, age, educational level (Non-formal, Primary, Secondary, and Tertiary) and plot size were used as indicators of socioeconomics (Table 4.11). Farmers' level of knowledge or awareness was also included in the model just as in the previous section together with attitudes of the farmers toward RESIS programme. In addition, the model took into account the effect of farmers' levels of participation during RESIS decision making stage. This was because decisions are taken across stages of the RESIS programme.

Dependent variable: The study used adequate, equitable and reliable access to water as criteria to determine overall access to water by farmers as dependent variable. Farmers who met these three criteria during survey were allocated a binary of 1 for yes and 0 for otherwise. In this section, the objective was to determine the effect of selected variables on the access to water by farmers in four selected smallholder irrigation schemes.

4.8.2. Probit Regression Model results

The likelihood of farmers to access water for irrigation in four revitalised irrigation schemes was statistically significantly affected by their attitudes toward access to rehabilitated irrigation infrastructure ($p<0.01$), markets ($p<0.05$), financial support ($p<0.05$), training ($P<0.15$), RESIS Implementers' effectiveness as well as during the RESIS decision making stages ($p<0.10$) as shown in Table 4.11.

Descriptions of the variables	Independent Variables	Coefficient	Std. err.
Socioeconomic and demographic factors	Age	0.001	0.008
	Household size	0.009	0.028
	Gender	0.035	0.175
	Marital status	-0.102	0.109
	Education level	-0.058	0.078
	Plot size	-0.028	0.022
General Knowledge of the RESIS programme	RESIS Knowledge	0.068	0.172
Farmers' attitudes towards the	Irrigation infrastructure	0.455***	0.109

RESIS programme	Market access	0.197**	0.087
	Financial support access	0.220**	0.098
	Training and extension access	0.232**	0.108
	Institutional support access	0.146	0.125
Farmers' attitudes toward RESIS implementers	Participatory approach	0.173	0.110
	Effectiveness and efficiency	-0.185*	0.113
	Fairness	-0.064	0.154
Farmers level of participation	Participation during the decision making stage	0.044*	0.023
Y Intercept	_cons	-3.085	0.806
Summary of the model	Number of observations		345
	LR Chi-square (16)		89.95
	Prob > chi-Square		0.0000
	Log likelihood		-193.63791
	Pseudo R -Square		0.1885

Table 4.11. Determinants of access to water for irrigation in Mooi River, Tugela Ferry, Makhathini and NdumoB irrigation schemes

Note: dependent variable is access to adequate, timely and equitable water for irrigation, ***,**,and *; significant at 1%, 5% and 10%, respectively.

Source: Survey Data (2021).

Generally, the study found that selected farmers' attitudes toward RESIS program and its implementers, and their level of participation during RESIS decision making stage were statistically significant factors likely to affect farmers' access to irrigation water in four revitalised irrigation schemes (Table 4.11).

4.9. Summary

The average age of farmers across four irrigation schemes is 54.38 years, according to the results presented. Household heads own an average of 4.66ha of land, but farmers in Makhathini and NdumoB own significantly larger plots compared to farmers in Mooi River and Tugela Ferry. Compared to the average household size of 3.4 in South Africa, all irrigation schemes have larger households (mean of 8.04). There is a statistically significant difference in the levels of education among farmers across four irrigation schemes, with the

majority of farmers having completed their primary education. There are also statistically significant differences in marital status among farmers in different irrigation schemes. Nonetheless, more than 50% of farmers were married. In relation to farmers' awareness of RESIS, more than 50% of farmers across the four irrigation schemes were aware of RESIS. Additionally, farmers expressed positive attitudes toward training and institutional arrangements but were not satisfied with their access to markets, financial support, and irrigation infrastructure. In Tugela Ferry, farmers were satisfied with their irrigation infrastructure, but other farmers in irrigation schemes were not satisfied with their revamped infrastructure. As far as market access is concerned, farmers in Makhathini were more satisfied than farmers in other irrigation schemes. Overall, farmers were satisfied with RESIS implementers' participatory approaches, efficiency, effectiveness, and fairness. In the four irrigation schemes, the overall FPI was about 50%, indicating that more farmers weren't participating. Over 50% of farmers did not have overall access to water across the four irrigation schemes based on adequacy, timeliness, and equity. Except for gender, all variables regressed against farmers' level of participation were statistically significant. However, the effect of these variables varied statistically significantly from one RESIS stage to another, both in levels of significance and directions. In terms of determinants of farmer access to irrigation water, the probability that farmers will access irrigation water in four revitalised irrigation schemes was statistically significantly affected by their attitudes toward access to rehabilitated irrigation infrastructure, markets, financial support, training, the efficiency and effectiveness of RESIS Implementers and participation during the RESIS decision making stage.

CHAPTER 5: DISCUSSIONS

The purpose of this chapter is to discuss the results based on variables found to have significant effects on farmers' participation in RESIS stages and their access to irrigation water.

5.1. Determinants of farmers level of participation during the RESIS stages

5.1.1. Socioeconomic and demographic factors

The average age of farmers in four selected revitalised smallholder irrigation schemes was 54.38 years (Table 4.1). Farmers' level of participation during the RESIS evaluation stage was positively statistically significantly affected by their age (Table 4.10). According to the results, older farmers are more likely to participate in RESIS evaluation. These results are in agreement with various research studies (Sheikh *et al*., 2014; Sharaunga and Mudhara, 2018; Sithole *et al*., 2014), age is positively correlated with farmers' participation in collective actions. The results could also implicate that most farmers with access to land are old. It was also discovered that youth have limited access to land during the project (International Fund for Agricultural Development, 2014). Young people often have difficulty obtaining land to enter into farming enterprise. It is often problematic for youth to access land in developing countries because of inheritance laws and customs which are paternalistic. Leasing arrangements that grant youth access to land, but not ownership, may also prove effective in assisting youth in acquiring land in the long term. Results of this study could also mean that selected revitalised smallholder irrigation schemes do not have a succession plan in place. Lack of succession plan could lead to unsustainability of these revitalised smallholder irrigation schemes.

The average household size across the four irrigation schemes was 8.04 (Table 4.1). This is higher than the average household size in South Africa, which is 3.34 (StatsSA, 2019). As indicated in Table 4.10, household size had a statistically significant positive effect on farmers' level of participation during the decision-making stage of the RESIS programme. Smallholder farmers with larger family sizes were more likely to participate in the decision-making stage of RESIS than their counterparts. Khosa *et al*. (2019) also found a statistically significant relationship between household size and farmers' participation in an agricultural development programme in Gauteng Province, South Africa. These results agree with

reviewed literature (Alam *et al*., 2012; Botlhoko and Oladele, 2013) that size of the household is one of social factors determining farmers' level of participation in PIM/IMT activities. According to Alam *et al*. (2012) and Sithole *et al*. (2014), the larger the household, the greater the need for the household head to participate in irrigation projects. They also found positive relationship between household size and food demand. It is also possible that a larger household size may complement the work of household heads on the farm (Martey *et. al.* 2013). The availability of family labour allows household heads to share responsibilities and concentrate on other areas of development, including irrigation and participation in decision-making.

Marital status positively affected farmers' participation during the RESIS programme's implementation, benefit sharing and evaluation stages (Table 4.10). According to the results, farmers who are married are more likely to participate in the RESIS programme during implementation and benefit sharing. Based on the study results in Table 4.2, more than 50% of farmers were married across all four irrigation schemes. At the scheme level, it was found that more farmers in Makhathini (62.20%) and Ndumo B (61.20%) irrigation schemes were married. As a result, Makhathini and Ndumo B farmers were able to participate in RESIS implementation and benefit sharing more than Mooi River and Tugela Ferry farmers. The results agree with Nnadi and Akwiwu (2008) who found that farmers' concerns about household welfare and food security are associated with their marital status, which affects their willingness to participate in agricultural projects. In addition, Haile (2016) found a positive correlation between farmers' marriage status and participation in agricultural extension programmes. Farmers who were married had good understanding, support, and encouragement from their spouses. Results also indicated that only RESIS implementation and benefit sharing stages were significantly affected by marital status. Accordingly, the effect of marital status on farmers' level of participation vary from one stage of RESIS programme to another.

Education, as indicted in Table 4.10, positively and statistically significantly affected farmers' level of participation during the RESIS evaluation stages. The results suggest that educated farmers are more likely to participate in evaluating RESIS. Various studies (Enete and Igbokwe, 2009, Olwande and Mathenge, 2010, Martey *et al*., 2013) have also found that education influenced farmers' willingness to participate in collective actions. Most farmers in this study had a primary education (Table 4.2). However, Makhathini farmers had a higher percentage of tertiary education than those in other irrigation schemes. As a result of their higher educational level, Makhathini irrigation scheme farmers were more likely to participate in RESIS evaluation stages than farmers in other irrigation schemes.

Most farmers in Makhathini and NdumoB had larger plots than those in Tugela Ferry and Mooi River (Table 4.1). The farm or plot size of the household statistically significantly affected farmers' participation levels in RESIS decision-making (Table 4.10). Therefore, farmers with larger plots were more likely to participate in the RESIS decision-making stage than their counterparts. Thus, farmers in Makhathini and NdumoB may be more willing to participate in RESIS decision making. There is also a relationship between gender and landownership. In contrast to Tugela Ferry and Mooi River farmers who primarily practice subsistence farming, Makhathini and NdumoB farmers are largely commercial. The reason for this is that farmers in Makhathini and NdumoB own larger plots than farmers in Mooi River and Tugela Ferry (Table 4.1). The majority of farmers in NdumoB and Tugela Ferry are women (Table 4.2.). Consequently, most female farmers do not have access to larger irrigated plots and are relegated to substance farming compared to majority of male farmers. As a result, female farmers are discouraged from participating in RESIS decision-making stages since they do not have access to larger irrigation lands. As reviewed in the literature (Muchara *et al*., 2014, Sharaunga and Mudhara, 2018, Sithole, *et al*., 2014), farmer participation in collective action is related to size of land owned. Farmers with larger irrigated plots are motivated to participate in collective actions because of their higher water needs.

5.1.2. Farmers' awareness of the RESIS programme

According to Figure 4.1, almost half of the farmers were unaware of the RESIS programme. In contrast, Makhathini irrigation scheme had more farmers aware of the RESIS programme than other irrigation schemes. Mooi River farmers were less aware of RESIS than other irrigation schemes. Farmers' general knowledge or awareness of the RESIS programme had statistically significant negative impacts on their participation in the RESIS decision-making process (Table 4.10). According to the results, farmers who are more familiar with the RESIS programme are less likely to participate in the decision-making process. These results were unexpected and contrary with various studies (Ayanda, 2011; Ajadi *et al*., 2016; Walder and Kantelhardt, 2018; Mustafa *et al*., 2018; Sulewski and Goła´s, 2019) which found that farmers who are aware of agricultural development programs are more likely to participate. Those aware of the RESIS programme might not bother to attend meetings related to decision-making because they already knew what should be done and that the RESIS implementers had made decisions. In accordance with DALRRD (2014), RESIS programme aims to support black farmers by providing infrastructure, access to input and output markets, training, and supportive institutions. Implementation decisions had already been made such that farmers who were more aware of the government's decision to implement the RESIS programme were unlikely to attend the decision-making process. Furthermore,

results on farmer's level of participation indicated that 40.90% of farmers across the four irrigation schemes were involved in consultation-type participation during RESIS decision making. More farmers in Makhathini (48.65%) and Mooi River (64.000%) who experienced consultation type of participation during RESIS decision-making were less likely to participate in the decision-making process. In general, most farmers were only consulted regarding RESIS after decisions had already been made. Consequently, their participation in decision-making was discouraged by the knowledge of decisions that would be implemented by RESIS implementers.

5.1.3. Farmers' attitudes towards RESIS programme

Farmers' attitudes toward the efforts of the RESIS programme to provide functional irrigation infrastructure, access to markets, financial support, training, and establish supportive institutional arrangements significantly affected their level of participation in RESIS (Table 4.10).

The study found that farmers' attitudes toward rehabilitated irrigation infrastructure negatively affected their level of participation in RESIS during the benefit sharing stages and positively during the evaluation stages (Table 4.10). On average, farmers in all irrigation schemes were not satisfied with the rehabilitated irrigation infrastructure, scoring 2.489 attitude value (Table 4.5). On the other hand, comparison at scheme level indicated that the majority of farmers in Mooi River and Tugela Ferry were satisfied with their revitalised irrigation infrastructure compared to those in Makhathini and NdumoB. Pumped irrigation systems are used in Makhathini and NdumoB irrigation schemes, which require high levels of management, operation, and maintenance. In Tugela Ferry and Mooi River, most farmers had both gravity and pumped irrigation. Compared to farmers operating pumped irrigation systems in Makhathini and NdumoB, gravity irrigation systems used in Tugela Ferry and Mooi Rivers are cheaper. Extension officers responsible for the selected irrigation schemes reported that farmers have difficulty maintaining and operating pump stations due to costs. Hence, the results that farmers' levels of participation in the RESIS benefit-sharing stage were negatively affected by their attitudes towards rehabilitated irrigation infrastructure was unexpected based on reviewed literature (Sevinç *et al*., 2019). According to Sevinç *et al*. (2019), a study in Turkey among cotton and wheat producers showed that those living in irrigation areas are most positive about government support. Conversely, those living in dry agricultural areas have the most negative attitudes toward agricultural policy. As a beneficiary of agricultural support policies, they have access to a functional irrigation system.

The results could imply that although farmers were grateful to government for revitalising their irrigation infrastructure, the revitalized irrigation infrastructure did not meet their expectations in terms of participating in benefit sharing stages of the RESIS programme. Hence attitudes of farmers towards objectives of RESIS programme could vary significantly. In other words, positive attitudes towards development programme does not necessarily mean high level of beneficiary participation.

Farmers' attitudes toward irrigation infrastructure had a statistically significant positive effect on farmer participation during the RESIS evaluation stage (Table 4.10). On the other hand, farmers attitudes towards their rehabilitated irrigation infrastructure had a statistically significant negative affect on their level of participation during RESIS benefit-sharing stage. Since farmers were not satisfied with the rehabilitated irrigation infrastructure, they were more inclined to make an input into the project evaluation process (Table 4.4). The purpose of RESIS programme evaluation is to collect information about the activities, characteristics, and outcomes of the RESIS programme in order to make judgments about its effectiveness and/or inform future planning decisions. In other words, farmer's participation in RESIS evaluation stage should result in providing researchers or RESIS implementers with feedback to improve strategies for ensuring increased performance of irrigation infrastructures. Senanayake et al. (2015) report that the majority of studies conducted on PIM/IMT-related projects rely on post intervention data. Similarly, the attitudes of farmers towards irrigation infrastructure could not be compared before and after the RESIS programme was implemented. There is a possibility that farmers were highly dissatisfied with their irrigation infrastructure prior to the implementation of RESIS.

The study also found that attitudes of farmers towards access to markets was positively statistically significantly affected level of participation during decision-making and evaluation stages (Table 4.10). In another words, farmers were more willing to participate during RESIS decision-making and evaluation stages only if they had positive perception of RESIS's objective of promoting their access to produce markets. The results were also in agreement with Ojediran *et al*. (2020) who found a relationship between farmers' attitudes in Nigeria and participation in agricultural development programme. Farmers' attitudes had a positive statistically significant effect on the farmers' participation in agricultural development programme. In this study farmers that were more positive about access to markets through the RESIS programme were more willing to be part of the decision-making and evaluation stage of the RESIS programme. According to Sevinç *et al.* (2019), other factors such as age, size of the land ownership, settlement area, education level, property type, crop pattern, land under irrigation, and household income could have a combined significant effect on farmers' attitudes. Additionally, the study found that farmers in the Makhathini irrigation scheme were

highly positive (3.230) about markets compared to farmers in the other irrigation schemes (Table 4.4). The majority of farmers in the Makhathini irrigation schemes cultivate sugarcane as the main crop and accessed markets via sugar mills located in the vicinity of Jozini Municipality. On the other hand, other irrigation schemes had to transport their produce to distant markets. Hence, it can be deducted that farmers in Makhathini were more willing to participate in the RESIS programme during decision-making and evaluation stages because of their access to produce markets.

Farmer attitudes towards financial support negatively affected their level of participation during RESIS evaluation stage, but has a positive statistically significantly effect on their levels of participation during RESIS implementation and benefit sharing (Table 4.10). These results indicate that farmers in all revitalised smallholder irrigation schemes were more motivated to participate in RESIS implementation and benefit sharing stages because of their positive attitudes towards financial support received as part of RESIS programme. Farmers generally were dissatisfied with financial support, scoring 2.060 on an attitude scale (Table 4.5). From personal communication with extension officers responsible for revitalising irrigation schemes, most of the time government did not provide farmers with cash but vouchers to purchase production inputs. Farmers had only been given cash (as a relief grant) during the outbreak of COVID 19 pandemic. These results agree with Sithole *et al*. (2014) and Etwire *et. al*. (2013) who also concluded that, for active participation, farmers can be motivated by access to funds through credit or grants. Mthombeni (2018) discovered that the funding framework in South Africa was not suited for emerging farmers but only caters for existing commercial farmers. Hence, the government in South Africa introduced the Comprehensive Agriculture Support programme (CASP) and Ilima/Letsema to cater specifically for food security, subsistence, emerging smallholder and commercial farmers (DALRRD, 2020). Farmers were encouraged to participate in RESISs' implementation and benefit sharing stages as a result of their positive attitudes towards RESIS's financial support in agreement with reviewed literature (Sithole *et al*., 2014; Etwire *et al*., 2013), which showed that to encourage farmers' active participation in agricultural developmental programme, credit or grants should be accessible through financial institutions or government departments. The results of the effect of farmers' attitudes towards RESIS financial support on farmers' level of participation during the RESIS evaluation stage were unexpected based on prior expectations of the study.

Farmer' attitudes towards training was also found to have statistically significant role in encouraging farmers to participate in the RESIS's benefit sharing and evaluation stages (Table 4.10). This study also found that farmers across the four irrigation schemes had positive attitudes (3.366) towards training offered through the RESIS programme (Table 4.4).

Most of reviewed literature (Meijer *et al*., 2015; Kazeem *et al*., 2017) agreed on various socio-economic characteristics of farmers affecting level of technology adoption. The results of this study, agree with Kazeem *et al*. (2017) and Meijer *et al*. (2015), that farmers' attitudes towards extension training play significant roles on farmers' decision to participate in government's programmes. In South Africa, irrigation schemes were allocated extension officers responsible for training farmers as well as providing technical support (DALRRD, 2023). According to DALRRD (2015) all farmers should be trained prior to the implementation of the RESIS programme. Based on the personal communication with extension officers responsible for selected revitalised smallholder irrigation schemes, all farmers in revitalised smallholder irrigation schemes were provided with various training opportunities. This may be why farmers rate training highly on the attitude scale as a RESIS objective.

Survey results revealed that farmers across the four irrigation schemes exhibited positive attitudes toward supportive institutional arrangements (Table 4.4). Farmers' attitudes towards access to institutional support negatively affected their level of participation during the RESIS implementation and benefit sharing stages (Table 4.10). This finding is contrary to the literature (Sirikwa, 2015; Phali, 2020; Mwadzingeni *et al*., 2020) that indicates farmers are more likely to participate in collective activities if they have access to supportive and robust institutional arrangements. Additionally, access to functional formal and informal institutions should create an appropriate environment for socializing, interacting and settling disputes, and leaving time to focus on farming operations to produce high yields and incomes (Mwadzingeni *et al*., 2020).

5.1.4. Farmers' attitudes towards the RESIS implementers

Farmers' attitudes towards RESIS implementers' participatory approach discouraged their participation during the decision-making stages of the RESIS programme. However, participation during the evaluation stages was significantly encouraged (Table 4.10). In other words, the effects of RESIS implementers' participatory approach varied statistically significantly from one stage to the other. Farmers could not participate in the RESIS decision-making stage due to a lack of trust between them and RESIS implementers. Nonetheless, farmer attitudes towards the participatory approach of the RESIS implementers were positive (2.623) across the four irrigation schemes (Table 4.5). These results were not expected and disagreed with Maake & Antwi (2022) who found that government officials' participatory approaches did not significantly affect farmers' or attitudes perceptions. In this

study, however, farmers are more likely to participate in RESIS evaluations when they are encouraged by RESIS implementers. Although farmers were positive about RESIS' participatory approach, they did not want to participate in decision-making because they knew decisions were made prior. According to this study, most farmers were passive participants rather than being involved in decision-making (Table 4.6). It could be implied that farmers knew the RESIS programme had already been decided by the RESIS implementers, and they were simply informed. It can be deducted that farmers were only consulted after decisions about RESIS programme were taken and they waited till performance evaluation stage of the RESIS programme to express their preference. Furthermore, participation by farmers, as indicated by results of this study, was symbolic. Farmers were made to feel like they were given opportunity to participate but only to be consulted after decisions were taken. In this case, farmers use the RESIS evaluation stage to express their real preference about the improvements.

According to Table 4.6, farmers across the four irrigation schemes were positive about the efficiency and effectiveness of the RESIS implementers. In another words, RESIS implementers were using allocated budgets efficiently (deliver desired outcomes with little or no waste) and effectively (deliver intended outcomes). According to the latest Batho Pele Strategy (Department of Public Service and Administration - DPSA, 2022), efficiency and effectiveness are championed as Good Governance Principles by the South African Government. In this study, only farmers in Makhathini felt that RESIS implementers were not efficient and effective. According to Table 4.10, farmers' attitudes towards RESIS implementers' efficiency and effectiveness significantly and positively affected their participation in decision-making and implementation stages. Unexpectedly, farmers' attitudes towards efficiency and effectiveness of RESIS implementers negatively affected their level of participation in the RESIS evaluation stages. This could be attributed to RESIS implementers using allocated resources with less wastage to achieve intended outcomes. Specifically, farmers in Tugela Ferry and NdumoB irrigation schemes had a positive attitude towards RESIS implementer's efficiency and effectiveness of 3.153 and 3.53, respectively (Table 4.5), suggesting that these farmers were more satisfied with RESIS implementers' efficiency and effectiveness. As a result, they were able to take part in decision-making and implementation of the RESIS programme. According to literature (Dittoh *et al*., 2013; Poussin *et al*., 2015; Venot and Hirvonen, 2013), non-adherence to good governance principles (including efficiency and effectiveness) could contribute to low performance of public irrigation schemes. It is clear from this study that poorly implemented PIM/IMT-related projects may lead to poor farmer participation due to inefficiency and ineffectiveness.

In this study, farmers across the four irrigation schemes indicated positive attitudes towards RESIS implementers' fairness (Table 4.5). According to Batho Pele Principles, government officials should be mindful of fairness and equity when providing services to smallholder irrigation farmers (DALRRD, 2023). This is aimed at ensuring that every citizen is afforded an equal and fair opportunity to access services from the government. Farmers' attitudes towards RESIS implementers' fairness and equity in the allocation of benefits statistically significantly positively affected farmers' participation during RESIS implementation and benefit sharing (Table 4.10). Farmers are likely to participate in RESIS implementation and benefit sharing stages if they perceive fairness and equitable treatment by RESIS implementers during benefit allocations.

5.1.5. Farmers' access to irrigation water and level of participation

Results of the study also indicated that farmers had 52.75% overall access to water for irrigation (Table 4.8). This means that almost 50% of farmers across four irrigation schemes were accessing water for irrigation adequately, timely and equitably. Access to water for irrigation had a positive statistically significant effect on farmers' level of participation during the RESIS decision making stages (Table 4.10). Muchara *et al*. (2014) also concluded that long-term water scarcity discourages farmers from participating actively in collective actions. The current study used three criteria to determine access to water: reliable, adequate, and equitable. Therefore, farmers' access to reliable, adequate, and equitable water was crucial to their participation in the RESIS programme, especially during the decision-making phase. Results show that more than 60% of households have access to adequate, reliable, and equitable water. However, farmers in Makhathini (40%) and NdumoB (33%) had difficulty accessing water on time. The source of water was adequate for everyone, but timely distribution of water was a challenge for most farmers operating pressurized irrigation systems (such as Makhathini and NdumoB). Gravity based irrigation systems comprised of canal networks can still be more effective than pressure-based irrigation systems used by smallholder farmers. Using pressurized irrigation systems presented farmers with challenges of high electricity and fuel costs. Moreover, farmers in areas where electricity is the primary energy source sometimes had to mitigate the impact of ESKOM load shedding.

5.2. Determinants of farmer's access to irrigation water

This study identified the factors driving farmers' access to water. The results indicated that variables associated with their attitudes toward RESIS and its implementers, as well as their level of participation in RESIS decision-making, significantly affected farmers' access to irrigation water.

5.2.1. Attitude of farmers towards RESIS programme

With reference to farmers' attitudes towards RESIS programme, farmers with positive attitude towards rehabilitated irrigation infrastructure, access to markets, training and financial support had significant better access to irrigation water (Table 4.12).

Results indicate that farmers who displayed positive attitudes or satisfied with their rehabilitated irrigation infrastructure had a high probability to access water for irrigation in the revitalised smallholder irrigation schemes (Table 4.11). Results are in agreement with reviewed literature (Anderies *et al*., 2013; Bastakoti *et al*., 2012; Ostrom, 2011) that the farmers with a positive attitude towards external initiatives or interventions, often have ease of initiating and maintaining collective action. In another words, there is strong relationship between attitude and behaviour, including intention to participate in collective activities such as operation and maintenance of irrigation infrastructure, leading to better water access.

On average farmers were negative or not satisfied with their rehabilitated irrigation infrastructure (Table 4.5). Comparison at scheme level, indicated that farmers in Mooi River and Tugela Ferry were satisfied with their irrigation infrastructure compared to farmers in Makhathini and Ndumo B. In other words, expectation of farmers in Tugela Ferry and Mooi River were met through rehabilitation of their irrigation infrastructure. On the other hand, majority of farmers in Makhathini and Ndumo B were not happy with pressurized irrigation systems compared Tugela Ferry and Mooi River irrigation schemes with a mixture of gravitated and pressurized irrigation systems.

Results also indicated that farmers attitude towards access to input and output markets significantly increased probability to access water in their respective irrigation schemes (Table 4.12). In other words, farmers who were assisted with input and output markets had a greater chance of accessing adequate, equitable, and timely irrigation water in their respective irrigation schemes. Water access is one of the performance indicators of smallholder irrigation schemes. Based on Poussin *et al*. (2015), inadequate market access was identified as the major constraint to the performance of SIS, including farmers' access to irrigation water. Compared to farmers in other irrigation schemes, only Makhathini farmers were positive about access to markets (Table 4.5) as the majority of them cultivate sugarcane as their main crop, according to Mjindi Farming Company's annual report for

2019/2020 (DARD, 2020). Sugarcane farmers in the Makhathini irrigation scheme have access to a more reliable market compared to farmers in other irrigation schemes. This study suggests that Makhathini farmers may be performing well commercially as a result of being able to access markets easily. A better market access can also increase production, increase farm income, and allow farmers to pay for irrigation infrastructure operation and maintenance. The Makhathini farmers, in particular, rely heavily on pressurized irrigation systems that are expensive to operate and maintain. Market access is pivotal for farmers in Makhathini to remain commercially viable..

This study also found that farmers' attitudes toward RESIS financial support resulted in a high probability of access to irrigation water for farmers (Table 4.12). Water for irrigation is more likely to be available to those with a positive attitude toward RESIS financial support. In general, farmers across irrigation schemes were not happy (scoring 2.060 on attitude scale) with the financial support they receive through RESIS (Table 4.5). The RESIS programme is mostly funded through conditional grants and equity funds from the DALRRD and provincial agriculture departments, respectively. Farmers are most often given vouchers instead of cash (DARD, 2020). According to personal communications with extension officers responsible for revitalising smallholder irrigation schemes, farmers only got money as relief funds during the COVID-19 pandemic and unrests in KwaZulu-Natal Province in July 2021. In the study, farmers who demonstrated negative attitudes towards RESIS financial support could also have preferred cash instead of vouchers. Smallholder farmers lack the essential inputs to improve their productivity and income, preventing them from unlocking economic and social development gains. A smallholder's access to these inputs is dependent on financing, particularly cash to fund emergency intervention. The daily operations and maintenance of smallholder irrigation schemes are crucially dependent on cash. It is particularly true for farmers in Makhathini and Ndumo B irrigation schemes, which rely heavily on pressurized irrigation systems in comparison to farmers in Tugela Ferry and Mooi River irrigation schemes.

The results also indicated that farmers' attitudes towards access to RESIS training and extension services significantly increase their chances of having access to irrigation water in their irrigation schemes (Table 4.12). Farmers across the four irrigation schemes were generally positive about access to training and extension services provided by RESIS (Table 4.5), i.e., farmers were satisfied with the training and extension services they received. Xiuling *et al*. (2023) found that farmers are significantly more likely to adopt water-saving irrigation technology if technical training is provided to them. In addition, the results are in agreement with Mgendi (2021) who found that training increases productivity, especially in irrigation, since farmers who participate in training programs use irrigation water more

effectively. A number of studies have found that training in water management and agronomical practices is associated with positive effects on agricultural production and food security (Bizikova *et al*., 2017). For irrigation farmers to remain profitable and improve their sustainability, they require advice from time-to-time. This study also found that farmers were happy with their access to extension services. It can be concluded from the results that most farmers in the four irrigation schemes had access to training and extension services which could help them manage, operate, and maintain their irrigation systems better, and giving them access to water.

5.2.2. Attitude of farmers towards RESIS implementers

According to the Probit Model, farmers' attitudes toward the RESIS programme (rehabilitated irrigation infrastructure, market access, training and financial support) increased their likelihood of accessing irrigation water in selected four revitalised smallholder irrigation schemes (Table 4.11).

The results of the study suggest that farmers with high probability to access irrigation water were more satisfied or had high positive attitudes toward rehabilitated irrigation infrastructure (Table 4.11). In accordance with the reviewed literature (Anderies et al., 2013; Bastakoti et al., 2012; Ostrom, 2011), farmers with a positive attitude toward external initiatives or interventions, where benefits outweigh costs of participation, are often more likely to initiate and maintain collective action. In other words, there is strong relationship between attitude and behaviour, including intention to participate in collective activities such as operation and maintenance of irrigation infrastructure. Nonetheless, on average farmers were negative or not satisfied with their rehabilitated irrigation infrastructure (Table 4.4). But comparison at scheme level, indicated that farmers in Mooi River and Tugela Ferry were satisfied with their irrigation infrastructure compared to farmers in Makhathini and Ndumo B. In other words, expectation of farmers in Tugela Ferry and Mooi River were met through rehabilitation of their irrigation infrastructure. On the other hand, majority of farmers in Makhathini and Ndumo B were not happy with pressurized irrigation systems compared Tugela Ferry and Mooi River irrigation schemes with a mixture gravitated and pressurized irrigation systems. Hence farmers in Tugela Ferry and Mooi River pay less to access water for irrigation compared to farmers in other irrigation schemes.

Results also indicated that farmers attitude towards access to input and output markets significantly increased probability to access water in their respective irrigation schemes (Table 4.11). In other words, farmers who were assisted with input and output markets had a greater chance of accessing adequate, equitable, and timely irrigation water in their respective irrigation schemes. Water access is one of the performance indicators of

smallholder irrigation schemes. Based on Poussin et al. (2015), inadequate market access was identified as the major constraint to the performance of SIS, including farmers' access to irrigation water. Compared to farmers in other irrigation schemes, only Makhathini farmers were positive about access to markets (Table 4.4). The majority of farmers cultivate sugarcane as their main crop, according to Mjindi Farming Company's annual report for 2019/2020 (DARD, 2020). Compared to farmers in other irrigation schemes, sugarcane farmers in the Makhathini irrigation scheme have access to a reliable market. This study suggests that Makhathini farmers may be performing well commercially as a result of being able to access markets easily. A better market access can also increase production, increase farm income, and allow farmers to pay for irrigation infrastructure operation and maintenance. The Makhathini farmers, in particular, relies heavily on pressurized irrigation systems that are expensive to operate and maintain. In order for farmers in Makhathini to remain commercially viable, they must have access to markets.

This study also found that farmers' attitudes toward RESIS financial support resulted in a high probability of access to irrigation water for farmers (Table 4.11). Water for irrigation is more likely to be available to those with a positive attitude toward RESIS financial support. In general, farmers across irrigation schemes were not happy (scoring 2.060 on attitude scale) with the financial support they receive through RESIS (Table 4.4). The RESIS programme is mostly funded through conditional grants and equity funds from the DALRRD and provincial agriculture departments, respectively. Farmers are most often given vouchers instead of cash (DARD, 2020). According to researchers' personal communications with extension officers responsible for revitalising smallholder irrigation schemes, farmers were only given money as relief funds during the COVID 19 pandemic and unrests in KwaZulu Natal province in July 2021. As a result of the study, farmers who demonstrated negative attitudes towards RESIS financial support could also have preferred cash instead of vouchers. Smallholder farmers lack the essential inputs to improve their productivity and income, preventing them from unlocking economic and social development gains. A smallholder's access to these inputs is dependent on financing, particularly cash to fund emergency intervention. The daily operations and maintenance of smallholder irrigation schemes are crucially dependent on cash. It is particularly true for farmers in Makhathini and Ndumo B irrigation schemes, which rely heavily on pressurized irrigation systems in comparison to farmers in Tugela Ferry and Mooi River irrigation schemes.

The results also indicated that farmers' attitudes towards access to RESIS training and extension services significantly increase their chances of having access to irrigation water in their irrigation schemes (Table 4.11). Farmers across four irrigation schemes were generally positive about access to training and extension services provided by RESIS (Table 4.4). In

other words, farmers were satisfied with the training and extension services they received. A study by Xiuling et al. (2023) found that farmers are significantly more likely to adopt water-saving irrigation technology if technical training is provided to them. In addition, the results are in agreement with Mgendi's (2021) findings that training increases productivity, especially in irrigation, since farmers who participate in training programs use irrigation water more effectively. A number of studies have found that training in water management and agronomical practices is associated with positive effects on agricultural production and food security (Bizikova et al., 2017). For irrigation farmers to remain profitable and improve their sustainability, whether they are small or large commercial operations, they require advice from time to time. The agricultural extension officer provides advice to many of these farmers, especially smallholder farmers. This study also found that farmers were happy with their access to extension services. It can be concluded from the results that most farmers in four irrigation schemes had access to training and extension services which could help them manage, operate, and maintain their irrigation systems better.

5.2.3. Attitude of farmers towards RESIS implementers

Unexpectedly, results in this study indicated that farmers' attitudes towards RESIS implementers' efficiency and effectiveness significantly reduced farmers' probability to access water in their respective irrigation schemes (Table 4.11). Results in this study indicate that farmers, on average, were happy with efficiency and effectiveness of RESIS implementers (Table 4.5). Comparison at scheme level indicated that only farmers in the Makhathini irrigation scheme were not happy with RESIS implementers' efficiency and effectiveness. Effective irrigation systems require good governance, including being efficient and effective during management, operation, and maintenance (Dittoh et al., 2013b). It was expected that farmers' attitudes towards RESIS implementers' efficiency and effectiveness would increase probability of farmers to access irrigation water. The results are in contrast with literature reviewed (Akuriba, 2018) which found that adherence to good governance principles such as efficiency and effectiveness could increase performance of irrigation scheme, including farmers' access to water.

5.2.4. Farmers' level of participation and access to irrigation water

According to this study, farmers who participated in the RESIS decision making stages were more likely to have access to water (Table 4.11). Results of the study also indicated that almost 50% of farmers across irrigation schemes did not participate during the RESIS programme (Table 4.7). It is possible that farmer participation during RESIS decision making stage led to farmers being able to choose the type of irrigation system they preferred. In

Tugela Ferry and Mooi River, farmers use both gravity and pumped irrigation systems. A majority of farmers surveyed in Tugela Ferry used gravity and did not pay any fees to access water, compared to those in NdumoB and Makhathini. A study conducted by Adekunle (2015) found that 80.5% of irrigation scheme farmers in Nigeria did not participate in irrigation management because of a lack of water during dry seasons. Based on this study, farmers' participation in irrigation management is associated with water access for irrigation. This could be attributed to the fact that majority of farmers in Tugela Ferry and Mooi River irrigation schemes were given options during the decision-making process and were therefore able to choose a cheaper method to irrigate their crops.

5.3. Summary

According to the study, household and plot sizes, RESIS market access, RESIS implementers' efficiency and effectiveness, and farmers' access to water for irrigation all had a statistically significant positive effect on farmer participation during the RESIS decision-making stage. However, RESIS knowledge and the participatory approach of RESIS implementers had a statistically significant negative impact on farmer participation during the RESIS decision-making stage. Marital status, financial support, RESIS implementers' fairness, and farmers' access to water for irrigation were found to have statistically significant effects on farmer participation during the RESIS implementation stage. However, access to RESIS institutional support was found to have a statistically significant negative effect on farmer participation during the RESIS implementation stage. Marital status, RESIS financial support, and the fairness of RESIS implementers were found to have a statistically significant positive effect on farmer participation during the RESIS benefit sharing stage. In contrast, rehabilitated irrigation infrastructure and access to institutional support had a statistically significant negative effect on farmer participation during the benefit sharing stage. Farmers were encouraged to participate during the RESIS evaluation stage due to their age, education level, rehabilitated irrigation infrastructure, market access, training, and participatory approach of the RESIS implementers. On the other hand, marital status, RESIS financial support, access to institutional support, and the effectiveness and efficiency of RESIS implementers all had a statistically significant negative impact on farmer participation during the RESIS evaluation stage. The magnitude and direction of the effect of variables found to be statistically significant affecting farmer participation in various stages of the RESIS programme varied from one stage to the other.

According to the study, household and plot sizes, RESIS market access, RESIS implementers' efficiency and effectiveness, and farmers' access to water for irrigation all had

a statistically significant positive effect on farmer participation during the RESIS decision-making stage. However, RESIS knowledge and the participatory approach of RESIS implementers had a statistically significant negative impact on farmer participation during the RESIS decision-making stage. Marital status, financial support, RESIS implementers' fairness, and farmers' access to water for irrigation were found to have statistically significant effects on farmer participation during the RESIS implementation stage. However, access to RESIS institutional support was found to have a statistically significant negative effect on farmer participation during the RESIS implementation stage. Marital status, RESIS financial support, and the fairness of RESIS implementers were found to have a statistically significant positive effect on farmer participation during the RESIS benefit sharing stage. In contrast, rehabilitated irrigation infrastructure and access to institutional support had a statistically significant negative effect on farmer participation during the benefit sharing stage. Farmers were encouraged to participate during the RESIS evaluation stage due to their age, education level, rehabilitated irrigation infrastructure, market access, training, and participatory approach of the RESIS implementers. On the other hand, marital status, RESIS financial support, access to institutional support, and the effectiveness and efficiency of RESIS implementers all had a statistically significant negative impact on farmer participation during the RESIS evaluation stage. The magnitude and direction of the effect of variables found to be statistically significant affecting farmer participation in various stages of the RESIS programme varied from one stage to the other. Farmers' likelihood to access water for irrigation in four revitalised irrigation schemes was statistically significantly affected by their attitudes towards access to rehabilitated irrigation infrastructure, markets, financial support, training, the effectiveness of RESIS Implementers, and farmer participation during the RESIS decision-making stages.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

The study investigated factors affecting farmers' level of participation in the RESIS programme during the decision making, implementation, benefit sharing, and evaluation stages, as well as their effect on farmers' access to water for irrigation in selected revitalised smallholder irrigation schemes. There is limited literature on the determinants of farmers' level of participation during different phases of PIM/IMT related programmes. According to the findings of this study, socioeconomic and demographic factors, level of RESIS awareness, farmers' access to irrigation, and attitudes towards the RESIS programme and its implementers all had varying effects on farmers' level of participation during various stages of the RESIS programme.

Age, household size, marital status, educational level, and household land size are selected demographic and socioeconomic factors that have been found to have varying statistically significant effects on farmers' level of participation during different stages of the RESIS programme implementation in the Makhathini, NdumoB, Mooi River, and Tugela Ferry irrigation schemes. The study found that all farmers in Makhathini, NdumoB, Mooi River, and Tugela Ferry irrigation schemes are elderly. These results also indicate that Makhathini, NdumoB, Mooi River, and Tugela Ferry irrigation schemes are the most important source of employment for older people. Therefore, these farmers have no choice but to participate in the evaluation process of RESIS. This ensures that farmers evaluate the performance of government funded programs and recommend what resources and support they need. Moreover, these revitalised smallholder irrigation schemes have proven to be particular importance for older women because they make up the majority of farmers in the revitalised schemes. The study also found that farmers across all smallholder irrigation schemes belong

to larger households (more than the South African average household size of 3.34). Based on the results of the study, it can be concluded that a farmer with a large household can easily participate in decision making stages of RESIS project whiles delegating other important activities to other household members and vice versa. By sharing the responsibility and saving time, the household head can participate in RESIS decision making processes and share responsibility with his or her family. These farmers in revitalised smallholder irrigation schemes with large family sizes are more likely to engage in subsistence farming as a means of ensuring food security. The study results further indicate that farmers who were married were more willing to participate in all RESIS stages, except for the decision making stage. There were more than 60% of married farmers in Makhathini and NdumoB. A married farmer may have access to the spouse's information and resources, making it possible to participate in RESIS project activities than a farmer who is not married. A good understanding, support, and encouragement from their spouses contributed to active participation of married farmers during RESIS stages. The study results could also mean that single farmers are struggling to access resources and financial support for irrigation projects, including projects related to RESIS. The study also found that level of education was a factor encouraging farmers to participate during RESIS evaluation stages. This indicate that farmers that have high level of education are interested in participating in assessing the effectiveness of the RESIS programme. A farmer who is educated has skills and knowledge about farming and knows what it takes to farm profitably. Makhathini farmers, in particular, had a higher level of education than farmers from other irrigation schemes. The study also found that those farmers with larger land sizes were more likely to participate in RESIS decision making due to the level of commercialisation. On average, farmers in Makhathini and NdumoB have larger plots than those in Tugela Ferry and Mooi River. Most farmers with bigger plots are commercially oriented due to economies of scale. Since they are aware of what they want, they prefer being part of RESIS' decision-making processes. Most farmers with small plots practice subsistence farming and are discouraged from participating in decision making because their investment in farming is minimal compared to farmers with larger plots. Subsistence farming is the main form of farming in Mooi River and Tugela Ferry.

The majority of farmers were female, but in NdumoB and Makhathini, the majority of farmers were male. In contrast with other schemes, Makhathini and NdumoB irrigation schemes have larger plots. Therefore, the majority of female farmers in Tugela Ferry and Mooi River irrigation schemes practiced mainly subsistence farming compared to those in NdumoB and Makhathini. Makhathini and NdumoB also have a higher percentage of married farmers than other schemes where majority of the farmers are women. Based on study findings, farmers

in Mooi River and Tugela Ferry mostly farm for subsistence, are single without spousal support, and do not have access to more profitable land. A majority of farmers are also aging across the four irrigation schemes, which shows a lack of succession plans for revitalised smallholder irrigation schemes.

Although the study found that most farmers were aware of the RESIS programme, most were discouraged to participate in the decision-making stages. It is important to understand these results in conjunction with those of the Farmer Participation Index during Decision Making Stages (FPID) and the types of farmer participation. According to the study, most farmers engaged in consultation type participation. In conclusion, the majority of farmers never experienced genuine farmer participation. Since those familiar with the RESIS programme knew that decisions about the RESIS programme had already been made, they didn't bother to attend meetings related to RESIS decision making. The farmers were only invited to the meetings to be informed about the decisions taken by RESIS implementers.

Farmers' attitudes toward RESIS and its implementers played a significant role in their level of participation during various RESIS stages. The size and direction of this effect varied from one RESIS stage to another. Farmers generally expressed negative attitudes towards irrigation infrastructure, markets, and financial support. RESIS' efforts to provide irrigation infrastructure, market access, financial support, training, and establish supportive institutional arrangements significantly impacted farmers' willingness to participate. The study also discovered that the participatory approach, effectiveness and efficiency, and fairness of RESIS implementers all had a significant impact on farmers' level of participation at various stages of the RESIS programme. In conclusion, farmers are discouraged from participating in RESIS activities if their negative perception of the RESIS programme and its implementers outweighs their positive perception.

The availability of water for irrigation in selected irrigation schemes was a significant factor encouraging farmers to participate in the RESIS programme, especially during the decision-making process. A reliable, equitable, and adequate water supply to farmers can indicate the performance of irrigation schemes. Across the four revitalized irrigation schemes, almost half the farmers do not have access to water for irrigation. NdumoB and Makhathini farmers were particularly affected by this. The farmers in Makhathini and NdumoB have larger plots, but they also use pumped irrigation systems that require electricity, unlike those in Mooi River and Tugela Farmers. Farmers in Makhathini and NdumoB find it difficult to farm profitably due to challenges such as pump station maintenance and burst underground pipes.

As part of this study, factors driving farmers' access to water for irrigation were also identified. The study indicated that farmers' attitude toward RESIS and its implementers, as

well as their level of participation in RESIS decision making, significantly influenced their access to irrigation water. Based on farmers' access to irrigation water, negative perception with the RESIS implementation and its implementers can also be seen as a reason for the failure of the RESIS programme. The negative perception of farmers towards RESIS implementers create distrust between the two parties. Due to farmers' low sense of ownership over their irrigation schemes, they are discouraged from participating in RESIS activities. As a result of all these challenges, irrigation schemes could collapse after government support is withdrawn.

In light of the results of the study, the discussions and conclusions of the study, the following policy recommendations are presented:

- Since majority of farmers across four irrigations are aging, succession plans are required to ensure revitalised irrigation schemes remain sustainable. Campaigns should be undertaken by government to conscientize youth about the importance of these irrigation schemes and agriculture in general. It is also crucial to ensure that economically active older people in rural areas have equal access to productive resources and support as well as participation in RESIS related programmes, given that the majority of economically active older people in rural areas derive their primary income from these revitalised smallholder irrigation schemes. As in the case of South Africa, youth are increasingly migrating to urban areas and engaging in non-agricultural activities, while elders remain in rural areas to look after their kids. Hence agriculture remains the only activity that ensures food security.
- The government should continue funding the RESIS programme since it not only aims to commercialize smallholder farmers, but also helps rural communities to produce their own food. Given that most farmers are women and practice subsistence farming, ambiguity in policies that promote RESIS as a means of reducing poverty and creating jobs must also be addressed. It is inevitable that these farmers will rely heavily on the government for support since they cannot reinvest profits in farming.
- Farmers who are single, especially women, should receive support from the government to balance domestic duties and RESIS activities. As a result, farmers will be in better position to participate equally in RESIS stages regardless of their marital status.

- Farmers should be educated by the government during the introduction of the RESIS programme, so they are aware that the programme is demand driven and they are the primary stakeholders.
- It is difficult for youth and female farmers to farm commercially due to traditional laws that restrict their access to larger plots of land. A priority should be given to the redistributing of commercial agricultural lands to women and youth by the government.
- The government should review the objectives of the RESIS programme to determine if farmers' needs have not changed and give them the opportunity to decide what they really want. By doing this, government officials or RESIS implementers will be able to build better relationships with farmers.
- The government should first undertake a natural resource assessment prior to investing in costly irrigation infrastructure to ensure water availability. It is also necessary to classify farmers according to their farming practices. It is necessary to provide gravitated irrigation systems such as short furrow systems to those who practice subsistence farming on small plots. However, those farming commercially should be allowed to use pressurised irrigation systems if they have access to markets, and they should be assessed to ensure the farming will be profitable.
- The implementation plans for the RESIS programme should not be viewed as one size fits all because demographic and socioeconomic factors may vary from irrigation scheme to irrigation scheme. Consequently, the study recommends determining a suitable project implementation plan for each scheme that will encourage farmers to participate throughout all phases of RESIS.
- A farmer-centered approach should be employed when implementing RESIS. The RESIS implementation team should be viewed as facilitators, and farmers should be the main stakeholders. In other words, plans should not be implemented without farmers' consent.
- Batho Pele principles based on good governance should always be adhered to by RESIS implementers. The RESIS implementation team should always practice a participative approach, be fair, efficient, and effective. There should be no perception among farmers that government officials are corrupt, unapproachable, arrogant, and wasteful. As a result of such behaviour, RESIS Implementers and

farmers are unable to communicate, build trust, collaborate, and respect each other.

- A natural resource assessment, especially that of water availability, should be conducted before the RESIS programme is implemented. Water availability in terms of adequacy, equity, and timeliness is paramount for farmer participation in the RESIS programme, which could ultimately contribute to irrigation schemes' sustainability. If water availability is limited, investing in massive irrigation infrastructure may seem naive.
- A farmers' participation in the RESIS decision-making process from the beginning and throughout is critical to ensure all decisions have the support of farmers, who are the primary stakeholders. As long as farmers participate in decision making, there will be a sense of ownership and farmers can continue to run their schemes after the government has withdrawn its support.

The study has made a contribution to the literature on farmer participation in the implementation of PIM/IMT related programmes. The study also extends this body of knowledge as it emphasise the varying effects of determinants of farmers' level of participation at various stages of the RESIS programme implementation. The study's findings could be used to develop guidelines for the RESIS programme's implementation in South Africa, with a focus on encouraging farmers to effectively participate in order to increase ownership and sustainability of revitalised smallholder irrigation schemes.

CHAPTER 7: REFERENCES

Abarinda, J., Kibwami, N. & Tutesigensi, A. (2019). Towards improving schedule performance of construction projects in Uganda with lean construction. In *Proceedings of the 35th Annual ARCOM Conference* (pp 658-667).

Achichi, C., Sennuga, S.O., Osho-Lagunju, B. & Alabuja, F.O. (2023). Effect of Farmers' Socioeconomic Characteristics on Access to Agricultural Information in Gwagwalada Area Council, Abuja. *Discoveries in Agriculture and Food Sciences*, 10(5), 28-47.

Adah, O.C., Chia, J.I. & Shaibu, M.U. (2016). Assessment of rural farmers' attitudes toward agricultural insurance scheme as a risk management strategy in Kogi State, North Central Nigeria. Assessment, 7(14).

Adekunale, O. A., Oladipo, F. O. & Busari, I. Z. (2015). Factors Affecting Farmers' Participation in Irrigation Schemes of the Lower Niger River Basin and Rural Development Authority, Kwara State, Nigeria. *South African Journal of Agricultural Extension*, 43(2), 42–51.

Adeniji, E.O. (2011).The significance of participatory management on project execution through direct labour; A case study of Adamawa State Nigeria. Unpublished Doctoral thesis.

Afshar, N. & Zarafshani, K. (2010). An analysis of the tendency toward participating in water management: a case study of water users associations in the cities of Sefidbarg and Sarabbas, Kermanshah, Iran. *The Iranian Journal of Agricultural Extension and Education*, 2, 99-113.

Afzal, M. & Barbhuiya, S. (2011). Effects of extreme weather events in Pakistan and their impacts on sustainable development. University of the West of Scotland, UK.

Aheeyar, M.M. (2006). Willingness to pay for improved irrigation services in Mahaweli system H.

Aheeyar, M. M. M. (2012). Climate change adaptation in water management for food security : Recent developments in Sri Lanka-A review of Existing Knowledge and Information. Accessed from: https://www.researchgate.net/publication/319007260_Climate_change_adaptation_in_water_management_for_food_security_Recent_developments_in_Sri_LankaA_review_of_Existing_Knowledge_and_Information.

Ajadi, A., Oladele, O., Ikegami, K. and Tsuruta, T., 2016. Farmers Awareness, Participation and Sources of Information on Extension Activities in Rural Nigeria: A Case of Patigi Local Government Area of Kwara State. *Journal of Rural Problems*, *52*(4), pp.253-258.

Ajani, E.N., Mgbenka, R.N. & Okeke, M.N. (2013). Use of indigenous knowledge as a strategy for climate change Adaptation among Farmers in sub-Saharan Africa: Implications for policy. *Asian Journal of Agricultural Extension, Economics & Sociology*, 2, 23–40.

Ajzen, I. & Fishbein, M. (1980). Understanding attitudes and predicting social behavior. Englewood Cliffs, NJ: Prentice-Hall.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50, 179–211.

Akpan, S.B., Patrick, I.V., Udoka, S.J., Offiong, E.A. & Okon, U.E. (2013). Determinants of credit access and demand among poultry farmers in Akwa Ibom State, Nigeria. *American Journal of Experimental Agriculture*, 3(2), 293.

Akuriba, M.A., Haagsma, R., Heerink, N. & Dittoh, S. (2020). Assessing governance of irrigation systems: A view from below. *World Development Perspectives*, 19, 100197.

Alam, A., Kobayashi, H., Matsumura, I., Eshan, M., Faridullah & Siddighi, B. B. (2012). Factors influencing farmers' participation in participatory irrigation management: A comparative sutdy of two irrigaiton systems in northern areas of Pakisstan. *Mediterranean Journal of Social Sciences*, 3(9), 275–283.

Ali, S.A.M. (2020). Driving participatory reforms into the ground: The bureaucratic politics of irrigation management transfer in Pakistan. *World Development*, *135*, 105056.

Amede, T. (2015). Technical and institutional attributes constraining the performance of small-scale irrigation in Ethiopia. *Water Resources and Rural Development*, 6, 78-91.

Anderies, J.M., Janssen, M.A., Lee, A. & Wasserman, H. (2013). Environmental variability and collective action: Experimental insights from an irrigation game. *Ecological Economics*, *93*, pp.166-176.

Angelakis, A., N., Zacarria, D., Krasilnikoff, J., Salgot, M., Bazza, M., Roccaro, P., Jimenez, B., Kumar, A., Yinghua, W., Baba, A., Harrison, J.A., Garduno-Jimenez, A., Angelakıs, A. N., Zaccaria, D., Krasilnikoff, J., Salgot, M., Bazza, M., Roccaro, P., ... & Fereres, E. (2020). Irrigation of World Agricultural Lands: Evolution Through the Millennia. *Water*, 12(5), 1285.

Aref, F. Marof, R. & Sarjit, S.G. (2010). Community capacity building:A review of its implications in tourism development. *Journal of American Science* 6(1): 172 - 180.

Aref, F. (2011). Farmers' participation in agricultural development: The case of Fars province, Iran. *Indian Journal of science and Technology*, 4(2), 155-158.

Armitage, CJ, Conner, M. (2001). Efficacy of the theory of planned behaviour: A meta-analytic review. *British Journal of Social Psychology*, 40, 471–499.

Arnstein, S.R., 1969. A ladder of citizen participation. *Journal of the American Institute of planners*, 35(4): 216-224.

Arun, G., Raj, D., Kumar, S., & Kumar, A. (2012). Canal irrigation management through Water Users Associations and its impact on efficiency, equity and reliability in water use in Tamil Nadu. *Agricultural Economics Research Review*, 25, 409–419. Accessed from: http://ageconsearch.umn.edu/bitstream/136758/2/6-G-Arun.pdf.

AU-SAFGRAD (The African Union Semi-Arid Food Grain Research and Development). (2018). Continental Irrigation and Agricultural Water Development Framework - Draft. Ouagadougou, Burkina Faso. Accessed from https://au.int/sites/default/files/bids/34823-au-safgrad - english.pdf.

Ayanda, I.F. (2011). Farmers' Assessment of the Effects of Duration on Awareness and Participation In Agricultural Projects In Nigeria. *The International Journal of Organic Agriculture Research and Development*, 3: 100-113.

Azfar, O., Kahkonen, S., Lanyi, A., Meagher, P. & Rutherford, D. (2018). Decentralization, governance and public services: The impact of institutional arrangements. In: *Devolution and development* (pp. 45-88). Routledge.

Bagdi, G.L. & Kurothe, R.S. (2014). People's participation in watershed management programmes: Evaluation study of Vidarbha region of Maharashtra in India. *International Soil and Water Conservation Research*, 2(3), 57-66.

Bailey, K. D. (1994). Methods of social research (4th ed., p. 345). New York: The Free Press.

Baker, J. (1997). Common property resource theory and the Kuhl irrigation systems of Himachal Pradesh, India. *Human Organization*, 56(2),199-208.

Balasubramanya, S. ()2019. Effects of training duration and the role of gender on farm participation in water user associations in Southern Tajikistan: Implications for irrigation management. *Agricultural Water Management*, 216: 1-11.

Barker, R. & Molle, F. (2004), Irrigation management in rice-based cropping systems: Issues and challenges in Southeast Asia, Ext. Bull. 543, Food and Fertil. Technol. Cent., Taipei, Taiwan. Accessed from www.fftc.agnet.org.

Bashir, A. & Kyung-Sook, C. (2018). A review of the evaluation of irrigation practice in Nigeria: Past, present and future prospects. *African Journal of Agricultural Research,* 13(40), 2087-2097.

Bastakoti, R.C., Ale, M. and Sharma, P., 2021. Trust and cooperation in managing small-scale irrigation systems of Nepal. In: *Natural Resource Governance in Asia*, 135-150. Elsevier**.**

Bastakoti, R. C., & Shivakoti, G. P. (2012). Rules and collective action: An institutional analysis of the performance of irrigation systems in Nepal. *Journal of Institutional Economics*, 8(2), 225–246. Accessed from: https://doi.org/10.1017/S1744137411000452.

Bhatta, G.D., Ojha, H.R., Aggarwal, P.K., Sulaiman, V.R., Sultana, P., Thapa, D., Mittal, N., Dahal, K., Thomson, P. & Ghimire, L. (2017). Agricultural innovation and adaptation to climate change: empirical evidence from diverse agro-ecologies in South Asia. *Environment, Development and Sustainability*, 19(2), 497-525.

Bizikova, L., Jungcurt, S., McDougal, K. and Smaller, C., 2017. Effective public investments to improve food security. International Institute for Sustainable Development.

Bjornlund, H. & Pittock, J. (2017). Exploring the productivity and profitability of small-scale communal irrigation systems in Sub-Saharan Africa. *International Journal of Water Resources Development*, *33*(5), pp.685-689.

Bjornlund, H., Zuo, A., Wheeler, S.A., Parry, K., Pittock, J., Mdemu, M. & Moyo, M. (2019). The dynamics of the relationship between household decision-making and farm household income in small-scale irrigation schemes in southern Africa. *Agricultural water management*, 213,135-145.

Bjornlund, V., Bjornlund, H. & van Rooyen, A.F. (2020). Exploring the factors causing the poor performance of most irrigation schemes in post-independence sub-Saharan Africa. *International Journal of Water Resources Development*, *36*(1), 54-101.

Blau, P. M. (1964). Exchange and power in social life. New York: John Wiley and Sons.

Boakye-Agyei, K. (2009). Fostering Civic Engagement: Stakeholder Participation in Rural Projects in Ghana. Unpublished PhD dissertation. George Mason University, Fairfax. Accessed from:

https://mars.gmu.edu/jspui/bitstream/handle/1920/4543/Boakye_Agyei_Kwame.pdf?sequence=1.

Borgia, C., García-Bolaños, M., Li, T., Gómez-Macpherson, H., Comas, J., Connor, D. & Mateos, L. (2013). Benchmarking for performance assessment of small and large irrigation schemes along the Senegal Valley in Mauritania. *Agricultural Water Management*, 121,19-26.

Botlhoko, G. J. & Oladele, O. I. (2013). Factors Affecting Farmers Participation in Agricultural Projects in Ngaka Modiri Molema District North West Province, *South Africa. Journal of Human Ecology*, 41(3), 201–206. Accessed from: https://doi.org/10.1080/09709274.2013.11906568.

Boudreau, F. & Godin, G. (2009). Understanding physical activity intentions among French Canadians with Type 2 diabetes: An extension of Ajzen's theory of planned behavior. *The International Journal of Behavioral Nutrition and Physical Activity*, 6, 35–45.

Braimah, I., King, R.S. & Sulemana, D.M. (2014). Community-based participatory irrigation management at local government level in Ghana. *Commonwealth Journal of Local Governance*, 15:141- 159.

Brewer, M.B. (1999). The psychology of prejudice: Ingroup love and outgroup hate?. *Journal of Social Issues*, 55(3), 429-444.

Brockhouse, J.W. & Wadsworth, J.J. (2010). Vital steps: A cooperative feasibility study guide (No. 2162-2018-8009).

Bryan, E., Hagos, F., Mekonnen, D. K., Gemeda, D. A., & Yimam, S. (2020). The diffusion of small-scale irrigation technologies in Ethiopia: Stakeholder analysis using net-map. IFPRI Discussion Paper 1950, Washington, DC: The International Food Policy Research Institute (IFPRI). Accessed from: https://www.researchgate.net/publication/343278463_The_Diffusion_of_Small-Scale_Irrigation_Technologies_in_Ethiopia_Stakeholder_Analysis_Using_Net-Map#fullTextFileContent

Byerlee, D. (1992). Technical change, productivity, and sustainability in irrigated cropping systems of South Asia: Emerging issues in the post-green revolution Era. *Journal of international development*, *4*(5), 477-496.

Cambaza, C., Hoogesteger, J. & Veldwisch, G.J. (2020). Irrigation management transfer in sub-Saharan Africa: an analysis of policy implementation across scales. *Water International*, *45*(1), 3-19.

Carter, S., 1989. Two Acres and a Cow:'Peasant'Farming for the Indians of the Northwest, 1889–97. *Canadian Historical Review*, 70(1): 27-52.

Cechin, A., Bijman, J., Pascucci, S., Zylbersztajn, D. & Omta, O. (2013). Drivers of pro-active member participation in agricultural cooperatives: Evidence from Brazil. *Annals of Public and Cooperative Economics*, 84(4), 443-468.

Cernea, M.M. (1985). The role of sociological knowledge in planned rural development. Sociologia ruralis, 24(3-4): 185-201.

Chandran, K. M. & Chackacherry, G. (2004). Factors Influencing Farmer Participation in Irrigation Management. *Journal of Tropical Agriculture*, 42(1–2), 77–79.

Chaudhry, A.M. (2018). Improving on-farm water use efficiency: Role of collective action in irrigation management. *Water Resources and Economics*, 22: 4-18.

Cheteni, P. (2016). Youth Participation in agriculture in the Nkokobe District Municipality, South Africa. *Journal of Human Ecology,* 55: 207–13.

Chifamba, E. (2013). Community participation in integrated water resources management in the Save catchment, Zimbabwe. *Journal of Environmental Science and Water Resources*, 2(10), 360 - 374.

Chilima, J.S., Blakley, J., Diaz, H.P. & Bharadwaj, L. (2021). Understanding Water Use Conflicts to Advance Collaborative Planning: Lessons Learned from Lake Diefenbaker, Canada. *Water*, 13(13), 756.

Christian, M. (2017). Analysis of the Impact of Smallholder Irrigation Schemes on the Choice of Rural Livelihood Strategy and Household Food Security in Eastern Cape (Doctoral dissertation, University of Fort Hare). Accessed from: http://vital.seals.ac.za:8080/vital/access/manager/Repository/vital:28526?conjunction1=OR&conjunction2=OR&source=Advanced&sort=ss_dateNormalized%5C&site_name=GlobalView&field1=text&from=2017&to=2018&field3=text&query1=arid&field2=text&query2=desert+&query3=drought+

Chun, N., 2014. The challenge of collective action for irrigation management in India. *Asian Economic Papers*, 13(2): 88-111.

Clarkson, G., Dorward, P., Osbahr, H., Torgbor, F. & Kankam-Boadu, I. (2019). An investigation of the effects of PICSA on smallholder farmers' decision-making and livelihoods when implemented at large scale–The case of Northern Ghana. *Climate Services*, 14, 1-14.

Cleaver KM. 1993. A Strategy to Develop Agriculture in Sub-Saharan Africa and a Focus for the World Bank. World Bank Tech. Paper No. 203. Washington, DC: World Bank.

Cleaver, F. (1999). Paradoxes of participation: Questioning participatory approaches to development. *Journal of International Development* ,11 (4), 597–612.

Cohen, J.M. & Uphoff, N.T.(1977). Rural Development Participation, Cornell University RDCCIS: New York**.**

Cohen, J.M. & Uphoff, N.T. 1980. Participation's place in rural development: Seeking clarity through specificity. *World Development*, 8(3), 213-235.

Cole, S. (2007). Tourism, culture and development: Hopes, dreams and realities in East Indonesia. Clevedon, UK: Channel view publications.

Conway, G. (2019). *The doubly green revolution: food for all in the twenty-first century*. Cornell University Press.

Coolican, H. (2009) .Research methods and Statistics in Psychology. 5th Ed. London. Hodder

Cornwall, A. (2002). Making Spaces, Changing Places: Situating Participation in Development, IDS Working Paper 170, Brighton: IDS.

Coward, E.W. (1986). Direct or indirect alternatives for irrigation investment and the creation of property. In: Easter, K.W. (Ed), *Irrigation investment, technology and management strategies for development*. Studies in Water Policy and Management 8. Colorado: Westview Press

Crase, L. (2020). Using Applied Economics to Study Participatory Irrigation Institutions and their Impact in South Asia. *Water*, 12(7), 2056.

Cristóvão, A., Koehnen, T. & Portela, J. (1997). Developing and delivering extension Programmes. In Improving Agricultural Extension: In Ed. Swanson, B. E. *et al*. A Reference Manual (Food and Agriculture Organization of the United Nations, 1997).

DAFF, (2012). The Strategic Plan for South African Agriculture. Pretoria: Government Printers.

DAFF (2013). The Strategic Plan for South African Agriculture. Pretoria: Government Printers.

DAFF (2014). The Strategic Plan for South African Agriculture. Pretoria: Government Printers.

DAFF (2015). The Strategic Plan for South African Agriculture. Pretoria: Government Printers.

DALRRD, (2020). The Strategic Plan for South African Agriculture. Pretoria: Government Printers.

DALRRD (2022). The Strategic Plan for South African Agriculture. Pretoria: Government Printers.

DALRRD (2023) The Strategic Plan for South African Agriculture. Pretoria: Government Printers.

DARD (2021) The Strategic Plan for South African Agriculture. Pretoria: Government Printers.

de Bont, C. & Veldwisch, G.J. (2020). State engagement with farmer-led irrigation development: Symbolic irrigation modernisation and disturbed development trajectories in Tanzania. *The Journal of Development Studies*, 56(12): 2154-2168.

de Bont, C., Liebrand, J., Veldwisch, G. J., & Woodhouse, P. (2019). Modernisation and African farmer-led irrigation development: Ideology, policies and practices. *Water Alternatives*, 12, 107–128.

de Loë, R.C., Murray, D. & Simpson, H.C. (2015). Farmer perspectives on collaborative approaches to governance for water. *Journal of Rural Studies*, 42, 191-205.

Deekor, H.L. (2019). Challenges Of Participation Of Rural Farmers In Community Development In Rivers State. *International Journal of Innovative Psychology & Social Development*, 7 (1), 75-81.

Delos Reyes, M.L.F. & Schultz, B. (2021). An assessment of farmers' perspective in support of the modernization of national irrigation systems in the Philippines. *Irrigation and Drainage*, 70(2), 207-223.

Denison, J., & Manona, S. (2007). Principles, approaches and guidelines for the participatory revitalisation of smallholder irrigation schemes, Volume 1: A rough guide for irrigation development practitioners (WRC Report No. TT 308/07). Water Research Commission.

Denison, J.A.N. (2018). An investigation into the performance of smallholder irrigation schemes in Limpopo Province, South Africa: success factors, typologies and implications for development (Doctoral dissertation, Rhodes University, South Africa).

Dittoh, S., Awuni, J.A. and Akuriba, M.A., 2013b. Small pumps and the poor: A field survey in the Upper East Region of Ghana. Water International, 38(4), pp.449-464.

Dittoh, S.; Bhattarai, M. & Akuriba, M.A. (2013). Micro irrigation-based vegetable farming for income, employment and food security in West Africa. In: Global food security: Emerging issues and economic implications, ed., Hanjra, M.A. New York, USA: Nova Science Publishers Inc. Pp. 177-199.

Dlangalala, S.F. (2018). Effects of interactions between governance, intergenerational and gender dimensions on smallholder irrigation scheme in KwaZulu-Natal, South Africa (Msc in Agric dissertation).

Dolage, D.A.R., Leelaratne, P.D. & Elakanda, D.C.S. (2015). Beneficiary participation in formulating social safeguard management programmes-experience from dam safety and water resources planning project of Sri Lanka. Accessed from http://iesl.nsf.ac.lk/bitstream/handle/1/1857/Engineer-2015-48%282%29_15.pdf?sequence=2&isAllowed=y.

DPSA (Department of Public Service and Administration). (2022). BATHO PELE Revitalisation Strategy. Accessed from https://www.dpsa.gov.za/dpsa2g/documents/sdi/2022/Batho%20Pele%20Revitalisation%20Strategy%202021.pdf

Dreze, J. & Sen, A. (2002). India: Development and participation. Oxford University Press on Demand.

Dugard, J. (2015). *Human rights and the South African legal order*. Vol. 1240. Princeton University Press.

Duhari, M. (2007). Participatory Irrigation Management (PIM) and Irrigation Management Transfer (IMT) Policy: Lessons from Mexico and the Philippines (Case Study: Indonesia) (Master in Environmental Planning dissertation). Accessed from: https://frw.studenttheses.ub.rug.nl/1633/1/TextoftheThesis.pdf

DWS (2017). Revised Strategic Plan. Accessed from https://www.dws.gov.za/Documents/Other/Strategic%20Plan/2016/Revised%20web_Strategic%20Plan%20(Vote%2036)%202015-16%20to%202019-2018-20-21-30.pdf

Elias, A., Nohmi, M., Yasunobu, K. and Ishida, A. (2013). Effect of agricultural extension program on smallholders' farm productivity: Evidence from three peasant associations in the highlands of Ethiopia. *Journal of Agricultural Science*, 5(8),163.

El shaikh, A.E., Yang, S.H., Jiao, X. & Elbashier, M.M. (2018). Impacts of Legal and Institutional Changes on Irrigation Management Performance: A Case of the Gezira Irrigation Scheme, Sudan. *Water*, *10*(11), 1579.

Enete, A.A., Igbokwe, E.M. (2009). Cassava market participation decision of household in Africa. *Tropicultura*, 27(3):129–136.

Enteshari, S. & Safavi, H.R. (2021). Development of System Dynamics for Holistic Conceptualization of Water Resources Problems Using Grounded Theory: A Case Study of the Zayandehrud River Basin. *Iranian Journal of Science and Technology, Transactions of Civil Engineering*, 45, 413-428.

Etwire, P. M., Dogbe, W., Wiredu, A. N., Martey, E., Etwire, E., Owusu, R. K., & Wahaga, E. (2013). Factors Influencing Farmer's Participation in Agricultural Projects: The case of the Agricultural Value Chain Mentorship Project in the Northern Region of Ghana. *Journal of Economics and Sustainable Development*, 4(10), 36–43.

Evenson, R. E. & Gollin, D. (2003). Assessing the impact of the Green Revolution, 1960 to 2000. *Science* 300, 758–762.

Fanadzo, M. (2012). Revitalisation of smallholder irrigation schemes for poverty alleviation and household food security in South Africa: A review. *African Journal of. Agricultural Research*, 7(13):1956-1969.

Fanadzo, M. & Ncube, B. (2018). Challenges and opportunities for revitalising smallholder irrigation schemes in South Africa. *Water SA*, *44*(3), 436-447.

.

FAO (2007). Agriculture and Water Scarcity: a Programmatic Approach to Water Use Efficiency and Agricultural Productivity. Accessed from https://www.fao.org/3/j9206e/j9206e.pdf

FAO (2011). The State of the World's Land and Water Resources for Food and Agriculture. Managing systems at risk. Rome, FAO and London, Earthscan

FAO (1999). Participation and information: The key to gender-responsive agricultural policy. Accessed from https://www.fao.org/3/X2950E/X2950e00.htm

FAO (2020). The State of Food and Agriculture 2020. Overcoming water challenges in agriculture. Rome. Accessed from https://doi.org/10.4060/cb1447en

Fawole, O. P. & Tijani, S. A. (2013). Awareness and participation of farmers in extension activities of agricultural media resources and extension centre in Ogun State. *Sabaragamuwa University Journal*, 12(1), 41–51.

Fischer, E. and Qaim, M. (2014). Smallholder farmers and collective action: what determines the intensity of participation?. *Journal of Agricultural Economics*, 65(3), 683-702.

Fishbein, M. & Ajzen, I. (1975). Belief, attitude, intention behavior. An introduction to theory and research. Reading MA: Addison-Wesley Publishing.

Flachs, A.2 (016). Green revolution. Encyclopedia of food and agricultural ethics, pp.1-7.

Galukande-Kiganda, M.P. & Nalumansi, R. (2021). Stakeholders‟ Participation In Agricultural Farmers‟ Extension Services Programmes in Sub-Saharan Africa: A Case of The Operation Wealth Creation (OWC) Programme in Uganda. *Economics*, 9(1), 23-28.

Gany, A. H. A., Sharma, P. & Singh, S. (2019). Global review of institutional reforms in the irrigation sector for sustainable agricultural water management, including water users' associations. *Irrigation and Drainage*, 68(1), 84–97.

García-Lorenzo, I., Ahsan, D. & Varela-Lafuente, M. (2021). Community-based fisheries organisations and sustainable development: Lessons learned from a comparison between European and Asian countries. *Marine Policy*, 132, 104672.

Gebre, A.; Getachew, D. & McCartney, M. (2008). Stakeholder Analysis of the Koga Irrigation and Watershed Management Project; IWMI: Addis Ababa, Ethiopia.

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

Gedara, K.M., Wilson, C., Pascoe, S. & Robinson, T. (2012). Factors affecting technical efficiency of rice farmers in village reservoir irrigation systems of Sri Lanka. *Journal of Agricultural Economics*, 63(3), 627-638.

George, D. & Mallery, P. (2003). SPSS for Windows step by step: A simple guide and reference. 11.0 update (4th ed.). Boston: Allyn & Bacon.

Geza, W., Ngidi, M., Ojo, T., Adetoro, A.A., Slotow, R. & Mabhaudhi, T. (2021). Youth participation in agriculture: a scoping review. *Sustainability*, 13(16), 9120.

Ghazouani, W., Marlet, S., Mekki, I., Harrington, L.W. and Vidal, A., 2012. Farmers'practices and community management of irrigation: Why do they not match in Fatnassa Oasis?. *Irrigation and Drainage*, 61(1): 39-51.

Gholamrezai, S. & Sepahvand, F. (2017). Farmers’ participation in Water User Association in Western Iran. *Journal of Water and Land Development*, 35, 49–56.

Ghosh, S., Kolady, D.E., Das, U., Gorain, S., Srivastava, S.K. & Mondal, B. (2019). Spatio-temporal variations in effects of participatory irrigation management (PIM) reform in India: A panel data analysis. *Agricultural Water Management*, 222, 48-61.

Gliem, J.A. & Gliem, R.R. (2003). Calculating, Interpreting, and Reporting Cronbach's Alpha Reliability Coefficient for Likert-type Scales. In Midwest Research-to-Practice Conference in Adult, Continuing, and Community Education; Ohio State University: Columbus, OH, USA.

Gomo, T., Mudhara, M. & Senzanje, A. (2014). Farmers satisfaction with the performance of the Mooi River Irrigation Scheme, KwaZulu-Natal, South Africa. *Water SA*, 40(3), 437-444.

Green, W. H. (2018) Econometric Analysis: Fifth edition. doi: 10.1007/978-3-540-78389-3.

Groenfeldt, D., & Svendsen, M. (eds.). (2000). Case studies in participatory irrigation management (Vol. 273). Washington, DC: World Bank

Gujarati, D.N. (2021). Essentials of econometrics. Sage Publications.

Haile, F. (2016). Factors affecting women farmers' participation in agricultural extension services for improving the production in rural district of Dendi West Shoa Zone, Ethiopia. *Journal of Culture, Society and Development*, 21(3), 0-41.

Hanafi, S., Marlet, S., Jamin, J.Y., Imache, A., Zaïri, A., Bahri, H., Rougier, J.E. & Bouarfa, S. (2020). Participation in a complex and conflicting context: implementing a shared diagnosis in a northern Tunisia irrigation scheme. *Irrigation and Drainage*, *69*, 60-69.

Hardina, D. (2004) Linking citizen participation to empowerment practice. *Journal of Community Practice*,11(4), 11-38.

Harrison, E. & Mdee, A. (2018). Entrepreneurs, investors and the state: The public and the private in sub-Saharan African irrigation development. *Third World Quarterly*, *39*(11), 2126-2141.

Havugimana, R. (2015). Beneficiaries' participation in the design and performance of project: A case study of survivors integration project of Avega Agahozo in Gasabo District (Master dissertation, Mount Kenya University).

Heck, N., Dearden, P., McDonald, A. & Carver, S. (2011). Stakeholder opinions on the assessment of MPA effectiveness and their interests to participate at Pacific Rim National Park Reserve, Canada. *Environmental management*, 47, 603-616.

Higginbottom, T.P., Adhikari, R., Dimova, R., Redicker, S. & Foster, T. (2021). Performance of large-scale irrigation projects in sub-Saharan Africa. *Nature Sustainability*, *4*(6), 501-508.

Homans, G. C. (1958). Social behavior as exchange. American Journal of Sociology, 63 (May), 597-606.

Huang, J., Wu, Y., Yang, Z., Rozelle, S., Fabiosa, J. & Dong, F. (2010). Farmer participation, processing, and the rise of dairy production in Greater Beijing, PR China. *Canadian Journal of Agricultural Economics*, 58(3): 321-342.

Imburgia, L., Osbahr, H., Cardey, S. & Momsen, J. 2021. Inclusive participation, self-governance, and sustainability: current challenges and opportunities for women in leadership of communal irrigation systems. *Environment and Planning E: Nature and Space*, 4(3): 886-914.

Inocencio, A., Sally, H. & Merrey, D.J. (2003). Innovative approaches to agricultural water use for improving food security in sub-Saharan Africa (Vol. 55). IWMI.

International Fund for Agricultural Development (IFAD), 2014. Youth and agriculture: key challenges and concrete solutions.

Isaac, A.A. (2016). Assessment of Decision-making in Rural Irrigation Schemes: A Case Study of Zanyokwe Smallholder Irrigation Scheme in Eastern Cape, South Africa. *Journal of Human Ecology*, *54*(3), 174-181.

Isgren, E. (2012). Participatory agricultural development in practice. Accessed from https://stud.epsilon.slu.se/4395/1/Isgren_E_120627.pdf.

IWMI (2004). Meta-analysis to assess impact of watershed program and people's participation (Vol. 8). IWMI.

Jiang, Y. (2023). Financing water investment for global sustainable development: Challenges, innovation, and governance strategies. *Sustainable Development*, 31(2), 600-611.

Jinapala, K. & De Silva, S. (2010). Overview: institutions and policies for water resources management. In Proceedings of the National Conference on Water, Food Security, and Climate Change in Sri Lanka, BMICH, Colombo, June 9-11, 2009. Volume 3. Policies, institutions, and data needs for water management (Vol. 3). IWMI.

Jones, W. I. (1995). The World Bank and irrigation. Washington DC: World Bank.

Kabeer, N. & Sulaiman, M. (2015). Assessing the impact of social mobilization: Nijera Kori and the construction of collective capabilities in rural Bangladesh. *Journal of Human Development and Capabilities*, *16*(1), pp.47-68.

Kadigi, R.M., Tesfay, G., Bizoza, A., Zibadou, G. & Zilberman, D. (2019). Irrigation and water use efficiency in Sub-Saharan Africa. *Gates Open Research*, *3*(587), 587.

Kadiri, Z., Kuper, M., Faysse, N. & Errahj, M. (2009). Local transformation of a state-initiated institutional innovation: The example of water users' associations in an irrigation scheme in Morocco. *Irrigation and drainage*, *58*(3), 346-357.

Kahimba, J., Maluka, S. & Dungumaro, E. (2021). 'Milking the Cow Without Feeding It': Perceptions of Communities on Water-user Fees for Smallholder Irrigation in Ruaha Sub-Basin, Tanzania. *Tanzania Journal of Development Studies*, 18(1), 17-28.

Kanji, N. (2004). Reflections on gender and participatory development. Participatory Learning and Action: Critical reflections, future action, pp.53-62. Accessed from https://www.iied.org/sites/default/files/pdfs/migrate/G02096.pdf.

Kanjii, N. & Stephanie B. (2002). 'Trade Liberalisation, Poverty and Livelihoods: Understanding the Linkages.' Institute of Development Studies, Working Paper 159, Brighton. Accessed from: https://www.ids.ac.uk/download.php?file=files/Wp159.pdf.

Kanyamuna, V. & Zulu, K. (2022). Participatory Research Methods: Importance and Limitations of Participation in Development Practice. *World Journal of Social Sciences and Humanities*, 8(1), 9-13.

Kazeem, A.A., Dare, A., Olalekan, O., Abiodun, S.E. & Komolafe, T.L. 2017. Attitudes of farmers to extension trainings in Nigeria: Implications for adoption of improved agricultural technologies in Ogun state southwest region. *Journal of Agricultural Sciences, Belgrade*, 62(4), 423-443.

Kendall, H.W. & Pimentel, D. (1994). Constraints on the expansion of the global food supply. *Ambio*, 23, 198-205.

Kerr, J., Vardhan, M. & Jindal, R. (2014). Incentives, conditionality and collective action in Payment for Environmental Services. *International Journal of the Commons*, 8(2), 595–616.

Kgosiemang, D.T & Oladele, O.I. (2012). Factors Affecting Farmers' Participation in Agricultural Projects in Mkhondo Municipality of Mpumalanga Province. *Journal of Human Ecology*, 37(1), 19-27.

Khadra, R., Sagardoy, J.A., Khadra, R. & Sagardoy, J.A. (2019). Participatory Irrigation and Institutional Reforms in the Mediterranean Region: Governance Achievements and Problems. Irrigation Governance Challenges in the Mediterranean Region: Learning from Experiences and Promoting Sustainable Performance, pp.79-121.

Khadra, R., Sagardoy, J.A., Taha, S. & Lamaddalena, N. (2017). Participatory irrigation management and transfer: setting the guiding principles for a sustaining monitoring &

evaluation system–a focus on the mediterranean. *Water Resources Management*, *31*, 4227-4238.

Khadra, R., Sagardoy, J.A., Taha, S. & Lamaddalena, N. (2018). MONEVA-a monitoring & evaluation system to assess the performance of participatory irrigation management/irrigation management transfer programs in the Mediterranean Region. *Water Resources Management*, 32, 123-140.

Khanpae, M., Karami, E., Maleksaeidi, H. & Keshavarz, M. (2020). Farmers' attitude towards using treated wastewater for irrigation: The question of sustainability. *Journal of Cleaner Production*, 243, p.118541.

Khoza, T.M., Senyolo, G.M., Mmbengwa, V.M. and Soundy, P. (2019). Socio-economic factors influencing smallholder farmers' decision to participate in agro-processing industry in Gauteng province, South Africa. Cogent Social Sciences, 5(1), 664193.

Knox, J.W., Kay, M.G. & Weatherhead, E.K. (2012). Water regulation, crop production, and agricultural water management—Understanding farmer perspectives on irrigation efficiency. *Agricultural water management*, 108, 3-8.

Kongolo, M. & Bamgose, O.O. (2015). Participation of rural women in development: A case study of Tsheseng, Thintwa and Makhalaneng villages, South Africa. *Journal of International Women's Studies*, 4(1), 79-92.

Koopman, J., Kweka, R., Mboya, M. & Wangwe, S.M. (2001). Community participation in traditional irrigation scheme rehabilitation projects in Tanzania: Report of a Collaborative Research Project. 88 pages. Broadening Access and Strengthening Input Market Systems (BASIS) Publication. University of Wisconsin Madison.

Kortenhorst, L.F., van Steekelenburg, P., Sprey, L.H. (2002). Prospects and problems of irrigation development in Sahelian and sub-Saharan Africa: Climate Change and Countries. *Advances in Global Change Research*, 11:179-223.

Krishna, K. R. (2013). Precision Farming: Soil fertility and productivity aspects. Apple academic press, Inc.

Kulkarni, S.A. & Tyagi, A.C. 2012. Participatory irrigation management: understanding the role of cooperative culture. In Proceedings of the International Annual UN-Water Zaragoza Conference, Rio de Janerio, Brazil, 20–22 Januaray 2012.

Kulkarnir, S.A., Sinha, P.K., Belsare, S.M. and Tejawat, C.M., 2011. Participatory irrigation management in India: achievements, threats and opportunities. *Water and Energy International*, 68(6), pp.28-35.

Kumar, D.S. (2012). Adoption of drip irrigation system in India: Some experience and evidence. *The Bangladesh Development Studies*, 61-78.

Kusnandar, K., Perdana, T., Achmad, A.L.H. & Hermiatin, F.R. (2021). November. A framework for designing symbiotic simulation decision support systems for horticultural supply chains involving smallholder farmers. In IOP Conference Series: Earth and Environmental Science, 922, (1), 012050

Lamers, M., Ottow, B., Francois, G. and von Korff, Y., 2010. Beyond dry feet? Experiences from a participatory water-management planning case in the Netherlands. *Ecology and society*, 15(1).

Lee-Kelly, L., & Sankey, T. (2008). Global virtual teams for value creation and project success: A case study. *International Journal of Project Management*, 26(1), 51-62.

Luo, F., Wang, Q., Sun, F.M., Xu, D. & Sun, C.H. (2018). Farmers' Willingness to Participate in the Management of Small-Scale Irrigation in China from a Social Capital Perspective. *Irrigation and drainage*, 67(4), 594-604.

Lusk, M.W. & Parlin, B.W. (2019). Bureaucratic and farmer participation in irrigation development. In Farmer participation and irrigation organization (pp. 3-33). CRC Press.

Ma'Mun, S.R., Loch, A. & Young, M.D. (2021). Sustainable irrigation in Indonesia: A case study of Southeast Sulawesi Province. *Land Use Policy*, 111, 105-707.

Maake, M.M.S. & Antwi, M.A. (2022). Farmer's perceptions of effectiveness of public agricultural extension services in South Africa: an exploratory analysis of associated factors. *Agriculture & Food Security*, 11(1), 34.

Mabe, F.N., Mumuni, E. & Sulemana, N. (2021). Does smallholder farmers' awareness of Sustainable Development Goal 2 improve household food security in the Northern Region of Ghana?. Agriculture & Food Security, 10(1), 1-13.

Machethe, C.L., Mollel, N.M., Ayisi, K., Mashatola, M.B., Anim, F.D.K. & Vanasche, F. (2004). Smallholder irrigation and agricultural development in the Olifants River Basin of Limpopo Province: Management transfer, productivity, profitability and food security issues. Report to the Water Research Commission on the Project "Sustainable Local Management

of Smallholder Irrigation in the Olifants River Basin of Limpopo Province," Pretoria, South Africa.

Maddala, G. S. (1983). Limited-dependent and qualitative variables in econometrics. Cambridge: Cambridge U.P.

Malano, H.M. & Van Hofwegen, P. 2018. *Management of irrigation and drainage systems*. CRC Press.

Mandri-Perrott, C. & Bisbey, J. (2016). How to develop sustainable irrigation projects with private sector participation. Washington, DC: World Bank

Manyara, R.K. (2014). School-based factors affecting Girl-child participation in education in public primary schools in Tigania central Division Meru county, Kenya (Master dissertation).

Mapiye, O., Makombe, G., Molotsi, A., Dzama, K. & Mapiye, C. (2021). Towards a revolutionized agricultural extension system for the sustainability of smallholder livestock production in developing countries: The potential role of icts. *Sustainability*, 13(11), 5868.

Marks, S.J. & Davis, J. (2012). Does User Participation Lead to Sense of Ownership for Rural Water Systems? Evidence from Kenya. *World Development,* 40 (8), 1569 –1576.

Marks, S.J., Komives, K., Davis, J. (2014). Community participation and water supply sustainability: Evidence from handpump projects in rural Ghana. *Journal of Planning Education and Research*, 34 (3), 276-286.

Maroo, K.I., Weeks, R. and Erasmus, L. (2015). Determining the significant factors for implementing and managing a rural development program: A case study of the Comprehensive Rural Development Program (CRDP) in the Mpumalanga province of South Africa. In 2015 Portland International Conference on Management of Engineering and Technology (PICMET) (pp. 1726-1735). IEEE.

Martey, E., Etwire, P.M., Wiredu, A.N. & Dogbe, W. (2014). Factors influencing willingness to participate in multi-stakeholder platform by smallholder farmers in Northern Ghana: implication for research and development. *Agricultural and Food Economics*, 2(1), 1-15.

Marwati, S., Rahajuni, D. & Supadi, S. (2020). Factors Affecting Income of Female Workers Producing Ketupat Casing and Their Contribution to Household Income. *Eko-Regional: Jurnal Pembangunan Ekonomi Wilayah*, 15(1).

Mathenge, M., Place, F., Olwande, J. & Mithöfer, D. (2010). Participation in Agricultural Markets among the Poor and Marginalized: Analysis of Factors Influencing Participation and Impacts on Income and Poverty in Kenya. Tegemeo Institute. Egerton University, Kenya.

Matlon, P.J. & Spencer, D.S. (1984). Increasing food production in Sub-Saharan Africa: Environmental problems and inadequate technological solutions. *American Journal of Agricultural Economics*, *66*(5), 671-676.

Meijer, S.S., Catacutan, D., Ajayi, O.C., Sileshi, G.W. & Nieuwenhuis, M. (2015). The role of knowledge, attitudes and perceptions in the uptake of agricultural and agroforestry innovations among smallholder farmers in sub-Saharan Africa. *International journal of agricultural sustainability*, 13(1), 40-54.

Menconi, M.E., Grohmann, D., Mancinelli, C. (2017). European farmers and participatory rural appraisal: A systematic literature review on experiences to optimize rural development. *Land Use Policy*, 60, 1–11.

Merrey, D. J., McCornick, P. G. & Nance, M.C. (2018). Pathways to Increasing Farmer-Led Investments in Sustainable Agricultural Water Management in Sub-Saharan Africa. Daugherty Water for Food Global Institute (DWFI).

Mgendi, G., Mao, S. and Qiao, F. (2021). Is a training program sufficient to improve the smallholder farmers' productivity in Africa? Empirical evidence from a Chinese agricultural technology demonstration center in Tanzania. *Sustainability*, *13*(3), p.1527.

Mhembwe, S., Chiunya, N. & Dube, E. (2019). The contribution of small-scale rural irrigation schemes towards food security of smallholder farmers in Zimbabwe. *Jàmbá: Journal of Disaster Risk Studies*, *11*(1), 1-11.

Miao, S., Heijman, W., Zhu, X. & Lu, Q. (2015). Social capital influences farmer participation in collective irrigation management in Shaanxi Province, China. *China Agricultural Economic Review*, 7(3), 448–466.

Miller, J.D. (1983). Scientific literacy: A conceptual and empirical review. Daedalus, pp.29-48.

Mishra, A. K. & Aithal, P. S. (2022). Performance Assessment of Irrigation: A Case from NepalAsia. *International Journal of Management, Technology, and Social Sciences*, 7(1), 444- 464.

Mkuna, E. & Wale, E. (2022). Explaining Farmers' Income via Market Orientation and Participation: Evidence from KwaZulu-Natal (South Africa). *Sustainability*, 14(21), 14197.

Mohammedshum, A.A., Mannaerts, C.M., Maathuis, B.H. & Teka, D. (2023). Integrating Socioeconomic Biophysical and Institutional Factors for Evaluating Small-Scale Irrigation Schemes in Northern Ethiopia. *Sustainability*, 15(2), 1704.

Mohan, S. (2007). Market-based Price-risk Management for Coffee Producers. Development Policy Review, 25(3): 333-354.

Molden, D., Frenken, K., Barker, R., De Fraiture, C., Mati, B., Svendsen, M., Sadoff, C., Finlayson, C.M., Atapattu, S., Giordano, M. & Inocencio, A. (2007). Trends in water and agricultural development. Water for food, water for life: A comprehensive assessment of water management in agriculture, pp.57-89.

Moss, T. & Hamidov, A. (2016). Where water meets agriculture: the ambivalent role of water users associations. Society-Water-Technology: A Critical Appraisal of Major Water Engineering Projects, 149-167.

Mthombeni, D. L., Antwi, M. A., & Oduniyi, O. S. (2022). Factors influencing access to agro-processing training for small-scale crop farmers in Gauteng province of South Africa. *Agriculture & Food Security*, 11(1), 1–7.

Mubita, A., Libati, M. & Mulonda, M. (2017). The importance and limitations of participation in development projects and programmes. *European scientific journal*, 13(5), 238-251.

Muchara, B., Ortmann, G., Wale, E., & Mudhara, M. (2014). Collective action and participation in irrigation water management: A case study of Mooi River Irrigation Scheme in KwaZulu-Natal Province, South Africa. *Water SA*, 40(4), 699.

Mudhara, M. & Senzanje, A. (2020). Assessment of policies and strategies for the governance of smallholder irrigation farming in Kwazulu-Natal province, South Africa. Water Research Commission *(WRC Report No. 2556/1/20)*.

Muhammed, Y., Akpoko, J.G., Wamdzu, M. M., Oladipo, J.A. & Usman, M. H. (2019). Factors Influencing Participation of Cassava Farmers in Survival Farming Intervention Programme in Kogi State, Nigeria. *Journal of Agricultural Extension*, 23, 22–33.

Mujuru, N.M. & Obi, A. (2020). Effects of cultivated area on smallholder farm profits and food security in rural communities of the Eastern Cape Province of South Africa. *Sustainability*, *12*(8), 3272.

Mukherji, A.; Fuleki, B.; Shah, T.; Suhardiman, D.; Giordano, M. & Weligamage, P. (2009). Irrigation reforms in Asia: A review of 108 cases of irrigation management transfer. Colombo, Sri Lanka: International Water Management Institute.

Mukhtarov, F., Fox, S., Mukhamedova, N. & Wegerich, K. (2015). Interactive institutional design and contextual relevance: Water user groups in Turkey, Azerbaijan and Uzbekistan. *Environmental Science & Policy*, 53, 206-214.

Mustafa, G.; Latif, I.A.; Bashir, M.K.; Shamsudin, M.N.; Daud, W.M.N. 2018. Determinants of farmers' awareness of climate change. Appl. Environ. Educ. Commun. 1–15.

Mutambara, S., Darkoh, M.B. & Atlhopheng, J.R. (2016). A comparative review of water management sustainability challenges in smallholder irrigation schemes in Africa and Asia. *Agricultural Water Management*, 171, 63-72.

Muzari, W., Gatsi, W. & Muvhunzi, S. (2012). The impacts of technology adoption on smallholder agricultural productivity in sub-Saharan Africa: A review. *Journal of Sustainable Development*, *5*(8), 69.

Mwadzingeni, L., Mugandani, R. & Mafongoya, P. (2020). Factors affecting the performance of Tshiombo Irrigation Scheme in Limpopo Province, South Africa. *Journal of Agribusiness and Rural Development*, 3(57), 269–277.

Mwadzingeni, L., Mugandani, R. & Mafongoya, P. 2020. Localized institutional actors and smallholder irrigation scheme performance in Limpopo province of South Africa. *Agriculture*, 10(9), 418.

Mwambi, M., Bijman, J. & Mshenga, P. (2020). Which type of producer organization is (more) inclusive? Dynamics of farmers' membership and participation in the decision-making process. Annals of Public and Cooperative Economics, 91(2), pp.213-236.

Mwendera, E. and Chilonda, P., 2013. Conceptual framework for revitalisation of small-scale irrigation schemes in southern africa. Irrigation and drainage, 62(2), pp.208-220.

Nagrah, A., Chaudhry, A. M., & Giordano, M. (2016). Collective Action in Decentralized Irrigation Systems: Evidence from Pakistan. *World Development*, 84, 282–298.

Nahayo, A., Omondi, M.O., Zhang, X.H., Li, L.Q., Pan, G.X., Joseph, S. (2017). Factors influencing farmers' participation in crop intensification program in Rwanda. *Journal of Integrative Agriculture*, 16(6):1406-16.

Naing, L., Winn, T.B.N.R. & Rusli, B.N. (2006). Practical issues in calculating the sample size for prevalence studies. *Archives of orofacial Sciences*, 1, 9-14.

Namara RE, Horowitz L, Nyamadi B, Boubacar B (2011). Irrigation development in Ghana: past experiences, emerging opportunities, and future directions. Ghana Strategy Support Program Working Paper No. 0027. Accra, Ghana: IFPRI.

Narayanan, K. (2014). Impact of participatory irrigation management–case study: Cocurirwa Cooperative, Rwamagana Rice Project, Rwanda. *Advances in Plants & Agriculture Research*, 1(3), 00013.

Ndlovu, P.N., Thamaga-Chitja, J.M. & Ojo, T.O. (2021). Factors influencing the level of vegetable value chain participation and implications on smallholder farmers in Swayimane KwaZulu-Natal. *Land Use Policy*, 109, 105611.

Ndou, D.N. (2012). An investigation into the reasons for failure of community-based projects at Folovhodwe, Limpopo (Master dissertation). Accessed from https://core.ac.uk/download/pdf/43172831.pdf

Nelson, A. R. L. E., Ravichandran, K., and Antony, U. (2019). The impact of the Green Revolution on indigenous crops of India. J. Ethnic Foods 6:8. doi: 10.1186/s42779-019-0011-9.

Nhundu, K., Mushunje, A., Zhou, L. & Aghdasi, F. (2015). Institutional determinants of farmer participation in irrigation development post fast-track land reform program in Zimbabwe. *Journal of Agricultural Biotechnology and Sustainable Development*, 7(2), 9–18.

Nnadi, F. N. & Akwiwu, C. D. (2008). Determinants of Youths' Participation in Rural Agriculture in Imo State, Nigeria. *Journal of Applied Sciences*, 8(2), 328-333.

North, D.C. (1990). Institutions, Institutional Change and Economic Performance. Cambridge: Cambridge University Press.

Nxumalo, K.K.S. & Oladele, O.I. (2013). Factors affecting farmers' participation in agricultural programme in Zululand district, Kwazulu Natal Province, South Africa. Journal of Social Sciences, 34(1): 83-88.

Nyam, Y.S., Kotir, J.H. & Jordaan, A.J. (2020). Drivers of change in sustainable water management and agricultural development in South Africa: a participatory approach. *Sustainable Water Resource Management*, 6, 62.

Obalola, T.O., Aboaba, K.O., Agboola, B.O., Ameh, E.P. & Abubakar, B.B. (2021). Effect Of Information System on Risk Attitudes Of Rural Farmers In Goronyo Irrigation Scheme, Goronyo Local Government Area, Sokoto State, Nigeria. Scientific Papers: Management, Economic Engineering in Agriculture & Rural Development, 21(1).

Ocharo, D.R., Rambo, C. & Ojwang, B. (2020). Influence Of Monitoring And Evaluation Frameworks On Performance Of Public Agricultural Projects In Galana Kilifi County, Kenya. *European Journal of Physical and Agricultural Sciences*, 8 (1), 96-123.

Oduor, M.I.O., Rambo, C. & Nyonje, R.O. (2018). Farmer participation in Project execution and sustainability of smallholder irrigation schemes in Busia County, Kenya. *European Journal of Research and Reflection in Management Sciences*, 6(1), 83-103.

Ofosa EA, Van der Zaag P, van de Giessen N, Odai SN (2014). Success factors for sustainable irrigation development in Sub-Saharan Africa. Afr. J. Agric. Res. 9(51):3720-3728.

Ojediran, J.T., Adeola, R.G., Ogunleye, K.Y. & Rahman, S.B. (2020). Assessment of farmers' participation and attitude towards growth enhancement support scheme in Ogbomoso Agricultural zone of Oyo state, Nigeria. *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*, 20 (3), 377- 384.

Okeyo, S.O., Ndirangu, S.N., Isaboke, H.N., Njeru, L.K. & Omenda, J.A. (2020). Analysis of the determinants of farmer participation in sorghum farming among small-scale farmers in Siaya County, Kenya. Scientific African, 10, p.e00559.

Okoth, A.B. & Mbugua, J. (2018). Factors influencing small scale farmers' participation in management of Gem Rae irrigation scheme in Nyando Sub-County, Kisumu County, Kenya. *International Academic Journal of Information Sciences and Project Management*, 3(2), 394-417.

Mathenge, M., Place, F., Olwande, J. & Mithoefer, D. (2010). Participation in agricultural markets among the poor and marginalized: analysis of factors influencing participation and impacts on income and poverty in Kenya. Tegemeo Institute.

Osmani, S.R. (2008). Participatory governance: An overview of issues and evidence. Participatory governance and the millennium development goals, pp.1-45.

Ostrom, (1998). A Behavioral Approach to the Rational Choice Theory of Collective Action. *American Political Science Review* 92(1): 1–22.

Ostrom, E. (2011). Reflections on "some unsettled problems of irrigation. *American Economic Review*, 101(1): 49-63.

Ostrom, E. (1987). Institutional arrangements for resolving the commons dilemma: some contending approaches. The Question of the Commons. The Culture and Ecology of Communal Resources, 250-265.

Ostrom, E. (1990) Governing the Commons: The Evolution of Institutions for Collective Action. New York: Cambridge University Press.

Ostrom, E. (2014). Do institutions for collective action evolve?. *Journal of Bioeconomics*, 16, 3-30.

Oswald, K., Apgar, J.M., Thorpe, J. & Gaventa, J. (2018). Participation in economic decision-making: A primer. Brighton, UK: Institute of Development Studies.

Oteros-Rozas, E., Martín-López, B. & López, C.A. (2013) Envisioning the future of transhumant pastoralism through participatory scenario planning: a case study in Spain. *The Rangeland Journal*, 35, 251–272.

Otsuka, K. & Kalirajan, K.P. (2006). Rice green revolution in Asia and its transferability to Africa: An introduction. *The Developing Economies*, *44*(2), 107-122.

Owusu-Sekyere, E., Bibariwiah, C., Owusu, V. & Donkor, E. (2021). Farming under irrigation management transfer scheme and its impact on yield and net returns in Ghana. *Land Use Policy*, 102, 105266.

Parlin, B.W. (2019). Farmer Participation and irrigation organization; CRC Press: Boca Raton, FL, USA.

Pavlis, E.S., Terkenli, T.S., Kristensen, S.B., Busck, A.G. & Cosor, G.L. (2016). Patterns of agri-environmental scheme participation in Europe: Indicative trends from selected case studies. *Land Use Policy*, 57, 800-812.

Pék, É. (2021). Poor farmers and irrigation: alternative methods for measuring the drivers and the benefits of the participatory irrigation management in a developing country (Doctoral dissertation, Magyar Agrár-és Élettudományi Egyetem).

Pék, É., Fertő, I. & Alobid, M. (2019). Evaluating the Effect of Farmers' Participation in Irrigation Management on Farm Productivity and Profitability in the Mubuku Irrigation Scheme, Uganda. *Water*, 11(11), 2413.

Phali, L., Mudhara, M., Ferrer, S. & Makombe, G. (2020). Determinants of Farmers' Participation in the Management of Smallholder Irrigation Schemes in Kwazulu-Natal Province, South Africa. *Journal of Economics and Behavioral Studies*, 12, (6J), 21-32.

Phiri, B. (2015). Influence of monitoring and evaluation on project performance: A case study of African Virtual University, Kenya (Master dissertation).

Poddar, R., Qureshi, M.E. & Syme, G. (2011). Comparing irrigation management reforms in Australia and India - a special reference to participatory irrigation management. Irrigation and Drainage, 60, 139-150.

Poussin, J.C., Renaudin, L., Adogoba, D., Sanon, A., Tazen, F., Dogbe, W., Fusillier, J.L., Barbier, B. & Cecchi, P. (2015). Performance of small reservoir irrigated schemes in the Upper Volta basin: Case studies in Burkina Faso and Ghana. *Water resources and rural development*, *6*, 50-65.

Pretty, J. N. (1995) Participatory learning for sustainable agriculture. *World Development*, 23(8), 1247 – 1263.

Radcliffe, C. (2021). Knowledge, learning and culture: Seeking agricultural sustainability among Indigenous farmers in Papua New Guinea and Vanuatu (Doctoral dissertation, Charles Sturt University).

Reddy, V. (1987). Attitude and adoption behaviour of farmers relating to watershed development programme in Bangalore. (Msc dissertation, UAS, Bangalore).

Reed, M. S., Graves, A., Dandy, N., Posthumus, H., Hubacek, K., Morris, J., Prell, C., Quinn, C. H. & Stringer, L. C. (2009). Who's in and why? A typology of stakeholder analysis methods for natural resource management. *Journal of Environmental Management*, 90(5), 1933-1949.

Reinders, F.B., Van Der Stoep, I., Lecler, N.l., Greaves, K.R., Vahrmeijer, J.T., Benadé, N., Du Plessis F.J., Van Heerden, P.S., Steyn, J.M., Grové, B., Jumman A., & Ascough, G. (2010). Standards and Guidelines for Improved Efficiency of Irrigation Water Use from Dam Wall Release to Root Zone Application: Supplementary Information. WRC Report No. TT 467/10. Water Research Commission, Pretoria, South Africa. pp 26.

Ricart S. (2019). Challenges on European Irrigation Governance: From Alternative Water Resources to Key Stakeholders' Involvement. *Journal of Ecology & Natural Resources*, 3(2), 000161.

Ricks, J.I. & Doner, R.F. (2021). Getting institutions right: Matching institutional capacities to developmental tasks. *World Development*, 139,105334.

Ricks, J.I. (2015). Pockets of participation: Bureaucratic incentives and participatory irrigation management in Thailand. *Water Alternatives* 8(2), 193-214.

Sari, F. A., Mahyuddin, M. & Heliawaty, H. (2022). Participation of Women Farmers Group Members to Sustainable Food House Area Program (Case Study of Tamalanrea District, Makassar City, South Sulawesi Province). *Journal of Universal Community Empowerment Provision*, 2(1), 19-27.

Scheumann, W., Houdret, A. & Brüntrup, M. (2017). Unlocking the Irrigation Potential in Sub-Saharan Africa: Are Public-Private Partnerships the Way Forward? Briefing Paper 7/2017; German Development Institute: Bonn, Germany.

Scheyvens, R. (2003) Tourism for development, empowering communities. New Jersey: Prentice Hall.

Schneiberg, M. (2013). Institutional theory and social movements. The Wiley-Blackwell Encyclopedia of Social and Political Movements, pp.1-5.

Senanayake, N., Mukherji, A. & Giordano, M. (2015). Re-visiting what we know about Irrigation Management Transfer: A review of the evidence. *Agricultural Water Management*, 149,175-186.

Serote, B., Mokgehle, S., Du Plooy, C., Mpandeli, S., Nhamo, L. & Senyolo, G. (2021). Factors influencing the adoption of climate-smart irrigation technologies for sustainable crop productivity by smallholder farmers in arid areas of South Africa. *Agriculture*, *11*(12), 1222.

Sevinç, G., Aydoğdu, M.H., Cancelik, M. & Sevinç, M.R. (2019). Farmers' attitudes toward public support policy for sustainable agriculture in GAP-Şanlıurfa, Turkey. *Sustainability*, 11(23), 6617.

Shah, T., Namara, R., & Rajan, A. (2020). Accelerating Irrigation Expansion in Sub-Saharan Africa: Policy Lessons from the Global Revolution in Farmer-Led Smallholder Irrigation. World Bank Group.

Shah, T., van Koppen, B., Merrey, D., de Lange, M. & Samad, M. (2002). Institutional alternatives in African smallholder irrigation: lessons from international experience with irrigation management transfer. Research Report No. 60, International Water Management Institute, Colombo, Sri Lanka.

Sharaunga, S., & Mudhara, M. (2018). Determinants of farmers' participation in collective maintenance of irrigation infrastructure in KwaZulu-Natal. *Physics and Chemistry of the Earth*, 105, 265–273.

Sheikh, M.J., Samah, A.A., Magsi, H. & Shahwani, M.A. (2016). Analysis of farmers participation for water management in Sindh province of Pakistan. Pakistan Journal of Agriculture, Agricultural Engineering and Veterinary Sciences, 32(1): pp.75-84.

Sheikh, M. J., Redzuan, M. B., Abu Samah, A. & Ahmad, N. (2014). Factors Influencing Farmers' Participation in Water Management: A Community Development Perspective. *Journal of Humanities and Social Science*, 19(11), 59–63.

Sheillah, N. D. (2020). Project Planning and Project Success in Local Government of Rwanda. *International Journal of Scientific and Research Publications*, 10(06), 457–464.

Shukla, K. (2015). Effects of project resource planning practices on project performance of Agaseke project in Kigali, Rwanda. *International Journal of Business and Management Review*, 3(5), 29–51.

Sibanda, D. (2011). The role of community participation in development initiatives: The case of the Danga ecological sanitation project in the Zvishavane district, Zimbabwe (Master dissertation, University of the Western Cape).

Sibanda, S. (2012). The relationship between factors that influence men, aged 20-50 years' perceptions and their participation in PMTCT programmes in Gwanda urban. Accessed from https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=3b040da987dcf84825a8a5f4c20cbf883c364e25

Sinyolo, S., Mudhara, M. & Wale, E. (2014). Water security and rural household food security: Empirical evidence from the uMzinyathi district in South Africa. *Food Security,* 6: 483–99.

Sirikwa, F.I. (2015). A comparative assessment of performance of private and cooperative institutional arrangements of irrigation schemes: case study of Mbarali district, Tanzania (Doctoral dissertation, Sokoine University of Agriculture).

Sithole, N. L., Lagat, J. K. & Masuku, M. B. (2014). Factors Influencing Farmers Participation in Smallholder Irrigation Schemes: The Case of Ntfonjeni Rural Development Area. Journal of Economics and Sustainable Development, 5(22), 159–168.

Snyder, K.A., Ludi, E., Cullen, B., Tucker, J., Zeleke, A.B., Duncan, A. (2014). Participation and performance: decentralised planning and implementation in Ethiopia. *Public Administration and Development*, 34(2):83–95.

Somvanshi, P. S., Pandiaraj, T., and Singh, R. P. (2020). An unexplored story of successful green revolution of India and steps towards ever green revolution. J. Pharmacogn. Phytochem. 9, 1270–1273. Available online at: https://www.phytojournal.com/archives/2020/vol9issue1/PartU/9-1-256-412.pdf

Sserunkuuma, D., Ochom, N. & Ainembabazi, H. (2004). Collective action in canal irrigation systems management: the case of Doho Rice Scheme in Uganda. Network Report, 9.

Sserunkuuma, D., Ochom, N., Ainembabazi, J.H. (2009). Collective action in the management of canal irrigation systems: the Doho rice scheme in Uganda. In: Kirsten, J.F., Dorward, A.R., Poulton, C., Vink, N. (Eds.), Institutional Economics Perspectives on African Agricultural Development. International Food Policy Institute, Washington, pp. 375–387.

Statista, 2023. Irrigated gross value added in agricultural gross domestic product of the Middle East and North Africa as of 2022, by country. Accessed from https://www.statista.com/statistics/1364417/mena-irrigated-gross-value-added-in-agricultural-gdp-by-country/

Stats SA. (2019). Mid-year Population Estimates 2019. Pretoria: Statistics South Africa.

Steiner, A. A., & Farmer, J. (2018). Engage, participate, empower: Modelling power transfer in disadvantaged rural communities. Environment and Planning C: Politics and Space, 36(1): 118-138. doi:10.1177/2399654417701730

Steup, R., Santhanam, A., Logan, M., Dombrowski, L. & Su, N.M. (2018). Growing tiny publics: Small farmers' social movement strategies. Proceedings of the ACM on human-computer interaction, 2(CSCW), pp.1-24.

Subedi, R. (2008). Women farmers' participation in agriculture training: In Kavre district of Nepal. Larenstein University of Applied Sciences.

Subramanian, K. (2015). *Revisiting the Green Revolution: Irrigation and food production in twentieth-century India* (Doctoral dissertation, King's College London). Accessed from: https://kris.kcl.ac.uk/portal/files/54484756/2015_Subramanian_Kapil_1348311_ethesis.pdf

Suhardiman, D. & Giordano, M. (2014). Is there an alternative for irrigation reform? *World Development*, 57, 91–100.

Sulewski, P.; Goła´s, M. 2019. Environmental awareness of farmers and farms' characteristics. Probl. Agric. Econ. 4, 55–81.

Sullivan, G. M. & Artino, Jr., A. R. (2013). Analyzing and Interpreting Data from Likert-Type Scales. *Journal of Graduate Medical Education*, 5(4), 541-542.

Takayama, T., Matsuda, H. and Nakatani, T., 2018. The determinants of collective action in irrigation management systems: Evidence from rural communities in Japan. *Agricultural Water Management*, 206: 113-123.

Taqiopur, M., Abbasi, E. & Chizari, M. (2015). Farmers' Behavior toward Membership in Water User Associations (WUAs) in Iran: Applying the Theory of Planned Behavior. European Online Journal of Natural and Social Sciences, 4(2), 336. Accessed from https://www.researchgate.net/profile/Enayat-Abbasi/publication/302909836_Farmers'_Behavior_toward_Membership_in_Water_User_Associations_WUAs_in_Iran_Applying_the_Theory_of_Planned_Behavior/links/57332e6808ae298602dce3a1/Farmers-Behavior-toward-Membership-in-Water-User-Associations-WUAs-in-Iran-Applying-the-Theory-of-Planned-Behavior.pdf

Taylor, B.M. & Van Grieken, M. (2015). Local institutions and farmer participation in agri-environmental schemes. *Journal of Rural Studies*, 37,10-19.

Timmer, C.P. (1988). The agricultural transformation. *Handbook of Development Economics*, *1*, 275-331.

Toenniessen, G., Adesina, A. & DeVries, J. (2008). Building an alliance for a green revolution in Africa. *Annals of the New York academy of sciences*, *1136*(1), 233-242.

Tohidyan, F. S., & Rezaei, M. K. (2015). Attitudes of farmers toward participation in irrigation and drainage projects: the structural equations modeling analysis. *Iran Agricultural Research*,12, 34(1), 80-91.

Tokula, M.H. (2019). Farmer participation in root and tuber crops Technology Development and Transfer (TDT) in Benue State Nigeria. *Nigeria Agricultural Journal*, 50(1), 110-114.

Tran, H.L. (2020). Farmer participation and irrigation performance: A case study of Nam Thach Han irrigation system, Vietnam (Doctoral dissertation, The University of Waikato).

Tufte, T. & Mefalopulos, P. (2009). Participatory communication: A practical guide (Vol. 170). World Bank Publications.

Turral, H., Svendsen, M. & Faures, J.M. (2010). Investing in irrigation: Reviewing the past and looking to the future. *Agricultural Water Management*, *97*(4), 551-560.

Uhlaner, C. (2015). Political participation. International Encyclopedia of the Social & Behavioral Sciences (Second Edition).

Umugwaneza, M.A.J.M., Nyabera, S. & Njenga, G. (2021). Project Implementation Phases and Performance of Agricultural Projects in Rwanda A Case of N2Africa Project/CIAT in Kamonyi District. Journal of Advance Research in Business Management and Accounting ISSN, 2456, p.3544.

Upasena, J., & Abeygunawardena, P. (1992). Determinants of Farmer Participation in Irrigation Management : the Case of Kimbulwana Oya Scheme. *Tropical Agricultural Research*, 4, 271–283.

Cohen, J.M. & Uphoff, N.T. (1980). Participation's place in rural development: Seeking clarity through specificity. World development, 8(3), pp.213-235.

Uphoff, N. (1986). Getting the process right: Improving irrigation water management with farmer organization and participation. Ithaca: Cornell University Press.

Uphoff, N. (2000). Understanding social capital: learning from the analysis and experience of participation. Social capital: A Multifaceted Perspective, 6(2), 215-249.

Uphoff, N. (2019). Improving international irrigation management with farmer participation: Getting the process right. Routledge.

Usadolo, S.E. & Caldwel, M. (2016). A stakeholder approach to community participation in a rural development project. *Sage Open*, *6*(1), p.2158244016638132.

Van Averbeke, W., 2012. Performance of smallholder irrigation schemes in the Vhembe District of South Africa. *Problems, Perspectives and Challenges of Agricultural Water Management*, *21*, 413-438.

Van Averbeke, W., Denison, J. & Mnkeni, P.N.S. (2011). Smallholder irrigation schemes in South Africa: A review of knowledge generated by the Water Research Commission. *Water SA*, 37(5), 797–808.

Van Koppen, B., Tapela, B.N. & Mapedza, E. (2018). Joint Ventures in the Flag Boshielo Irrigation Scheme, South Africa: A History of Smallholders, States and Business; IWMI Research Report 171; International Water Management Institute: Colombo, Sri Lanka.

Venot, J.P. & Hirvonen, M. (2013). Enduring controversy: small reservoirs in sub-Saharan Africa. Society & Natural Resources, 26(8): 883-897.

Waithera, S. L. & Wanyoike, D. M. (2015). Influence of project monitoring and evaluation on performance of youth funded agribusiness projects in Bahati sub-county, Nakuru, Kenya. *International Journal of Economics, Commerce and Management*, 3(2), 375-394.

Walder, P. & Kantelhardt, J. (2018). The Environmental Behaviour of Farmers–Capturing the Diversity of Perspectives with a Q Methodological Approach. Ecol. Econ. 143, 55–63.

Walter, G., Wander, M. & Bollero, G. (1997). A farmer-centered approach to developing information for soil resource management: the Illinois soil quality initiative. *American Journal of Alternative Agriculture*, 12(2), 64-72.

Wandera B, Prashad P, Merry A. 2013. Piloting IBLI in Marsabit – ILRI Micro-insurance Innovation Facility brief. Accessed from:

http://www.microinsurancefacility.org/projects/lessons/piloting-ibli-marsabit

Wang, Y. & Wu, J. (2018). An empirical examination on the role of water user associations for irrigation management in rural China. Water Resources Research, 54(12): 9791-9811.

Wang, R.Y., Lam, W.F. & Wang, J. (2021). Irrigation Management in East Asia: Institutions, Socio-Economic Transformation and Adaptations. *Water Alternatives*, 14(2).

Wang, Y., Chen, C. & Tao, Y. (2014). Determinants of collective action in the commons: An empirical study of irrigation in China. In Unpublished manuscript, Fifth Workshop on the Ostrom Workshop held at Indiana University. Accessed from https://dlc.dlib.indiana.edu/dlc/handle/10535/9402.

Wesselink, A., Paavola, J., Fritsch, O. and Renn, O., 2011. Rationales for public participation in environmental policy and governance: practitioners' perspectives. Environment and Planning A, 43(11).

Winch, G. M., & Courtney, R. (2007). The organization of innovation brokers: An international review. Technology Analysis & Strategic Management, 19(6), 747–763. https://doi.org/10.1080/09537320701711223

Winrock International, (2023). A Trail of Traceable Impact: How Winrock Farmer-to-Farmer Creates Meaningful and Sustainable Change.Accessed from https://winrock.org/volunteer_cat/spotlights/page/2/

Woodhouse, P., Veldwisch, G.J., Venot, J., Brockington, D., Komakech, H. & Manjichi, Â. (2017). African farmer-led irrigation development: Re-framing agricultural policy and investment?. *The Journal of Peasant Studies*, 44 (1), 213-233

World Bank. (1982). World development report 1982. New York: Oxford University Press.

Wotie, T.G. & Hanaraj, K. (2013). Challenges in farmer-managed small-scale irrigation schemes: Case study on South Achefer Woreda of Amhara region, Ethiopia. *Journal of Scientific Research and Reviews*. 2(2), 019 – 029.

Xie, H., You, L., Dile, Y.T., Worqlul, A.W., Bizimana, J.C., Srinivasan, R., Richardson, J.W., Gerik, T. & Clark, N. (2021). Mapping development potential of dry-season small-scale irrigation in Sub-Saharan African countries under joint biophysical and economic constraints-An agent-based modeling approach with an application to Ethiopia. *Agricultural Systems*, *186*,102987.

Xiuling, D., Qian, L., Lipeng, L., & Sarkar, A. (2023). The Impact of Technical Training on Farmers Adopting Water-Saving Irrigation Technology: An Empirical Evidence from China. Agriculture, 13(5), 956. https://doi.org/10.3390/agriculture13050956

Yakubu, I.A., Zakaria, H., Abujaja, M.A. and Allotey, S.S. (2022). Determinants of participation in contracting farming among yam farmers in the Mion District of the northern region of Ghana.

Yami, M. (2013). Sustaining participation in irrigation systems of Ethiopia: what have we learned about water user associations?. *Water Policy*, 15(6), 961-984.

Yapa, L.G.D.S., Abdullah, A.L., Rainis, R. & Hemakumara, G.P.T.S. (2022). Determinants and Measures to Assess Farmers' Participation in Participatory Irrigation Management (PIM) at the Tail-end of Irrigation Schemes in Sri Lanka: A Review of the Empirical Evidence. *Journal of Social Sciences and Humanities*, S19(2), 35-57.

Yilak, K. (2013). Participation of beneficiary farmers in large scale irrigation scheme management: A case study on 'Koga Irrigation Project in Mecha District of Amhara Regional State, Ethiopia (Master dissertation, St. Mary's University). Accessed from: http://repository.smuc.edu.et/bitstream/123456789/953/1/Kirubel%20Yilak%20Yigezu.pdf.

Yobe, C.L., Mudhara, M. & Mafongoya, P. (2019). Livelihood strategies and their determinants among smallholder farming households in KwaZulu-Natal province, South Africa. *Agrekon*, 58(3), 340-353.

Zondi, N.P. (2021). The role of public participation in reviewing land redistribution policy in South Africa (Doctoral dissertation).Accessed from: https://ukzn-dspace.ukzn.ac.za/handle/10413/20339

APPENDIX A

Block no…… Name of the Irrigation Scheme…… **Local Municipality……District**……

Interviewer's name…… **Name of the household head**……

Date……

PART A: DEMOGRAPHIC AND SOCIOECOMONIC FACTORS (HOUSEHOLD CAPABILITIES AND ASSETS)		
1. Human capital		
a) Household size	Number of members (irrespective of age)	
b) Age of household head	years	
c) Gender of household head	2=Prefer not to say, 1=Male, 0=Female,	
d) Marital status of household head	1= single, 2=Married, 3=Windowed, 4=Divorced	
e) Level of education of household head	0=non-formal education, 1=Primary education (Grade 1-6), 3=Secondary education (Grade 7-12), 4= Tertiary education (Certificate/Diploma/Degree)	
f) Primary occupation		
i) Government employee	1=Yes, 0=No	
ii) Private employee	1=Yes, 0=No	
iii) Businessman	1=Yes, 0=No	
iv) Farmer	1=Yes, 0=No	
v) other	1=Yes, 0=No	
g) Irrigation farming experience of household head	years	
2. Natural capital		
a) Proximity to water source	1=near (<1km), 0=far (>1km)	
b) Size of household Plot	Own (ha)	
	Rent (ha)	
	Lease (ha)	
c) Size of land cultivated		
i) Irrigated	Number of hectares (ha)	
ii) Dryland	Number of hectares (ha)	
d) What is the type of the crop production method you practice?	1=Mono-cropping; 2= Inter-cropping; 3= Crop rotation; 5= Other (specify)	
e) Types of crops planted	1=Maize; 2=Tomatoes 3=Potatoes; 4=Sugarcane 5= Spinach; 6=Cabbage 7=Beans; 8=Onions 9=Butternut; 10=Other (specify)	
3. Financial capital		
a) Average monthly income:		
i) agricultural activities	ZAR/Month	
ii) non-agricultural sources	ZAR/Month	
4. Social capital		
a) Access to farmer support services	1=yes, 0=No	
b) Membership associations	1=yes, 0=No	

5. **Physical capital**		
Do you own one or more of the following as part of your household agricultural production assets? 1=yes, no=0	Water Pump	
	Ox-drawn plough	
	Wheelbarrow	
	Trailer	
	Tractor	
	Tractor-drawn plough	
	Vehicle	
	Cattle	
	Goats	
	Other	
6. **Psychological capital**		
a) Are you confident to farm as a means of maintaining household livelihoods and you do not give up easily when meeting challenges?	1=yes, 0=No	
b) Do you completely depend on government with little self-reliance and assume government is responsible for your success as farmer?	1=yes, 0=No	
c) Are you willing to invest most of your resources on irrigation farming enterprise because it will do well in the long run?	1=yes, 0=No	

PART B: AWARENESS OF THE RESIS PROGRAMME

1. Have you been farming in the scheme since the year 2010? 1=Yes, 0=No If no, which year did you start farming.....	
2. Do you know anything about the RESIS Programme (the programme of government aimed to revitalise smallholder irrigation schemes)? 1=Yes1, 0=No If yes, how were you informed?	
3. Did you receive any form of production inputs from government in the past 10 years? 1=Yes, 0=No If yes, specify (type and amount of inputs per year)	
4. Are you aware of any efforts by government to rehabilitate dilapidated irrigation infrastructure in the scheme in the past 10 years? 1=Yes, 0=No If yes, specify part of irrigation infrastructure repaired, re-designed, installed or constructed	
5. Did you receive any assistance from government to link you with markets for your produces in the past years? 1=Yes, 0=No If yes, specify type of market access (formal or informal markets).....	
6. Do you receive technical support on crop production from extension officials in the past 10 years? 1=Yes, 0=No If yes, how often?	
7. Do you have a commercial or experienced farmers agreed through government to mentor you in the past 10 years? If yes, specify type of mentorship.....	
8. Did you receive any form of training arranged by government in the past 10 years (including irrigation water management)? If yes, specify type of training and date provided.....	

9.	Did you receive any financial assistance for your farming enterprise arranged through government in the past 10 years? If yes, when and how much?					
10.	Do you know names of government departments responsible for revitalization of your scheme? 1=Yes, 0=No If yes, specify names of departments or organisations, year and type of revitalization activity provided?.....					

PART C: FARMERS' ATTITUDE TOWARDS RESIS PROGRAMME

Ask the Head of the household to respond to the following statements using the code below: Code: 1-Strongly disagree 2-Disagree 3-Neutral 4-agree 5-Strongly agree

1.	**RESIS: IRRIGATION INFRASTRUCTURE**					
i.	The RESIS programme consider rehabilitation of irrigation infrastructure as paramount to allocate adequate water for upstream and upstream farmers.	1	2	3	4	5
Please provide reason for your answer.....						
ii.	The RESIS programme ensures irrigation system are easy to operate.	1	2	3	4	5
Please provide reason for your answer.....						
iii.	The RESIS programme ensures irrigation systems are easy to maintain	1	2	3	4	5
Please provide reason for your answer.....						
iv.	The RESIS programme promote irrigation system that maximize efficiencies and minimize labour and capital requirements.	1	2	3	4	5
Please provide reason for your answer.....						
v.	The RESIS programme encourage farmers to be involved in water management.	1	2	3	4	5
Please provide reason for your answer.....						
2.	**RESIS: PRODUCTION INPUTS**					
i.	The RESIS programme promote access to fertilizers by farmers.	1	2	3	4	5
Please provide reason for your answer.....						
ii.	The RESIS programme promote access to tractors by farmers	1	2	3	4	5
Please provide reason for your answer.....						
iii.	The RESIS programme promote access to tractors	1	2	3	4	5
Please provide reason for your answer.....						

iv. The RESIS programme promote access to seeds or seedlings	1	2	3	4	5
Please provide reason for your answer…… ……					
v. The RESIS programme promote access to other production inputs	1	2	3	4	5
Please provide reason for your answer…… ……					
3. RESIS: INPUT AND OUPUT MARKETS					
i. The RESIS programme provide access to formal markets	1	2	3	4	5
Please provide reason for your answer…… ……					
ii. RESIS programme provide access to informal markets	1	2	3	4	5
Please provide reason for your answer…… ……					
iii. The RESIS programme provide transport for markets.	1	2	3	4	5
Please provide reason for your answer…… ……					
iv. The RESIS programme connect farmers with input markets	1	2	3	4	5
Please provide reason for your answer…… ……					
v. The RESIS programme provide farmers with pack houses and storage facilities.	1	2	3	4	5
Please provide reason for your answer…… ……					
4. RESIS: FINANCIAL ASSISTANCE					
i. The RESIS programme provides credit facilities to farmers.	1	2	3	4	5
Please provide reason for your answer…… ……					
ii. The RESIS programme provide grants to farmers.	1	2	3	4	5
Please provide reason for your answer…… ……					
iii. The RESIS programme subsidize farmers with electricity costs.	1	2	3	4	5

Please provide reason for your answer……. ……					
iv. The RESIS programme link farmers with other financial institutions.	1	2	3	4	5
Please provide reason for your answer……. ……					
v. The RESIS programme provides farmers with cash to attend emergency or disasters (drought, floods, etc.).	1	2	3	4	5
Please provide reason for your answer……. ……					
5. RESIS: TRAINING AND EXTENSION SERVICES					
i. The RESIS programme provides training for crop production	1	2	3	4	5
Please provide reason for your answer……. ……					
ii. RESIS programme provides training for proper timing of irrigation timing.	1	2	3	4	5
Please provide reason for your answer……. ……					
iii. The RESIS programme provides training on farming entrepreneurship skills.	1	2	3	4	5
Please provide reason for your answer……. ……					
iv. The RESIS programme provides training on financial management.	1	2	3	4	5
Please provide reason for your answer……. ……					
v. The RESIS programme provides training on leadership skills.	1	2	3	4	5
Please provide reason for your answer……. ……					
6. RESIS: INSTITUTIONAL ARRANGEMENT					

i.	The RESIS programme is centered around the interests of the farmers.	1	2	3	4	5
Please provide reason for your answer.....						
.....						
ii.	The RESIS programme uses a comprehensive systematic approach.	1	2	3	4	5
Please provide reason for your answer.....						
.....						
iii.	The RESIS programme is meant to encourage farmers on a scheme to use internal community structures to solve their conflicts.	1	2	3	4	5
Please provide reason for your answer.....						
.....						
iv.	The RESIS programme provides coordinated services by different government departments	1	2	3	4	5
Please provide reason for your answer.....						
.....						
v.	The RESIS programme promoted sense of ownership	1	2	3	4	5
Please provide reason for your answer.....						
.....						
The RESIS programme explores issues of land tenure and institutional arrangements on the scheme.		1	2	3	4	5
Please provide reason for your answer.....						
.....						
The RESIS programme promotes levels of representation of scheme participants (gender, youth, etc.)I		1	2	3	4	5
Please provide reason for your answer.....						
.....						
PART D: FARMERS' ATTITUDE TOWARDS RESIS IMPLEMENTERS						
Ask the Head of the household to respond to the following statements using the code below: Code: 1-Strongly disagree 2-Disagree 3-Neutral 4-agree 5-Strongly agree						
1. RESIS IMPLEMENTERS: PARTICIPATION						
i.	The RESIS implementers avail opportunities for farmers to participate in the programme and influence decision-making processes and actions.	1	2	3	4	5
Please provide reason for your answer.....						
.....						
ii.	The RESIS implementers engages all farmers in the formulation and implementation of decisions.	1	2	3	4	5
Please provide reason for your answer.....						
.....						
iii.	The RESIS implementers addresses and understand the Interests and rights of farmers in the scheme.	1	2	3	4	5

Please provide reason for your answer……. ……						
iv.	The RESIS implementers respect the Interests of farmers through appropriate engagement processes.	1	2	3	4	5
Please provide reason for your answer……. ……						
v.	The RESIS implementers seeks input from multiple sources during the implementation of the programme.	1	2	3	4	5
Please provide reason for your answer……. ……						
2. RESIS IMPLEMENTERS: CAPABILITY						
i.	The RESIS implementers have proper plan and vision to implement the programme.	1	2	3	4	5
Please provide reason for your answer……. ……						
ii.	The RESIS implementers have skills and knowledge to implement the programme.	1	2	3	4	5
Please provide reason for your answer……. ……						
iii.	The RESIS implementers have adequate resources to implement the programme.	1	2	3	4	5
Please provide reason for your answer……. ……						
iv.	The RESIS implementers have technical skills to implement the programme.	1	2	3	4	5
Please provide reason for your answer……. ……						
v.	The RESIS implementers have skills to manage resource available for the programme.	1	2	3	4	5
Please provide reason for your answer……. ……						
3. RESIS IMPLEMENTERS: ACCOUNTABILITY						
i.	RESIS implementers have clear roles and responsibilities.	1	2	3	4	5
Please provide reason for your answer……. ……						
ii.	RESIS follow laws and rules to refrain from abusing executive power as well as securing effective implementation of the programme.	1	2	3	4	5
Please provide reason for your answer……. ……						
iii.	The RESIS implementers are also accountable to farmers with regard to the programme.	1	2	3	4	5
Please provide reason for your answer……. ……						

iv.	The RESIS implementers are held accountable by other stakeholders.	1	2	3	4	5
Please provide reason for your answer……						
v.	The RESIS implementers manage resources allocated for the programme effectively and fairly.	1	2	3	4	5
Please provide reason for your answer……						
4.	**RESIS IMPLEMENTERS: TRANSPARENCY**					
i.	The RESIS implementers are open about decision-making processes	1	2	3	4	5
Please provide reason for your answer……						
ii.	The RESIS implementers clearly communicate every decision taken about the programme.	1	2	3	4	5
Please provide reason for your answer……						
iii.	The RESIS implementers have relevant information about governance and performance of the programme.	1	2	3	4	5
Please provide reason for your answer……						
iv.	The RESIS implementers are open about financial records of the programme.	1	2	3	4	5
Please provide reason for your answer……						
v.	The RESIS implementers are honest through consultation with regard to implementation of the programme.	1	2	3	4	5
Please provide reason for your answer……						
5.	**RESIS IMPLEMENTERS: EFFECTIVENESS AND EFFICIENCY**					
i.	The RESIS implementers achieve the objectives of the programme with allocated resources.	1	2	3	4	5
Please provide reason for your answer……						
ii.	RESIS implementers have used resource more efficiently during the implementation of the programme.	1	2	3	4	5
Please provide reason for your answer……						
iii.	The RESIS implementers promote efficient use of water in the scheme.	1	2	3	4	5

Please provide reason for your answer.....						
iv.	The RESIS implementers buy quality materials required for the implementation of the programme.	1	2	3	4	5
Please provide reason for your answer.....						
v.	The RESIS implementers encourage principle of 'doing more with less'.	1	2	3	4	5
Please provide reason for your answer.....						
6.	RESIS IMPLEMENTERS: FAIRNESS					
i.	The RESIS implementers provide youth, men and women equal opportunities during implementation of the programme .	1	2	3	4	5
Please provide reason for your answer.....						
ii.	The RESIS implementers avoid discriminatory practices during the implementation of the programme.	1	2	3	4	5
Please provide reason for your answer.....						
iii.	The RESIS implementers encourage farmers on a scheme to use internal community structures to solve their conflicts.	1	2	3	4	5
Please provide reason for your answer.....						
iv.	The RESIS implementers are respect indigenous knowledge of the farmers	1	2	3	4	5
Please provide reason for your answer.....						
v.	The RESIS implementers ensure equitable allocation of benefits from the programme.	1	2	3	4	5
Please provide reason for your answer.....						

PART E : QUALITY AND LEVEL OF PARTICIPATION IN RESIS PROGRAMME

Quality of Participation	Level of participation	Mark X for each level of participation for corresponding phases of the RESIS programme			
		Decision making	Implementation	Benefits sharing	Evaluation
Level 2: Genuine Participation (High)	Empowerment-6				
Level 1: Symbolic Participation (Average)	Partnership-5				
	Interaction-4				
	Consultation-3				
Level 0: Non-participation (Low)	Informing-2				
	Manipulation-1				

If participated, how did you participate? ……

PART F: ACCESS TO IRRIGATION WATER		
1. I have access to adequate, timely, and equitable water distribution in the scheme	1=Yes, 0=No	
2. If no, why?.....		

Part G: Key Informant Interview Guide

Scheme…… Local Municipality……District……

Interviewer's name…… Name of the Key Informant ……

Date……

Do you think farmers are aware of the RESIS programme? If no, what could the reason

……

What do you think farmers think about the RESIS programme?

……

What do you think farmers think about the RESIS implementers?

……

What was the quality and level of participation by farmers during the different stages of RESIS programme in the scheme?

What is the status of water access in the scheme in relation to timeliness, adequate and equitable distribution?

……

THANK YOU

APPENDIX B

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

15 July 2021

Mr Matome Freddy Rabothata (217080806)
School Of Agri Earth & Env Sc
Pietermaritzburg Campus

Dear Mr Rabothata,

Protocol reference number: HSSREC/00002962/2021
Project title: AN INVESTIGATION OF FARMERS' LEVEL OF PARTICIPATION IN REVITALIZED SMALLHOLDER IRRIGATION SCHEMES IN THE KWAZULU-NATAL PROVINCE, SOUTH AFRICA
Degree: PhD

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 15 June 2021 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted FULL APPROVAL.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

This approval is valid until 15 July 2022.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

All research conducted during the COVID-19 period must adhere to the national and UKZN guidelines.

HSSREC is registered with the South African National Research Ethics Council (REC-040414-040).

Yours sincerely,

[redacted]

Professor Dipane Hlalele (Chair)

/dd

Humanities and Social Sciences Research Ethics Committee
Postal Address: Private Bag X54001, Durban, 4000, South Africa
Telephone: [illegible] Email: [illegible] Website: [illegible]