



**WATER ALLOCATION PRACTICES TO SMALL-SCALE FARMERS IN THE
NWANEDI IRRIGATION SCHEME, LIMPOPO, SOUTH AFRICA.**



Mini-dissertation submitted in partial fulfillment of the requirements for the degree
Master of Philosophy in Integrated Water Management at
The Independent Institute of Education, IIE MSA.

Albertina Mojaji Rammalo

Student Number: [REDACTED]

Supervisor: Linda Downsborough

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Abstract

Water allocation is a process that distributes water among various users and plays a crucial role in managing water resources. This process determines who has the right to use a specific amount of water. Researchers, water planners, and government institutions worldwide have recognized the need for adequate water allocation plans and methods and the establishment of appropriate institutions and policies to guide this process. In South Africa, the National Water Act of 1998 created institutions and initiatives to address historical inequalities in water access, focusing on providing resources to previously disadvantaged communities. This research aims to determine how water allocation reforms work in obtaining equitable access by previously disadvantaged groups, mainly small-scale farmers.

Equity in water allocation requires the criteria to assess and realize water resource distribution among the competing users. A significant change introduced by the new National Water Act 1998, is that water no longer belongs to the property on which it is found; instead, it belongs to a water user. Small-scale farmers have a critical role to play in national food supplies and are critical water users. Having equitable access to water for small-scale farmers can make the difference between farming as a means of livelihood or farming for survival. The National Water Act authorizes the Department of Water and Sanitation to issue water-use licenses to potential water users. This license entitles the user to access specified amounts of water. The role of legislation and water allocation regulations are therefore very important for small-scale farmers to attain equitable access to water.

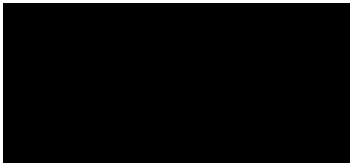
This study used a qualitative research approach, which included in-depth focus group discussions with small-scale farmers directly affected by water access challenges in the Nwanedi Irrigation scheme. Discussions focused on small-scale farmers' experiences and perceptions of water access issues. The in-depth focus group discussions also provided insights into how various forms of water rights are intertwined with social inequities.

The study revealed that water is not allocated equitably amongst the small-scale farmers along the Nwanedi River, which affects their production and has a negative impact on the local economy. The main challenges faced by small-scale farmers are the imbalance in water allocation, poor agricultural infrastructures such as irrigation equipment, climatic variability and the absence of water use licenses. Based on the findings obtained from this study, it is recommended that small-scale farmers participate in WUAs so that they can be assisted and supported in getting water licenses to abstract water from the Nwanedi River for their farms. As part of the support and assistance the DWS should provide an induction to small-scale farmers about water permit applications. Enforcement and monitoring of the conditions tied to the water permit should also be implemented for long term water security in the Nwanedi Irrigation Scheme.

Keywords: *Small-scale farmers, equitable water allocation, National Water Act, economic development, Nwanedi River.*

Copyright declaration

I, **Albertina Mojaji Rammalo**, declare that this mini dissertation has been submitted for the Master of Philosophy in Integrated Water Management at the Independent Institute of Education (IIEMSA). This dissertation has not been previously accepted in substance for any degree and is not concurrently submitted as a candidature. To the best of my knowledge, it contains no material previously published or written by another person except where due reference is made in the text of this dissertation. I state that this mini dissertation is my independent investigation/work.



08/01/2025

Dedication

This research project is dedicated to my family, particularly my husband Dimakatso Freddy Rammalo, whose unwavering love and support have driven my academic pursuits. His encouragement and belief in me have been a constant source of inspiration, and I am forever grateful for his guidance and wisdom.

I would also like to dedicate this work to my mentor and research supervisor, Linda Downsborough, whose expertise, guidance, and pertinence toward me have been instrumental in shaping my research skills and knowledge. Her mentorship has been an invaluable asset to my academic and professional growth.

Finally, I would like to dedicate this research to all those who contributed to its subject matter. I hope this work will advance knowledge and understanding in this field and ultimately lead to positive change and progress.

Thank you all for your unwavering support and encouragement throughout this research project.

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ACRONYMS

ACA	Agricultural Credit Act
CMAs	Catchment Management Agencies
CPA	Communal Property Association
DAFF	Department of Agriculture, Forestry and Fisheries
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
NDP	National Development Plan
NIS	Nwanedi Irrigation Scheme
NCMA	Nwanedi Catchment Management Area
NWA	National Water Act
SSIFTP	Small-Scale Intensive Farm Training Program
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WAR	Water Allocation Reform
WMA	Water Management Area
WRM	Water Resource Management
WUAs	Water Users Associations

CHAPTER 1: INTRODUCTION

1.1 Introduction

Water is a precious and finite resource that must be protected and allocated for use in a sustainable manner. According to Wang et al., (2016), when allocating water, one of the basic water allocation rules is to allocate water considering water quotas while abiding by strict allocation principles. Water quotas are tools that are used in guiding water allocation practices. The purpose of a water quota system is to provide irrigation schemes with a way to allocate water and limit the overexploitation of an area's water resources (Wang et al., 2016). In South Africa, equitable water allocation faces significant challenges and inequalities which hinder economic growth for small-scale farmers (Department of Water and Sanitation (DWS)). It has been suggested that the role of water allocation in supporting economic development programmes will increase as water becomes more limited in the future (DWA 2005).

In 1998, when the National Water Act (Act 36 of 1998) came into effect (replacing the Water Act of 1954), it was mandated that “the National Department of Water, now the Department of Water and Sanitation, would be the guardian and trustee of water resources on behalf of the nation” (National Water Act, Act 36 of 1998).

Water is a critical input source for agricultural production, which plays an important role in national and global food security (Water in Agriculture-World Bank, 2023). Improving water management in agriculture is important but it is typically constrained by inadequate policies, financing limitations and significant institutional underperformance (World Bank, 2023).

Access to water is essential for small-scale farmers worldwide. In many countries, smallholder farmers are the backbone of national food supplies, producing more than half of the agricultural production (Ariabod et al., 2019). Many small-scale farmers however live in rural areas where poverty, hunger, food and water insecurity are prevalent. Equitable access to water for small-scale farmers can make the difference between farming as a livelihood or farming as a means of survival (Kamara et al., 2019).

In this study, equity in water allocation is essential among small-scale farmers along the Nwanedi River in Limpopo Province of South Africa. Despite their high level of water productivity and crucial role in contributing to national food security, small-scale farmers tend to be overlooked regarding water use rights (International Assessment of Agricultural Knowledge, Science, and Technology for Development (IAASTD, 2009).

The term ‘Equity’ is the main objective in water allocation. Defining, measuring, and determining global water allocation is difficult (van der Zaag, 2007). Equity in water

allocation requires strict criteria to assess and realize water resource distribution among the competing users. Van der Zaag and Savenije (2014) defined equity as *“the activity of providing every user an equal opportunity for access to water according to their needs.”* Equity, therefore, does not constitute ‘equal quantity’; instead, it means ‘equal opportunity’ to access water for use (Van der Zaag and Savenije 2014).

In South Africa, a significant change introduced by the new National Water Act 1998, is that water no longer belongs to the property on which it is found; instead, it belongs to a water user (Thompson, 2006). The NWA states that *“a person or a legal entity becomes a water user by registration. The registered use entity receives an entitlement to use water from the Department of Water and Sanitation (DWS)”*. The registration process requires answers to the following four questions:

- Who are you?
- Where do you live?
- How much water are you using?
- What are you using the water for?

The water-use registration is only a census, not an automatic entitlement to use water (National Water Act). Registration should be followed by entitlement verification, which leads to the issuing of a water-use license. The numbered certificate issued after registration provides each user with information on the volume of water to be used, the source of water, the farm on which it is used, the registered user, what water is used for, and lastly, the type of registration (National Water Act). The registration certificate is the only official document for the user to indicate the eventual water entitlement (National Water Act (Act 36 of 1998)). In this study, small-scale farmers in the Nwanedi Irrigation Scheme must register to become water users via the abovementioned process.

1.2 Research Issue

South Africa faces significant inequities in water allocation amongst users, mainly small-scale farmers. Government policies indicate that resources must be allocated with equity, but what constitutes equity is the subject of much debate (Syme et al., 1999). The NWA (1998) urges smallholding irrigation farmers to form Water Users Associations, which should be registered, licensed, and charged with water fees. According to the Act, these WUAs are “cooperative associations of individual water users who intend to undertake water-related activities for their mutual benefit.” The role of the WUA is to enable a community, such as small-scale farmers, to draw financial and human resources to undertake more effective water-related activities. Irrigation, for example, is one of those activities (DWAf, 1999 & 2000).

Schreiner et al., (2000) recommended that small-scale farmers who cultivate less than 2ha should be exempt from the water user license registration campaign and process, even if they market a substantial part of their crops. In 2006, The South African Department of Water Affairs and Forestry (DWAF), now known as the Department of Water and Sanitation commissioned a project to develop an approach for estimating allocations to Black users in which small-scale farmers were to be considered. The project was known as the Water Allocation Reform (WAR) Programme. However in May 2008, DWAF suspended the project. Currently, there is no system in place to reliably measure the impact that WAR has on the water allocation in South Africa. This mini-dissertation aims to determine how equitably water from the Nwanedi River is allocated among small-scale farmers and determine the need to modify allocation while giving recommendations. It also considers the economic growth that small-scale farmers participate in in their locality and the challenges they face. Small-scale farmers along the Nwanedi River, as in many other rural areas, are vital elements/actors in the government's strategy to increase economic growth and alleviate poverty.

1.3 Research Aim, Question, and Research Objectives

This mini-dissertation aims to explore how equitably water from the Nwanedi River is allocated among small-scale farmers and the effectiveness of the water allocation policy, as stated by the National Water Act. The study also examines the economic development of Nwanedi small-scale farmers.

An overarching research question guided the research.

Research Question: How is water equitably allocated to small-scale farmers along the Nwanedi River?

Three research objectives were developed to address the overall aim of the research.

- Is the water allocated to small-scale farmers being allocated as per the water allocation policy of the Republic of South Africa?
- What challenges do small-scale farmers face regarding water allocation?
- How do the small-scale farmers contribute to the economic development growth of the Nwanedi area?

1.4 Structure of the mini dissertation

This mini-dissertation comprises six chapters, including the introduction (**Chapter One**), which presents the research question and provides an overview of the study objective within the broader context.

Chapter Two (Literature Review) outlines the concepts of equity in water allocation to small-scale farmers. It follows the implementation of the water allocation policies by the government of South Africa. Stakeholders' participation in water allocation policy in water governance for equitable water allocations at all levels is then discussed.

Chapter Three (Research Methodology) presents the overall study design and the methods used to collect data. A qualitative approach was used to collect data, which included a focus group discussion and a site visit to the study area. This chapter also presents information on data analysis, trustworthiness, limitations and research ethics.

Chapter Four (Findings and analysis) presents the findings from the data collection process. Focus group interviews and documents obtained from the field were used for this analysis. Policies and other documents which indicate how water should be allocated equitably to small-scale farmers per the water allocation policy were obtained. The economic growth of small-scale farmers in the Nwanedi area was determined.

Chapter Five (Discussion of findings) This chapter discusses the findings, reflecting on how water is allocated to small-scale farmers and comparing them to the responses made during the focus group discussion as well as to existing policies and legislation.

Chapter Six (Conclusions and Recommendations) This chapter concludes the study, highlighting key findings and offering recommendations for various stakeholders.

The next chapter presents a review of the literature relevant to this study.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Poverty eradication and economic growth are achieved through equitable water allocation amongst water users. The Water Allocation Reform (WAR) is a key programme in the Department of Water and Sanitation for redressing equitable water allocation. The programme covers several activities, including financial support for small-scale farmers, water licensing, and equitable reallocation. Prior to democracy in 1994, water permits were issued to and owned only by white commercial farmers, who were in the minority. In 1994, the new Constitution (Act 108 of 1996) was established to redress past imbalances, including the allocation and management of water resources. This was achieved through the National Water Act (NWA no 36 of 1998) together with the Water Services Act (WSA) (Act no 108 of 1997).

The National Water Act is used to govern South Africa's national water resources, and it encourages equity principles amongst the water users. The NWA has also emphasized the participation of all relevant stakeholders in the decision-making processes of establishing new Water Management Institutions (WMI), such as Catchment Management Agencies (CMAs) and Water Users Associations (WUAs). Several Irrigation Boards (IBs) which were established under the 1956 Water Act have not been transformed according to the National Water Act 36 of 1998. This has resulted in the ownership of several water resources remaining under the authority of the white minority commercial farmers.

According to Khalil et al., (2017), small-scale farmers in many developing countries provide food security and economic growth in rural communities. In South Africa, high levels of poverty and unemployment confront most rural communities. In this research, the small-scale farmers in the study area are also affected by poverty and unemployment so by encouraging them to participate and be included in water-related decisions will assist in raising their voices toward equity in water allocation.

2.2 Equitable Water Allocation to Small-Scale Farmers

Authors such as Mnyaka, (2018) have highlighted that “even after three decades of water allocation reforms, small-scale farmers still face challenges to water access” Inequality in water allocation negatively affects the local economic transformation of rural communities. Water use licenses and small-scale farmers' access to water for irrigation are often not prioritized or achieved. The National Water Act 36 of 1998 separates land ownership from ownership of water. According to the NWA, farmers must register as water users and officially get licenses to use a specified amount of water for production (NWA, 1998). Water licenses obtained before the dawn of democracy are still considered in the new National Water Act under sections 32 to 35. Those sections state that “small-scale farmers do not automatically get access to

water, especially if water sources are fully allocated". On the other hand, it states that "the government must ensure that water is secured for basic needs and ecological purposes".

The water resources in South Africa are managed and controlled by the Department of Water and Sanitation. Agricultural institutions, such as the Department of agriculture, have no authority to access water to distribute to small-scale farmers (Sylvain et al., 2002). Most Small-scale farmers are seen to be practicing agricultural production for their household consumption, not for sale to the higher markets. Water access is the main challenge experienced by most small-scale farmers in producing food in rural areas. For those farmers who do sell their produce to markets, they also provide employment opportunities for others. Some scholars have highlighted that economic factors such as income from farming can influence the participation and motivation of small-scale farmers in collective action initiatives. Farmers not receiving enough income from farming are usually unwilling to participate in collective action which impacts their water security status. There is therefore a great need to ensure that access to water is improved for small scale farmers.

Not only do farmers need access to water but water allocation needs to take place in an equitable manner to ensure sustainable long term use of water resources. Poverty eradication and growth promotion are often achieved through equitable access to water.. Water needs to be allocated according to the socio-economic developments that are taking place in the area. For the proper water allocation, water users need to be identified and registered according to their agreed allocation.

Van der Zaag (2007) and Roa-García and Brown (2015) indicate that the allocation of water volumes among farmers in the agricultural sector is inequitable because the criteria for water allocation are often inconsistent. The authors state that "flexible allocation mechanisms are required to reconcile efficiency and equity principles". Equity is a core principle, but it is extremely difficult to achieve in water allocation. Boelens et al., (1998), identify the following five levels of equity in irrigation and water management at the local levels:

1. "Equitable water distribution and allocation among different water users and uses.
2. Equitable distribution of services involved in irrigation development.
3. Equitable distribution of the added agricultural production and other benefits under irrigation.
4. Equitable distribution of burdens and obligations related to functions and positions.
5. Equitable distribution of the rights to participate in decision-making processes, since this relates to the fundamental issue of whether every farmer has rights to speak, vote, claim an entitlement to irrigated land, and enjoy equality of status" (Boelens et al., 1998).

According to Speed et al., (2013), water allocation planning should always focus on achieving equity as a part of policy objectives of water allocation mechanisms. Boelens et al., (1998) argue that *“equity should not be seen from the pervasive point of view dominated by the West. Rather, each society should be allowed to conceptualize equity in line with its values and economic sufficiency”*. Because water is a public good which provides essential services for water users such as small scale farmers, the equitable distribution of water within the water allocation process becomes increasingly important.

2.3 Small-Scale Irrigation Farms

Small-scale irrigation farmers have been identified in a study by the Water Research Commission (2009) as underdeveloped in rural areas and in need of supported in economic development and growth (Water Research Commission, 2009). Oeloftse (2012) noted that small-scale irrigation farms are limited in numbers due to various factors such as poor and run-down infrastructure, lack of knowledge of crop production, poor participation in water management structures, such as WUA's, and lack of reliable markets and effective credit services. It is, therefore, important to assess the performance of small-scale farm irrigation for economic development and livelihoods (Oeloftse, 2012).

"Small-scale" is often seen as a non-productive and non-commercial space whereby agricultural activity occurs in remote rural areas. All farms below the size of 2Ha, were previously excluded from assistance (Agricultural Credit Act, 1987). Small-scale farming does not need sizeable agricultural land; it only permits the vegetation of multiple crops to be planted in a desirable size. The main challenge small-scale farmers face when irrigating crops is equitability in water allocation. Small-scale farmers are increasingly suffering from water shortages for their crops, whereas on the other hand, there is growing popular demand to improve access to water for rural livelihoods (Jean-Marc et al., 2014). Because water users increase in a catchment, equitability in water allocation becomes very important. There is evidence that small-scale farmers in underdeveloped areas have no access to water for their crops (Mnyaka, 2018).

Water management and irrigation infrastructure maintenance are essential in small-scale canal irrigation. Wim et al., (2006) revealed that a system of simple rules governing the sharing of water among farmers and the routine maintenance of the canal system could form the appropriate basis for sustainable water management by small-scale farmers. "The entire exercise will ensure that water is shared equitably among small-scale farmers and that canals are always maintained and in good condition". This would result in small-scale farmers producing enough products/crops and accessing markets through improved voluntary cooperation. In this situation, the local government should support small-scale farmers instead of regulating their farms.

2.4 Stakeholders Participation in Water Allocation Policy

The participation of stakeholders in the water allocation policy for both public and private sectors is essential. That allows everyone concerned to have a voice in the decisions taken. Local communities have background information about the land they have occupied and Indigenous knowledge about natural water sources available that external people do not have. Participating in the water allocation policy does not require any educational qualification. Adom and Sematele (2022) stated that “Indigenous knowledge had been undermined by academics and politicians when developing the water allocation policy”. That conduct compromises the objective water allocation policy as it does not provide the outcome that will benefit the people affected, the small-scale farmers. Everyone who is to be affected by the allocation in one way or another is considered a stakeholder. Delegations from relevant sectors are invited to participate in the water policy discussions to produce credible outcomes.

Significant water users who may not be in the agricultural sectors abstracting water for their production are considered stakeholders in water resource management and must be accounted for in the water allocation policy. The NWA (1998) also covers significant water users not in the agricultural sector who get water from natural sources. These users are also affected by the sharing of water amongst users. Public participation is constitutional in South Africa and is covered in the Batho Pele principles as a set of guidelines for interacting with the beneficiaries for the services that they are receiving. In this case, the participation of stakeholders in allocating water is essential for water use production, as stated in the National Water Act. That will ensure fairness to the interests of all beneficiaries in water process management.

Ostrom (1990) and Jacobs et al., (2010) state that it is vital to have sound approaches when allocating water. Institutional arrangements for coordinating public participation in water allocation are often unclear. In some instances, it has been observed that WUA's coordinate the stakeholders to participate through WRM. The Water Users' Association (WUA) is the organization that is currently active in water resource management and is considered to coordinate stakeholder participation. According to Subramanian et al. (1997), WUA's manage the Water Resources while operating at the water catchment level which is joined to the large water basin. The participation of small-scale farmers in Nwanedi is minimal since many are not part of the WUA. This means that their interests and concerns, particularly around water allocations, are not considered.

Adom and Sematele (2022) stated that stakeholder participation is the right way to address challenges associated with sharing common resources. A common understanding and adequate support between competing parties in water management is critical. The pressures observed on water resources in competition to access water are crucial for stakeholders' engagements. Stakeholder inputs in the

water allocation policy play an important role in increasing the trustworthiness of water resource management towards equity in allocating water amongst users.

The participation of stakeholders in the water allocation policy minimizes conflicts and ensures sustainable solutions to any dispute.

2.5 Economic Growth in Small-Scale Farming

According to Warsaw and Archambault (2021), communities and their local communities generate the economic advantages of farming on the land owned by local farmers and the local economy. The literature indicates the need for small-scale farmers to be involved in high-value sales with high value-added. The participation of small-scale farmers in marketing firms is essential to improve their economic growth. Support from farmers in increasing their products to good quality is needed to provide their profitable market outlets. The quality of the product to the customer needs to be an acceptable standard to comply with the agricultural marketing system. To maintain good products, the crops are harvested in time to prevent them from being spoiled to achieve the standard target market.

Small-scale farmers receive a living income by selling their products to local communities and getting better income when taken to the markets (Warsaw and Archambault, 2021). Small-scale farmers who have good access to water are able to produce sustainable food to combat poverty in rural societies. Rural societies benefit from successful and productive small farms. Economic growth in rural society is created by small-scale farmers who inject their incomes directly into the rural economy while creating growth.

Agriculture has remained the most labour-intensive production sector with employment linkages for decades. Competency in the agriculture sector is measured in terms of food security and employment contribution. The income from agricultural products is an asset for most poor rural communities. The Department of Agriculture has developed an Integrated Food Security Strategy (DBSA, 2011). The food system contributing to the local economies of rural areas is limited. Local food systems do not ensure food security alone but contribute to rural development to get a sense of customers. Agriculture food products protect the profitable sales within its local communities. Local markets near urban areas benefit farmers by providing enough consumers with the purchasing power and the willingness to pay for local premium products.

In the small-scale economic growth, other studies revealed that water is used for different purposes. Water is used for various purposes in the post-harvest value chain of indigenous crops. A certain amount of water is needed for different levels of the post-harvest value chain. Walker et al., (2012) conducted a study determining the water required to produce a marketable yield. Studies conducted by other scholars

indicated that 80% of rainfall contributes to water lost through evaporation and transpiration, whereas 20% is abstracted from natural water resources for irrigation purposes. Open surface water sources, such as rivers, are reported to be highly contaminated with various pollutants, including faecal coliforms, coming through sewage spillages (Barnes, 2003).

Figure 2 highlights the Government water management policy framework, contributing to local economic development.

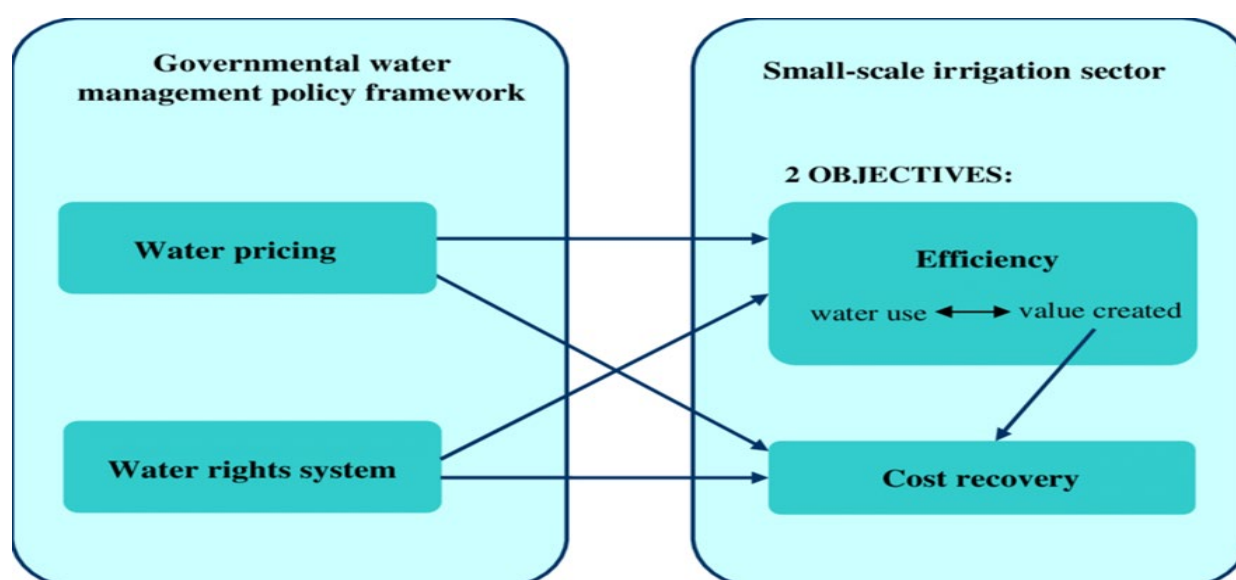


Figure 2: Water management policy on water rights for economic development

2.6 Water Allocation Equity Approach

There is a relationship between water allocation, water use and poverty levels in my rural communities.. Poor rural communities need water to reduce poverty through farming and maintain sustainable, stable livelihoods. The 1997 White Paper on National Water Policy stated that “equity implies fair water allocation in response to different social, economic, and environmental needs”. The NWA, 1998 stipulates that “equity, sustainability, and efficiency are the guiding principles of water resources management”.

The National Water Policy, 1997, stated that prioritizing equity in reallocating water supports equity and equitable access's fundamental principles and constitutional imperatives. Allocation by the state has been the public allocation for decades and has not addressed economic efficiency. Since water services are public goods, allocating them to one another does not deprive other individuals of using them.

The lack of beneficiary identification results in under-investment and misallocation, which leads to market failure. The objectives of water resources policy and the criteria for the allocation of water are targeted through numerous forms of allocation, ranging from complete control by the government to a mixture of market and government allocation to predominantly market allocation (Water Allocation Reform Strategy, 2008). The inequity of water allocation created the imbalance, leading to water scarcity for irrigated agricultural land. The irrigation sector is the primary water user and supports food security, but water allocation has not been managed with sustainability-efficiency-equity. The existing institutional arrangement, legal frameworks, and the water resources infrastructure influence the form of any water allocation system.

Water allocation influences society's economy (Rawlins, 2019). Debates on water policy focus more on equitable fairness in water allocation. Public allocation is observed in many large-scale irrigation systems, where the government decides on water resources for its use, considering economic growth (Rawlins, 2019). Public allocation is associated with the volume of water supplied depending on physical norms and political influence; it intends to promote equity objectives by ensuring water provision to areas with a limited volume of water. Allocation rules are based on historical facts, equal shares in available water volumes, individual needs, or political pressure. Public allocation is important at some levels, particularly for inter-sectoral allocation. Challenges with this allocation form are seen in the poor performance of government-operated irrigation systems and licensing irregularities.

The public allocation mechanism fails to practice cost recovery for water users to conserve water and improve use efficiency (Meinzen-Dick and Mendoza, 1996). Public water allocation mechanisms constitute different inefficient water pricing systems; flat rates or fixed charges are commonly used, which are easy to manage, and users get along with them. The fee structure for water use in public allocation does not, in most instances, incentivize users to save water and use it more efficiently.

Most irrigation systems charge a flat rate per hectare; water consumption increases as farmers feel entitled to more water because they are paying. Water transfers initiated by large-scale farmers utilizing their capital obtained through bank loans also benefit small-scale farms.

Market-based water allocation is precisely referred to as an exchange of water-use rights. The water market has many benefits. Under certain conditions, sellers have an opportunity to increase profitability, and buyers benefit since the water market influences the increase in water availability. Allocating water through tradable rights gives maximum chances to respond to changes in crop prices and water values. The market-based system is more effective than the centralized allocation of water. Effective market allocation needs water trades to be identified and quantified with the associated costs in the exchange process. The market allocation can incentivize users to determine the highest-value applications for scarce water resources. Developing

markets with clear and firm water rights and the state's involvement will expand users' participation in water management.

The National Water Act 1998 section 3(2) requires that water be allocated equitably and used beneficially in the public interest while promoting environmental values. In recognition of the fundamental importance of protecting a river's ecological services and values, water is often allocated to meet environmental flow requirements before it is assigned to other users (Pegram et al., 2013).

2.7 Chapter Summary

This chapter highlighted the practices/methods used to allocate water equitably amongst water users, mainly small-scale farmers and the importance of this. The literature presents the equity concepts used in the allocation of water rights, particularly in South Africa, where there is a significant inequity in water allocation to small-scale farmers. Stakeholders' participation in water allocation policy in water governance for equitable water allocations at all levels and the economic growth in small-scale farming is also discussed.

The next chapter present the research design and methodology on which the research was based. It also presents background information on the study area.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

The study used a qualitative research approach. The research explored how water was allocated to small-scale farmers along the Nwanedi River and highlighted whether this aligns with the set goals and objectives of the water allocation policies. Focus group discussions, observations, and documentary analysis were used to determine the equitability in water allocation and propose whether a change or modification in the water allocation policies is necessary. This chapter also describes the data gathering process and ethical procedures followed during the data collection.

3.2 Study Area

The Nwanedi River, the focus area of this study, is a small river that forms part of the Nzhelele River Catchment (Figure 1). Small-scale agriculture and irrigation are the main economic activities along the Nwanedi River. However, the Nwanedi water resources are limited and are in a deficit due to the over-allocation of water by the irrigation sector, leaving limited surplus water available for allocation.

Nwanedzi and Luphephe dams manage the release of water for agriculture to the downstream environment. Under natural conditions, the rivers above these dams are considered historically perennial, while the Limpopo Plain is seasonal.

A total of 55 farmers abstract water for irrigation from the Nwanedi River (pers comm, field work). The main crops produced are tomatoes, butternuts, corn, and Chilies. The irrigation scheme covered an area of about 1986 hectares of land, of which 40% belongs to the state and 60% belongs to the Communal Property Association (CPA) (pers comm, field work). The Nwanedi River is the primary water source for all the farmers in the Nwanedi Irrigation Scheme (NIS).

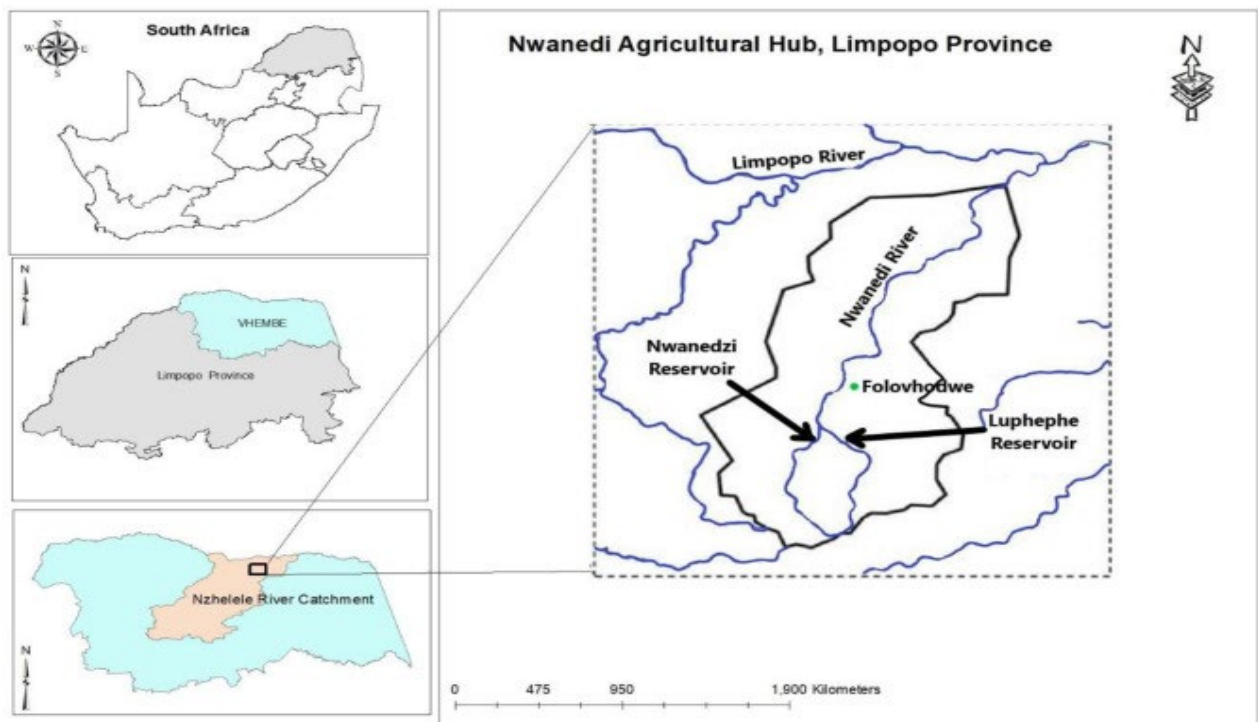


Figure 1: Map of the study area: Nwanedi River, Limpopo Province, South Africa.

The Nwanedi River flows north across the far north-eastern portion of Limpopo Province. Its source is in the upper Soutpansberg Mountains, where several small streams converge. It merges with the Luphephe River inside the Nwanedi Nature Reserve and forms the Nwanedi–Luphephe dams. The river lies entirely within the Limpopo Water Management Area and lies in quaternary catchments A80H and A80J with a gross area of 1136 km² and a Gross Mean Annual Runoff (MAR) of 24.5 10⁶ m³ (Midgely et al., 1994).

3.2.1 Meteorological Data of Nwanedi Area in the Vhembe Region

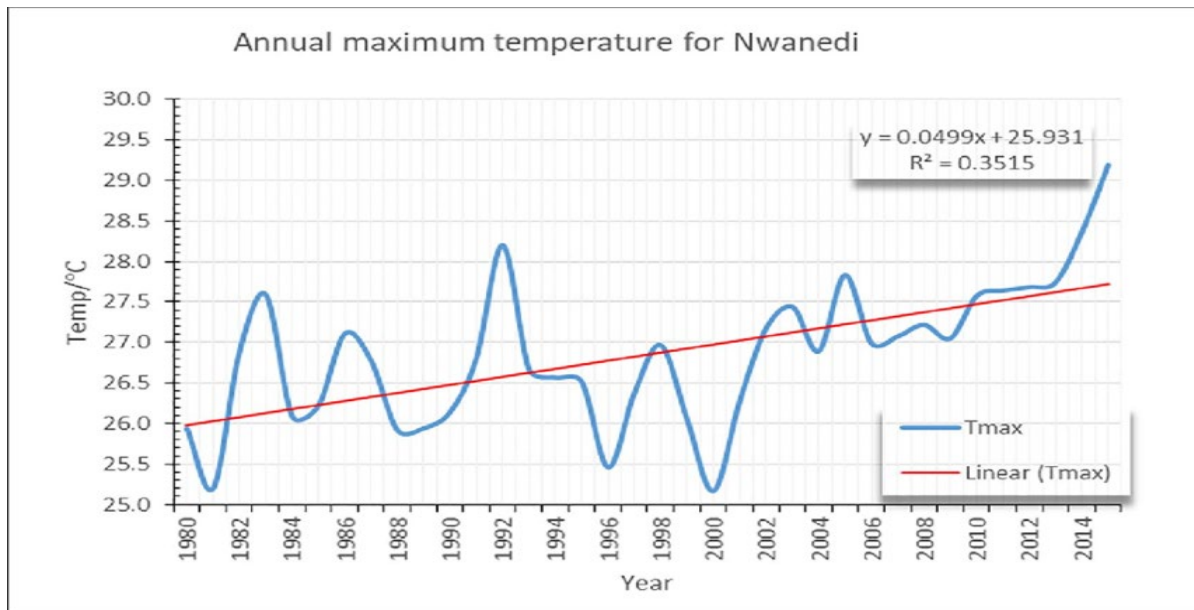


Figure 2: Annual rainfall trends in Nwanedi from 1980-2015.

Small-scale farmers are affected by the local climate, and the changes to this affect the production of crops that support their livelihoods. Figure 3 shows the rise in temperature from 2010 to 2015, which increased the rate of water evaporation from open water sources such as rivers. When this situation occurs, most small-scale farmers become aware of high-volume floods affecting the growing season as they obtain less produce. According Phakula et al., (2020) temperatures may vary from a minimum of 22.30°C to 34.52°C in summer and between 9.6°C and 25.6°C in winter. The rainfall pattern from the graph shows a decline, whereas the temperature has shown a constant increase in the past three decades. Many small-scale farmers in the area are concerned about the decreasing rainfall and increasing temperatures (Pers comm, fieldwork 2021).

3.3 Research Design and Methodology

A paradigm refers to a set of processes and beliefs that influence how research should be undertaken (Du Plooy-Cilliers, Davis and Bezuidenhout, 2014). It is a framework under which research takes place. The research paradigm that was used in this study is that of Social Constructivism. This paradigm supports the notion that the social world can be interpreted in a subjective manner. It promotes the idea that attention is directed to how people experience their world and therefore reports on what is meaningful to them (Du Plooy-Cilliers, Davis and Bezuidenhout, 2014).

According to Du Plooy-Cilliers, Davis and Bezuidenhout, 2014, qualitative research deals with the subjective experience of participants and the meanings attached to these experiences. Also, with qualitative research, the researcher seeks to gather rich in-depth experiences in a specific context. A qualitative study does not produce findings or results by using statistical techniques or means of quantification (Mouton, 2001), rather it studies the aspects of human beings that cannot be investigated adequately using quantitative methods.

To understand how water is being allocated to small scale farmers and if this is being done equitably and in line with legislation it was important to understand small scale farmers perspectives around water allocation. During the field visit to the study area, a focus group discussion took place with small-scale farmers at the Nwanedi Agri-Hub packhouse. During the discussions, issues affecting small-scale farmers were discussed, focusing on their experiences of equity in water allocation. Qualitative methods were also used to collect data for this research study.

3.4.1 Field Research Methods

Qualitative data is regarded as “non-numerical data and consists mainly of texts, which could be images, written texts, recorded audio, and words spoken directly by people” (Babbie, 2010)



Figure 4: Qualitative Data Collection Methods. Source (Babbie, 2011)

As the figure above indicates, several methods can be used to collect qualitative data in research studies. In this study observations were used for collecting qualitative data, including observing a person's or situation's behaviours and writing the events in notes (Babbie, 2011).

A focus group discussion method was also used. In this method, direct interaction and face-to-face conversation between participants took place. The discussions guided the interaction, which gained insight into the individual's knowledge surrounding the investigation of equity in water allocation (Boland, 2007).

Primary sources provide raw information and first-hand evidence and gave the researcher direct access to the subject of study (Streefkerk, 2018). Field research was used to collect data. According to Strydom & Bezuidenhout in Du Plooy-Cilliers et al., (2014), field research is *“a qualitative method of research concerned with understanding and interpreting the social interactions of groups of people, communities, and society by observing and interacting with people in their natural settings”*. The approaches and methods used in field research vary across disciplines. In this research, in-depth focus group discussions and the behaviours of small-scale farmers abstracting water from the Nwanedi River for watering their agricultural products were observed.

The field research for this study took place from the first week of May to the end of June 2021. As an essential worker in the Department of Water Services, lockdown restrictions were lifted, and a permit to travel was granted with limited restrictions. The participants, who were small-scale farmers, could not travel far. An in-depth focus group discussion was used to explore the thoughts and feelings of small-scale farmers around water allocations. Two places best suited the participants, the board room in the Agri Pack House and on-site farming schemes were visited.

A telephonic appointment was made with the head of the Agri Pack House to meet all small-scale farmers who abstracted water from and along the Nwanedi River. During the discussion, the head of the Agri Pack House formally introduced the researcher to each participant (small-scale farmers) before the in-depth focus group discussions commenced. Figure 6 below shows the board room in the Agri Pack House, where the focus group discussions took place, and on-site farming schemes visited during the field research.

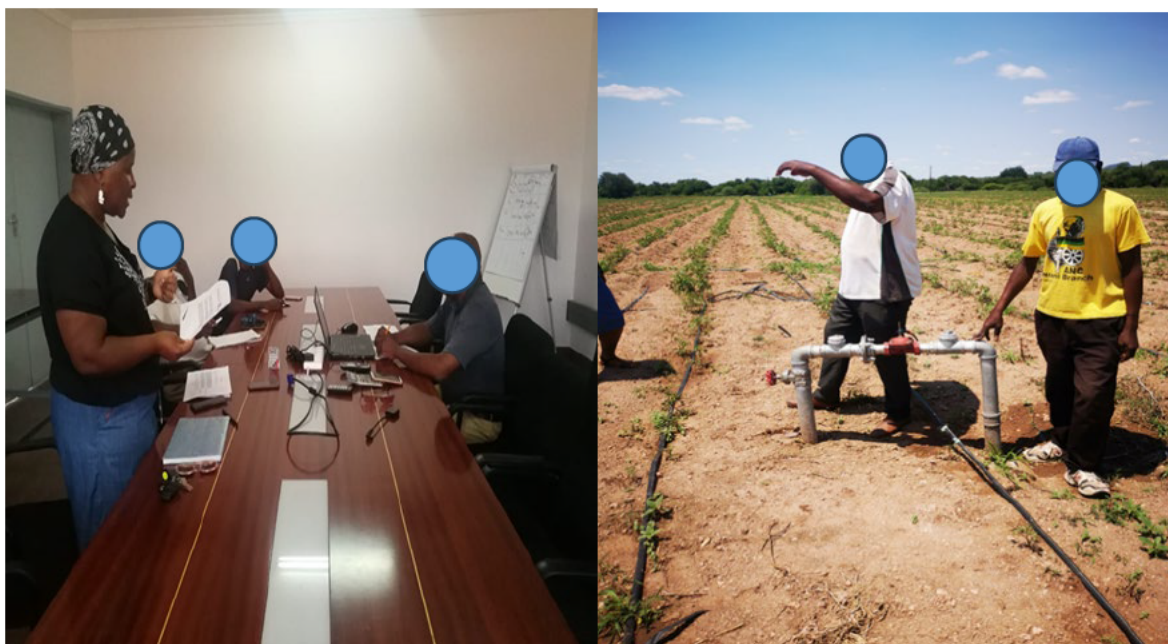


Figure 5: Focus group discussion and Irrigation Site visited. Source (Fieldwork)

This allowed the participants to feel confident knowing they got permission from the head of the Agri Pack House to speak to them. I used face-to-face discussions with the small-scale farmers in the boardroom, which took about 55 minutes. Discussions took place until a point of data saturation was reached. Data saturation is when participants are no longer providing the researcher with new information, and everything being said has already been said. After the face-to-face interaction, we went to the site of the irrigation schemes and the water drawing points in the Nwanedi River, where small-scale farmers abstract water for irrigation.



Figure 6: Nwanedi River, Source (Fieldwork)

The discussions and interactions with the small-scale farmers provided more information on how water is allocated to their farms and what crops they produce for the local markets. The physical inspections of the water sources and water-related infrastructure, such as water storage dams, which serve as reserves in case of drought, the area size of the land, and the amount of water that each farmer is abstracting from Nwanedi River were also noted during the visit and observation.

3.4.2 Secondary Sources

Secondary sources are second-hand information that analyses, synthesizes, and interprets primary sources. They include documents such as textbooks, articles, reports, etc. (Streefkerk, 2022). In this research, secondary data was gathered through various sources of literature relating to the research topic. The literature review is discussed in chapter two of this study. After reviewing the relevant theory of the research topic, I evaluated the water allocation policy amongst small-scale farmers. This was to determine how the water allocation policy was established in the new democracy and how effectively the government of South Africa implemented it. Most of the secondary data utilized in this study was sourced from books, published journals, databases, and online sources. Documents from secondary sources provide valuable information for the researcher to read and assess how best to achieve the research's objective of the study. Documents should be examined and interpreted in

line with the research question (Mnyaka, 2018). In the field, more information is needed on water allocation to small-scale farmers and what the water allocation policy says about allocating water equitably to small-scale farmers from the Nwanedi River—table 1 below shows documents I acquired for the water allocation from the Nwanedi River to small-scale farmers.

Documents from the Department of Water and Sanitation, such as ‘Water Use Allocation Impact on Farmers’ and ‘A Guide to Water Allocation Reform’ and ‘Compulsory Licensing’, provide valuable information for the researcher to read (Mnyaka, 2018).

Table 1: Documents collected and analysed.

Documents Analysed
• <i>Public Participation and Water Use Rights (King, 2015).</i> The NWA provides equitable water allocation principles among water users, which helped in this research document on how water can be allocated equitably to small-scale farmers.
• <i>The Dynamics and Discourses of Water Allocation Reform in South Africa (Movi, 2009).</i> The overriding notion of achieving equity represented the redistribution of privileged users as vital to sustaining South Africa’s economy.
• <i>Nwanedi Agri-Hub: (2017).</i> The initiative falls under the ‘Inclusive food economy’ pillar and was conceptualized as a process to develop a model by-law to support the development of smallholder producer hubs linked to local-level food markets—essentially linking smallholder producers to local markets in a short value chain.
• <i>Basin Water Allocation Planning (Robert Speed, 2013).</i> This document helped to describe how basin water can be allocated.
• <i>A framework for developing smallholder farmers through cooperatives development by the Department of Agriculture, Forestry, and Fisheries (July 2012).</i>

The government has identified cooperatives as one of the central pivots to reduce poverty, unemployment, and high levels of inequality and accelerate empowerment and development for the benefit of the previously disadvantaged majority. Agriculture cooperatives have been found to play a crucial role in enhancing the productivity of small-scale farmers. This document helped to explain how small-scale farmers grow local economic development.

3.5 Selection of research participants

Simple purposive sampling is a sampling method and is the technique I employed to carry out this study. I travelled to the Nwanedi area in Musina Local Municipality in Limpopo province from the 25th to the 27th of September 2020 to conduct a preliminary site visit. I established contact with Nwanedi Masisi Farmers Primary Co-operative during the site visit. During our meeting, I explained the research topic and its purpose and asked for small scale farmers in the Nwanedi Irrigation scheme to participate. On the 15th of April 2021, I returned to the Nwanedi area for data collection. I collected data on-site with the assistance of the two Nwanedi Masisi Farmers Primary Co-operative representatives.

I also physically inspected the water sources and infrastructure, such as water storage dams that serve as reserves in case of drought, the size of the land used for farming as well as the amount of water that each farmer abstracts from the Nwanedi River.

3.6 Data analysis

According to Bezuidenhout et al., (2014), data analysis aims to bring structure, order, and meaning to data collected through the research process. Often, the research process generates a large amount of primary data, such as focus group discussions and secondary literature data, in the form of water allocation policies and other department policies regarding water allocations. During data analysis, the researcher must identify the significant data from the less significant data by identifying common/ recurring patterns. The focus group discussion, for example, was transcribed and compared with the notes the researcher had taken during the discussion. The focus group discussion transcript and informal conversations with the farmers during the field observation visit were read and reviewed several times until key themes emerged from the data. These themes were used to help structure the discussion of findings and make recommendations.

3.7 Trustworthiness

It is important to trust researchers' findings. Data triangulation, which is the use of multiple methods/data sources is one way to enhance the credibility and reduce potential biases' from just a single method. This study made use of focus group discussions, direct observations and secondary documents such as legislation and policy documents. Triangulation took place when something was noted in the focus group discussion, for example that there are no functioning boreholes and then this was confirmed with direct observation during the site visit – 2 methods used to confirm a claim or finding.

Providing a good description of the research context, participants, and methods allows readers to evaluate the similarities between their context and the study, enabling them to judge the applicability and relevance of findings to their settings or situations. Describing the sampling methods used and the criteria for participant selection assists in determining whether the findings might apply or be transferable to similar populations or settings outside the study context.

Another means of ensuring trustworthiness is thorough documentation of the research context, the participants and each step of the research process. This helps ensure transparency and allows other researchers to replicate the study or assess the dependability of the findings by following the same procedures.

Involving participants in the verification process is also an important step as it ensures that their viewpoints and experiences are accurately represented. This helps to strengthen the confirmability of the findings by allowing participants to validate and offer corrections to the interpretations. By ensuring credibility, transferability, dependability, and confirmability, researchers can enhance the quality of the research and make valuable contributions to the existing body of knowledge.

3.8 Research Ethics

The application and observing of research ethics is important in any research project. One of the main principles of research ethics is to avoid causing any hard or discomfort to research participants (Streubert and Carpenter, 1999). In this study, a qualitative research approach was applied, making use of focus group discussions with small scale farmers and observation to collect primary data. It was important to protect the participants in this study, especially during Covid. The researcher travelled to places convenient to the participants as they were not able to travel due to restrictions. All covid protocols were observed.

Gaining the group's trust and willingness to support the research study was an important step in the research process. By working with the Nwanedi Masisi Farmers Primary Co-operative the researcher was able to do this. The research question and

the study's objective were translated and explained to the participants in their vernacular to ensure that there was no miscommunication. Permission was sought for the focus group and participants signed a consent form to confirm they had understood and agreed to participate. The participants were also informed that since participation was voluntary, they could withdraw at anytime if they felt uncomfortable.

Finally ethical clearance and permission for the research project was covered under MSAEC-0022-2018 which was a project approval application. This research formed part of a larger Water Research Commission project entitled '*Water use in food value chains of indigenous crops with special focus on production and postharvest handling of food products*'.

3.9 Limitation and Mitigation Strategies

Table 2 below details the limitations I encountered while conducting this study and the mitigation strategies I employed.

Table 2: Limitations and Mitigation Strategies

Limitation	Mitigation Strategy
COVID-19 restrictions limited the size of the focus group due to meeting restrictions, social distancing, and travel restrictions.	Only five (5) small-scale farmers could participate following the COVID-19 rules.
Restrictions of movement due to the COVID-19 pandemic	Documents must be used to source information considering COVID restrictions
Time and Financial Constraints	As an essential worker at my workplace, during COVID-19, I attend the water projects next to my study area in Vhembe region. Therefore, I had to visit my study sites while visiting water projects.
Limited Documents Collected for Analysis	I used the documents utilized by the previous researchers to complement the data from interviews.

3.10 Chapter Summary

In this chapter, the methods used to collect and analyse data were presented. Qualitative methods such as focus group discussions and observations were used in this study, together with secondary documentary sources. Data was collected and analysed through a process of qualitative content analysis. Ethical procedures were also followed throughout the study. The next chapter outlines the analysis of the findings obtained from the fieldwork process and secondary resources.

CHAPTER 4: ANALYSIS OF FINDINGS

4.1 Introduction

This chapter presents and analyzes the information obtained from the focus group discussions and other documentary sources on how equitably water is allocated among small-scale farmers in the Nwanedi Irrigation Scheme. This has been determined considering the water allocation policies post-1994. Before the analysis of the results for the water allocation from Nwanedi River, the current situation on how small-scale farmers allocate water for irrigation is presented. The economic growth of small-scale farmers in the Nwanedi area is also identified.

4.2 Nwanedi Irrigation Scheme

The Nwanedi Irrigation Scheme is an irrigation scheme that falls under the category of commercial farmers' irrigation systems. It comprises approximately 140 farmers and covers about 2000 hectares of land. Sixty percent of this land belongs to the government, and 40% belongs to the Communal Property Association (CPA). The Nwanedi Irrigation Scheme is located near the Nwanedi River, the primary water source for agricultural activities. The nearest town is about 130 km away, where they market vegetables at organizations such as NAMPAK and Tiger Brands. The agricultural economic sector and some employment opportunities are created within local communities. Figure 7 shows the Nwanedi Irrigation Scheme, which covers 40% of the 2000 hectares covered by the CPA.

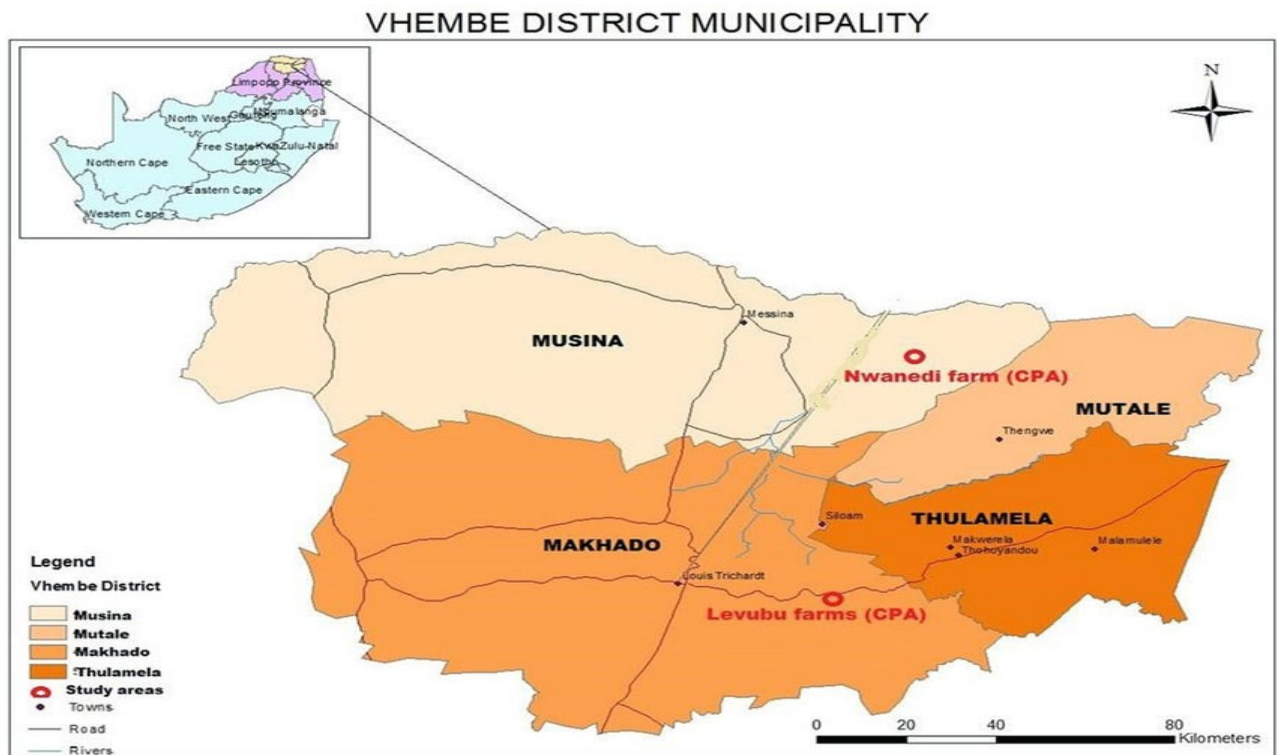


Figure 7: The Nwanedi Irrigation Scheme. Source (Fieldwork)

4.3 Water Security for Nwanedi Small-Scale Farms

Many small-scale farmers experience various water security challenges. During the field visit, it was found that farmers depend on the water from the Nwanedi River for irrigation. Other sources of water available were boreholes belonging to large-scale farmers, which are used to supplement the water from the Nwanedi River. Small-scale farmers do not have boreholes or storage dams; they only have water from the Nwanedi River and the water received during rainfall. Some farmers have installed water pressure pumps in the Nwanedi River and abstract the water to their farms without storage. The river becomes depleted due to improper monitoring of the amount of water abstracted; there is an imbalance of water abstracting by small-scale farmers. The rainfall distribution is important because it indicates how much water is available for small-scale farmers in rain-fed areas. Figure 8 shows the Limpopo province rainfall overview status from 2013 to 2019, which shows the extreme drought experienced in 2019.

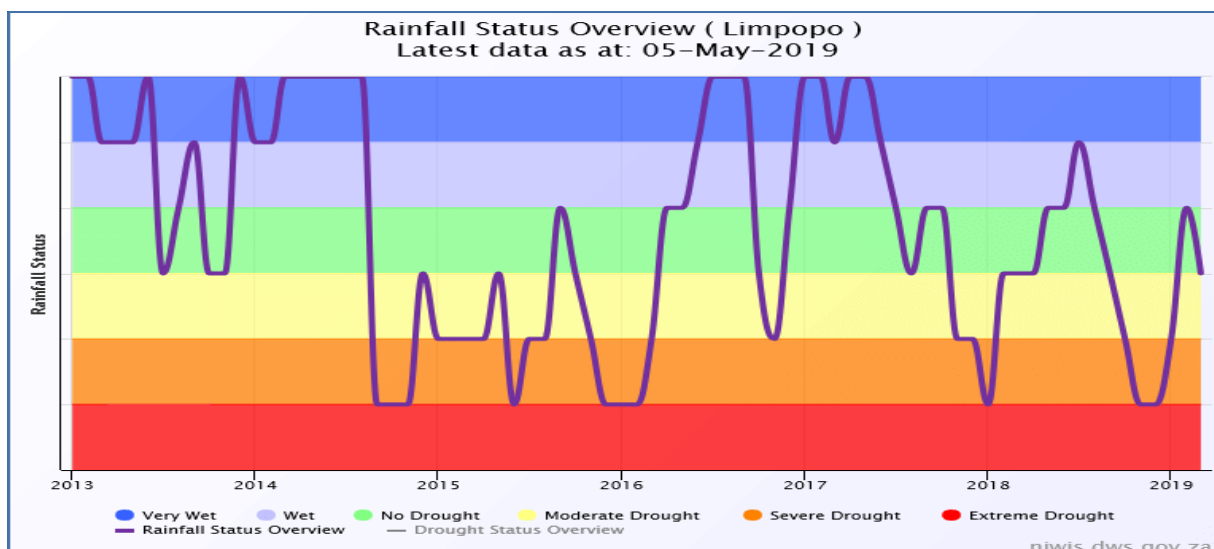


Figure 8: Limpopo province rainfall overview status. Source (niwis.dws.gov.za)

Various factors influence water security for small-scale farms in Nwanedi. Given the challenges of water scarcity in some parts of Limpopo province, Nwanedi small-scale farmers implement various water management practices to cope. These include rainwater harvesting, drip irrigation, mulching, and efficient water use to optimize water resources and minimize wastage (Fieldwork observations).

Table 4. Proposed solutions for water insecurity challenges faced by small-scale farmers in the Nwanedi Irrigation Scheme

Challenges	Proposed Solutions
Lack of proper water infrastructure	- Strengthening agricultural infrastructure, such as irrigation systems and storage facilities, is vital for small-scale farmers to optimize production and minimize post-harvest losses. - Initiatives such as the Accelerated Community Infrastructure Programme (ACIP) are imperative. They focus on improving infrastructure in rural areas, benefiting small-scale farmers and their communities.

• Poor performance of the water infrastructure	• Basic training for the operations and maintenance of water infrastructure by small-scale farmers is critical.
• Lack of integration among water institutions	• Non-Governmental Organizations (NGOs) and private sector organizations are crucial in filling the gaps in government support for small-scale farmers. • These collaborations contribute to the holistic development of small-scale farmers and the promotion of sustainable agricultural practices.
• Poor participation in water management	• Small-scale farmers should form part of water management activities such as WUAs so that their inputs can be considered in water-related decision-making solutions. • The availability of comprehensive policies and adequate government support tailored to the specific needs of small-scale farmers will enhance their development.
• Lack of disaster management strategies such as drought and floods	• Disaster management strategies are to be developed and applied during a disaster such as a drought or flood affecting small-scale farmer's crops. Farmer's vegetation.
• Inadequate water use licence	• Qualified and experienced technical staff co-ordinating water use license applications is required.

Source: Field Work and Focus Group Discussions

4.4 Water Allocation to Small-Scale Farmers along the Nwanedi River

Small-scale farmers abstract water for irrigation directly from the Nwanedi River. They have no water rights or permits to utilize water from the Nwanedi River, and only large-scale farmers have boreholes to irrigate their crops. Figure 9 shows the overall amount of water available for irrigating small-scale farmers.

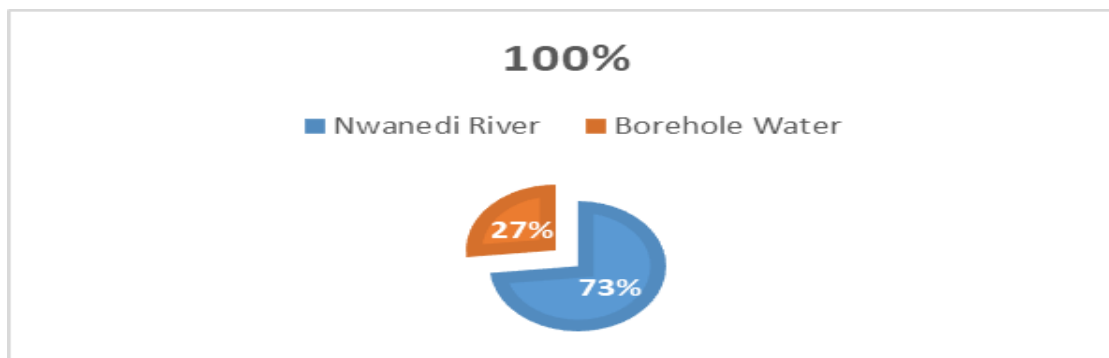


Figure 9: Water available for irrigation. Source (Fieldwork)

Large areas under irrigation characterize the Nwanedi River's northeastern Limpopo Water Management Area. The catchment is in a water deficit due to the irrigation sector's overdevelopment. The water allocation is not flowing through to small-scale farmers. During the focus group discussions, it was revealed that there is an imbalance in allocation. Due to drought conditions, the Nwanedi irrigation area has also been forced to reduce production by 50% because there is insufficient water.

Limited documentation regarding water abstraction licensing is available among small-scale farmers. Therefore, small-scale farmers appear to have abstracted water from the Nwanedi River illegally since no evidence was produced for the water quantity they each received. In the Nwanedi Catchment Management Area (NCMA), no Water Users Association has been formed. Figure 10 indicates the Nwanedi Catchment Area, where the small-scale farmers abstract water for irrigation.

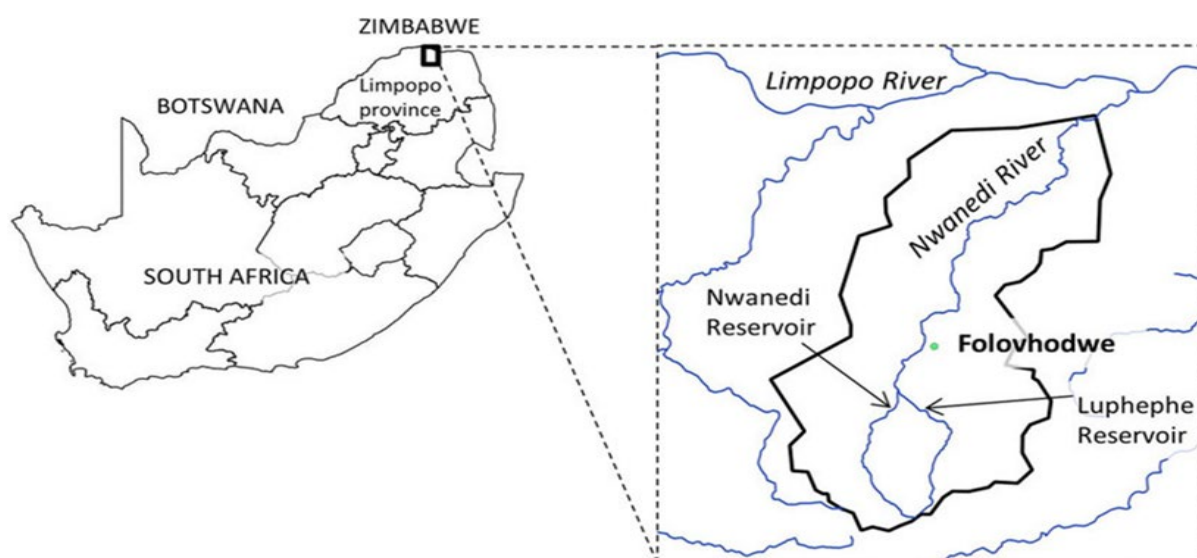


Figure 10: Nwanedi Catchment Area. Source (Research Gate)

When water is allocated, it must be done strategically and equitably. Basic human needs must come first, as water is the primary source of life. Following essential human needs, water is allocated for ecological needs, in which a certain amount of

water needs to be reserved in the water source for aquatic life. The South African reserve is 25%. Where inter-state agreements and transboundary arrangements exist, water must be allocated towards these, followed by strategic water use. Strategic water use prioritizes activities such as mining, forestry, and irrigation. Once these allocations have been made, the remaining water is considered 'allocatable' for domestic consumption and other activities.

Figure 11 below shows the hierarchy of water allocation in order of priority.



Figure 11: Available Water is Allocated in Order of Priority

The small-scale farmers in the Nwanedi Irrigation Scheme utilize various methods to irrigate their crops. During the site visits, it was observed that some farmers use drip irrigation, which supplies water directly to the root zone; sprinkler irrigation, flood irrigation, where water covers the entire field; and lastly, furrow irrigation, which directs water through channels between rows of crops. Figure 12 shows these different methods in the Nwanedi Irrigation Scheme.

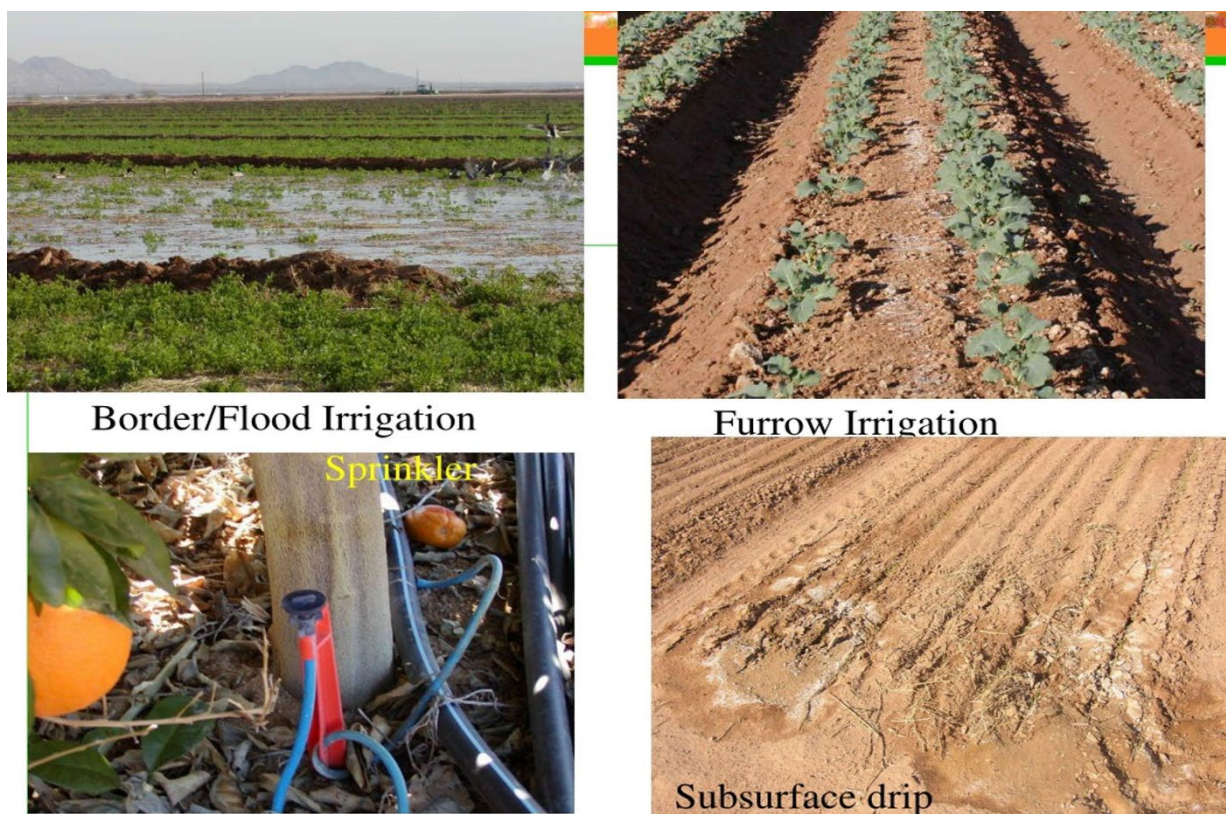


Figure 12: Irrigation methods used in small-scale farms. Source (Fieldwork)

4.5 The National Water Act (Act 36 of 1998)

Under the NWA, only WUAs may apply for a license and be granted the right to use water under specified conditions. Failure to become a member would limit individuals' right to use water other than as specified in Schedule 1. Individually, at the household level, rural people are automatically granted a free and unregistered right to "reasonably" use water for irrigation (Schedule 1). The NWA urges rural communities and small-scale irrigation farmers to form WUAs that should be registered, licensed, and charged (water fees). Moreover, WUAs are likely to impose water management rules and schedules, which are often sources of conflict and discontentment in farming communities. The DWS argues that a license might allow intensification and commercialization through increased water allocation review and consumption.

Due to their race and structural inequalities, small-scale farmers have been hindered from claiming their water use rights, increasing their unequal access to water for productive uses (Mul et al., 2011). During the in-depth focus group discussions, one of the small-scale farmers indicated that government officials who are supposed to assist farmers with the licensing processes are not adequately responsive. Since the

small-scale farmers did not establish a Water Users Association, they tried to make water lines individually, which failed.

4.6 Potential Agricultural Areas

During data collection, the Department of Agriculture identified five areas with agricultural potential. An area along the Limpopo River, followed by an area along the Sand River west of Mopane, then the Nwanedi farms, which is the small section in the municipal area, an area along the Nzhelele River (Nzhelele irrigation area), and lastly an area along the Nwanedi River which is the state land leased by small scale farmers in the Nwanedi area. It has been found that out of the five areas identified, water shortage exists in the catchment areas covering Nwanedi and Luphephe dams due to insufficient rains and over-allocation of water resources.

On the 20th of March 2020, the Acting Director General of the Department of Water and Sanitation released circular number 359 delegating the authority in terms of item 6 (1) of Schedule 3 to the Act, limit the taking of water from various catchment areas including Nwanedi and Luphephe dams, and any other source of abstraction within the catchment areas of the systems and the dams by all users. Table 5 shows the restrictions for the dams in the Vhembe water operational region, including the water restriction for Nwanedi and Luphephe dams.

Table 5: Water Restrictions for Dams in the Vhembe Water Operational Region

Number	Dam/Source	Restriction %	
		Domestic/Industrial	Irrigation
1	Mutshedzi	35	-
2	Nzhelele	-	10
3	Nwanedi	-	45
4	Luphephe	-	35
5	Albasini	20	35

Source: Field Work

Out of the five dams in which the restriction has been made by the Acting Director General of the Department of Water and Sanitation, the water restriction for the Nwanedi dam is higher by 45% compared to the other water sources. The remaining 55% of the water available was not equitably shared amongst the users, and in this case, the water users referred to are small-scale farmers in the Nwanedi area. Nwanedi River remains the primary water source for all the farmers on Nwanedi small-

scale farms—seventeen small-scale farmers abstract water for irrigation from the Nwanedi River. Figure 13 below depicts the types of irrigation applied in small-scale farms.

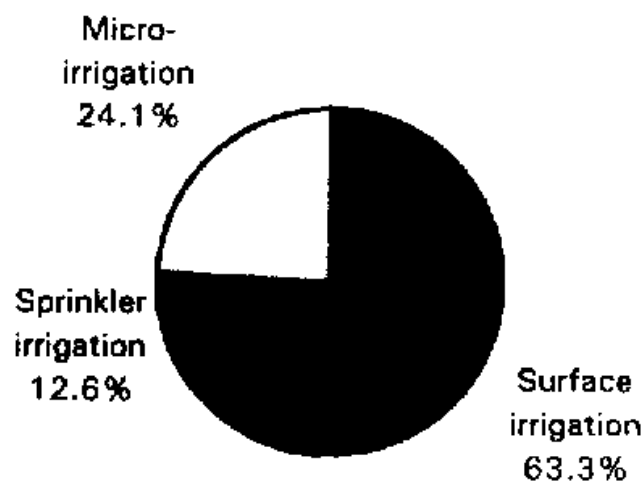


Figure 13: Types of irrigation applied in the small-scale farms. Source (Research Gate)

The small-scale farmers have formed the Nwanedi Masisi Farmers Primary Co-operative. Out of these seventeen small-scale farmers, five of them had focus group discussions. Nwanedi Masisi Farmers Primary Co-operative Limited is a Close Company business incorporated in Musina Local Municipality on June 11, 2009. The major crops the small-scale farmers in the Nwanedi area produce are cabbage, legumes, green beans, okra, butternuts, watermelons, green peppers, and tomatoes. All these products are marketed within and outside the Nwanedi area and to those who walk in to buy directly from the farms. Small-scale farmers in the Nwanedi area are the main drivers of rural economic growth and remain an important sector in their area's economy.

4.6.1 Focus Group Discussion Findings

During the in-depth focus group discussions, it was found that small-scale farmers are unhappy with the water allocation scales managed centrally by the cooperative. Their main concern about the centrally managed scales is that they have minimum decision-making powers. The participants expressed that:

“We are not supported by the cooperative on water provisioning to our scales. Some of us do not have water rights, and we expect to be helped by them to get them. We are also not allowed to make our own choices when choosing the

type of crops we want. Instead, they make decisions for us without considering our opinions.”

During the discussions, it was stated that drought influences the imbalances in water cycles, whereby high evaporation reduces the volume of water from the river. Water reduction during drought contributes to water insecurity in the area, threatening water allocation to small-scale farmers. Drought remains a significant disaster that severely affects water resources compared to climate-related natural disasters.

“Commercial farmers have proper water infrastructure such as dams, canals, and water boreholes to be used during drought periods,” said one of the participants.

Small-scale farmers further stated that the water flow capacity is insufficient to meet the daily water consumption requirements for the farms, so supplementary storage is essential to argue the supply. One of the Small-scale farmers was quoted saying:

“Commercial farmers have water storage dams on their farms to store water that will be used during the drought periods, unlike us who do not have water infrastructure facilities to conserve water for our crops during drought.”

Rural societies and economies alike benefit from prosperous and productive small farms. This creates jobs and wealth for their communities, reduces pressure on young people to migrate, and contributes to more stable and peaceful societies. When small-scale farmers earn more, they inject their incomes directly into the rural economy, creating growth and diversification. Small-scale farmers expressed concerns about being denied a say in marketing their crops. They said they need to get their goods to market and to earn decent incomes from selling them. That means investing in storage and transport infrastructure to reduce waste and enable market access is critical. The participants in the in-depth focus group stated that:

“Firstly, we need to make markets work for us. This would help create opportunities for selling our products to people in large towns and cities and create new income-earning opportunities. Our First Grades will be taken to the commercial markets, and then Second Grades will be taken to the local business markets for selling to the local communities in the villages”.

Small Scale Farmers indicated they do not have enough water sources, such as boreholes, except the Nwanedi River, which will be used during drought. It has been found that some of the small-scale farmers have one borehole, whereas others have nothing at all, as some boreholes have been delimited due to poor maintenance, and others have dried up. During the field visit, it was found that only one borehole was in operation but produced a very low volume of water. The poor condition of the boreholes needs proper maintenance or a complete replacement, which has cost implications.

During the discussions, most irrigation infrastructure was reported to perform below expectations. Insufficient maintenance of water infrastructure reduces water flow capacity and consequently increases water insecurity.

Irrigation infrastructure managed well and maintained can control the water supply to enhance water security. In Irrigation schemes, payments for water from water users are usually used for operation and maintenance activities to improve the performance of the irrigation infrastructure and increase access to water. The inability of farmers within the Nwanedi Irrigation scheme to pay for water contributes to the limited funds for the operation and maintenance of irrigation infrastructure. The in-depth focus group mentioned that:

“We are not producing enough crop products to be taken to the local markets due to low production caused by the limited amount of water available for irrigating crops. That means we do not manage to pay for water use fees to operate and maintain the irrigation infrastructure.”

Another concern raised during the discussion was small-scale farmers' sharing of water sources, which affects their irrigation schedules regarding flexibility. The sharing of water sources is not well aligned with the control, operation, and maintenance of infrastructures. During drought, irrigation often acts as a mitigation measure to enable farmers to boost their agricultural production. Not having access to available water is one of the significant factors limiting agricultural production. Some small-scale farmers have observed that they do not have reliable irrigation equipment. Some small-scale farmers indicated using small water pumps to abstract water from the Nwanedi River to their irrigation scales, producing a very low water volume. The focus group discussions expressed that:

“There are not enough water sources to supplement us during droughts except water from the Nwanedi River, which also does not have enough water; only a few farmers have boreholes. The government should subsidize the small-scale farmers”.

It was found that some small-scale farmers do not have water licenses due to several challenges. The major challenge is the poor responsiveness of the relevant institutions in assisting them in obtaining water permits. Another reason is that they do not know how to get underground or borehole water permits.

“Government officials who are supposed to assist us with the licensing they are not assisting.” “We do not know how to make applications for water licenses for our scales. The support from the cooperative will be much appreciated to assist us on how to apply for the water license”.

Some farmers mentioned that they had been assisted in making the applications for water licenses but stated that,

“It takes a long time to be granted those water permits.”

Redistribution of formal water use rights should be done through a compulsory licensing process as one instrument to address water allocation inequalities. The National Water Act encourages small-scale farmers to join WUAs, hoping to promote their participation in water resource management and enhance their access to water.

The participants said, *“We need to participate in the meetings about water allocation in the WUAs.”*

Small-scale farmers' involvement in WUA organizations can help them participate in water management training that the government and other initiatives might coordinate. In WUAs, commercial farmers are usually more numerous than smallholder farmers, giving them more water rights because they have more voice in decision-making processes concerning water access. However, small-scale farmers must be encouraged to participate in these.

4.7 Agri-Food Value Chain by Small-Scale Farmers in Nwanedi

Small-scale farmers contribute to the local economic development of the Nwanedi area. The demand for high-value agricultural products is high, particularly outside the Nwanedi area. However, small-scale farmers have been forced to reduce their production by 50% due to insufficient water. Due to water shortages, small-scale farmers struggle to participate fully in commercial food systems. To supply their products to fresh produce markets and wholesales, small-scale farmers must follow specific criteria, such as complying with quality assurance processes. Nevertheless, the small-scale farmers in the Nwanedi area have some market power since they have established the Nwanedi Masisi Farmers Primary Co-operative.

For small-scale farmers to be incorporated within the value chain, they must be able to comply with specific market requirements, such as good quality of their products, which is linked to getting enough water through irrigation of their crops. The value chain approach can help small-scale farmers access secure and high-value markets. Nwanedi small-scale farmers are in rural areas where there is limited growth in terms of economic development. According to Armitage, 1999, the new Water Act provides the framework for water markets in the country. Water available for small-scale farmers is limited, and good management practices are essential to make the most available water. Small-scale irrigation plays a significant role in food security and poverty alleviation in the Nwanedi community.

Nwanedi Agricultural Development, now called Nwanedi Agricultural Agri-Park Development, has been developed within the Nwanedi village and is meant to unlock market opportunities for all small-scale farmers. The development initiated has attracted R58 million over three years from the Job Fund and R7.6 million from

the Department of Trade and Industry. Employment opportunities have increased from 03 to 09 permanent employees per farmer. This (Nwanedi) project has already created more than 562 job opportunities during the installation of irrigation systems and 187 during production. The Limpopo province has also established an agricultural programme called *Fetsa-Tlala*, which is meant to improve the livelihood and income of rural communities.

The Agri BEE Fund was conceptualized as a support intervention to enable the participation of African-owned businesses, previously excluded from mainstream economic activities. The objectives of the Fund are to promote the agro-processing of black people in the entire agriculture activities through the provision of funding for equity in economically and financially viable sector entities and enterprise development (value addition and agro-processing) to the people who were previously marginalized to participate in the economy thus, ensuring an increase in the number of black people who own, manage and control sustainable enterprises in the sector.

4.8 Chapter Summary

In this chapter, it has been highlighted that due to water shortages, small-scale farmers struggle to participate fully in commercial food systems. The Nwanedi River is the only source of water for small-scale farmers. Most farmers abstract water illegally from the Nwanedi River as they do not have valid licenses. It is, therefore, tough to determine the water quantity each small-scale farmer receives. By establishing WUAs, small-scale farmers may apply for a license and be granted the right to use water under specified conditions. Through the establishment of the WUAs, the remaining 55% of the water available, which was not equitably shared amongst the small-scale farmers, could be shared equitably. For small-scale farmers to access secure markets and high-value markets, they must be able to comply with specific market requirements within the value chain.

The next chapter discusses the findings in the context of other literature, policies, and studies.

CHAPTER 5: DISCUSSION OF FINDINGS

5.1 Introduction

Water rights in South Africa were subject to successive water legislations rooted in the Roman, Dutch, and English laws (Thompson et al., 2001). South Africa's past water legislation had been primarily oriented towards irrigated commercial agriculture without involving small-scale farmers particularly in rural areas (Geldenhuys, 1998). The new government has undertaken to reduce rural poverty, adopt new water legislation, and improve service delivery in rural areas (Gregersen, 2000; Kirsten et al., 2000). Water is the most valuable agricultural input, and its allocation to different farm activities must be efficient and guided by economic considerations.

The concept of small-scale agriculture in South Africa is laden with subjectivity and has been associated with non-productive and non-commercially viable agriculture. In recent years, some effort has been made to find a socio-economically accurate and relevant definition of a small-scale farmer. An appropriate definition would then enable the Government to make small-scale farmers the target of various support measures that would improve their access to resources, thus redressing the inequities created by past apartheid related policies. The problem with a common definition is that small-scale farmers are not a homogeneous group, and several of them cannot be defined as small-scale, regardless of whether 'small' refers to land size, income, or labour utilization.

5.2 Nwanedi Small-Scale Farmers Water Policy

A comparison between policy guidelines and water allocations in practice is presented. Agriculture in the Nwanedi area has a significant role in building a strong economy and reducing inequalities by increasing incomes and employment opportunities for people experiencing poverty. The main aim of the NWA was to establish a CMA in all the Water Management Areas of operation in South Africa. Establishing a CMA was to delegate water resource management to the catchment level and involve local communities in that exercise. According to its catchment management strategy, the CMA manages water resources within its defined water management area.

South African water governance is mainly driven by the constitution and water-related legislation, such as the National Water Act (NWA; Act 36 of 1998). The Department of Water and Sanitation (DWS) is responsible for bulk water supply, monitoring, and control (rights and licensing), while the Water Services Institutions (WSI) are responsible for end-user water supply (installations, metering, and billing). According to the figure 14 below, the Act defines water management institutions such as Catchment Management Agencies (CMA) and Water Users' Associations (WUAs)

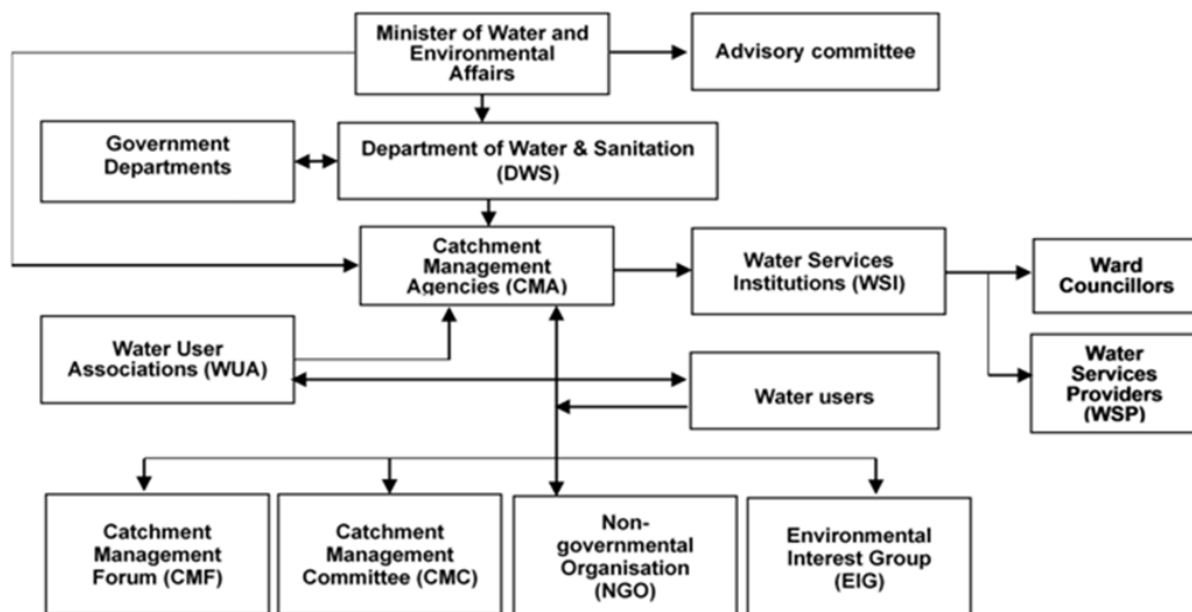


Figure 14: Water Management Institutions in South Africa. Source (adapted from Kapfudzaruwa & Sowman (2009).

Within the CMA are Catchment Management Committees and Catchment Management Forums that promote community participation within a water management area. WUAs are groups of water users who wish to work together for a common interest. Under the National Water Act (Act 36 of 1998), only WUAs may apply for a license and be granted the right to use water under specified conditions. According to Swatuk, (2010), WUAs enable individual water users who want to undertake water-related activities for their benefit to form cooperative associations.

On June 11, 2009, the small-scale farmers in the Nwanedi established the Nwanedi Masisi Farmers Primary Co-operative. The cooperative focuses more on local economic development based on the products produced on small-scale farms. It provides limited support for small-scale farmers on the water rights application since no WUA is established in the Nwanedi area to assist. According to Thompson, (2006) the South African constitution grants a right of access to sufficient water for domestic uses and excludes water for other uses. This means that small-scale farmers cannot compel the government to provide enough water for their crops except for domestic needs during disasters like drought, whereby small-scale farmers abstract water for irrigation directly from the Nwanedi River without water rights or permits.

5.2.1 Strengthen inter-governmental departmental coordination for the application of water licenses

The Department of Water and Sanitation is responsible for allocating or sharing of water, but the Position Paper on Water Allocation Reform states that stakeholders must participate. There must be ongoing communication and consultation with water

users, new users, and other stakeholders in the sector. The Department of Agriculture, Water and Sanitation, Land Reform, and Rural Development Department must work jointly to ensure the water licensing process is coordinated well, transparent, and operates accordingly.

Compulsory Licensing allows stakeholders to make their voices heard about how raw water is allocated in their area. Water users should become involved by joining or forming a Water Users Association (WUA) or working directly with the DWS or the CMA to decide how the water should be allocated. Water users can also form partnerships to make productive use of water. There is a need for land and water reform programmes to be aligned so that small-scale farmers can ensure access to productive water before the occupation of the land or very soon after that to ensure that meaningful agricultural production is not delayed.

5.2.2 Resolving the inequities of water allocations embedded in the National Water Act

The issue of water allocation and ownership in South Africa is challenging. The main problem that makes this issue challenging is the Water Act of 1998, which still contains the clauses (sections 32 to 35) that were based on riparian rights of the 1912 Irrigation Act and those formalized in the 1956 Water Act. The National Water Act protects water rights that were issued under the apartheid system, even though white commercial farmers mostly owned these old water rights. In addition, these old water rights account for most of the available water for irrigation. Therefore, the solution could be found in new legislation that is well-informed by the scope and depth of deprivation inherent in current national legislation.

The National Water Act says that DWS or the CMA must authorize or give permission for all the different ways water is used. DWS has already done much work to ensure that people use water lawfully in preparation for compulsory licensing. Water users nationwide have been asked to register how much water they use. Registration is the first step to determining who uses water in the catchment and how much they use it. Water permit systems have prevented equitable water access for many small-scale farmers. The water reform was developed with a strong emphasis on maintaining the water rights of economically and commercially viable people. The small scale farmers in Nwanedi do not have a, accurate means for measuring how much water they use in crop production.

5.3 Economic Growth and Development through Small-Scale Farming in Nwanedi

To contribute to economic growth and employment, the Limpopo Province has identified agriculture as one of the key strategic economic sectors that can provide labour-intensive growth as outlined in the National Development Plan (NDP). The structure of the agricultural sector and its features make it important to pursue inclusive and labour-intensive economic growth. *“The sector is no longer just about food security and rural livelihoods to address a social policy question, but a major contributor to economic growth,”* as noted by the State President in the State of Nation Address (SONA), February 2019. The government intends to expand the agriculture and agro-processing sectors by supporting key value chains and products, developing new markets, and reducing reliance on imports.

As indicated in Stats SA's fourth-quarter Quality of Life Survey 2019 (released on 11 February 2020), the unemployment rate in Limpopo has increased by 17% in the fourth quarter from the previous low of 1,1%. The agricultural sector recorded a 6,000 job increase at the national level. Limpopo's sector employment remained the same at 140,000 as in the previous quarter of 2019. Farmers were reluctant to plant at the beginning of the season as early rains did not materialise. In some areas, the drought was short-lived by heavy rains during mid-December 2019 and January 2020. Statistically, the Limpopo Province still has the highest number of households experiencing adequate food access. The province has maintained this lead for the past 5 years, owing to the effort of the province to support household food security and provide farmers with production inputs, infrastructure, and extension advice.

The Limpopo Province has the highest percentage of people involved in agriculture at 37.1% percent. To sustain this status, the Department is developing a strategy to increase agricultural production towards supporting agro-processing and Agri-parks and supporting emerging and small-scale farmers who are graduating to be commercial farmers. A Nwanedi project in the Vhembe District irrigation infrastructure and a packhouse for product value addition and processing were completed. The packhouse is Global Gap certified for the export market of the produce. The Nwanedi Development Project has contributed to creating 72 permanent and 356 short-term jobs. On average 1, 215 seasonal jobs are created during planting and harvesting seasons.

Equity in access to water and the benefits derived from water allocation reform is a key principle of the legislation. The most significant water users in Limpopo province remain white commercial farmers. Small-scale farming is a natural outgrowth of sustainable agriculture, which produces abundant food without depleting the earth's resources or polluting its environment. Determining how to allocate water supplies in small-scale farming requires the consideration of certain factors, including the source of the water and methods for obtaining it. The basic water allocation rule is to allocate

water considering water quotas while abiding by the allocation principles. Agriculture, at its core, depends on the delicate balance of resources, with water being one of the most crucial. Water management has become essential for farmers in recent years, particularly in regions prone to drought and irregular rainfall. Efficient water management is not just an environmental challenge; it is also an economic challenge. The water used for irrigation is sourced from already constrained water sources such as boreholes or rivers. To ensure high water use efficiency, well-designed irrigation systems are crucial to ensuring optimal water distribution and maximizing crop yields while conserving water resources. Factors such as soil type, crop water requirements, topography, and available water sources in the design process are considered to achieve this. This results in enhanced agricultural productivity that contributes to food security, economic development, and environmental sustainability by reducing water wastage, soil erosion, and efficient water use approaches.

Agritourism, often overlooked, is one such option. Agritourism has become a vital lifeline for many small farms struggling with cash flow. By diversifying their operations, farmers can create a more stable income with minimal capital investment and expertise required to start a small-scale agritourism business.

Running a profitable farm comes with challenges, including climate uncertainty, fluctuating market prices, and threats from pests and diseases, which can cause significant short-term disruptions. Agritourism offers a solution by providing farmers with a steady income during tough times. It requires low capital investment and minimal risk while contributing to food security. Over time, agritourism can generate profits, surpassing traditional small-scale farming, proving that farm-based tourism is valuable to agriculture. Agritourism is an accessible and profitable complement to farming.

5.4 Chapter Summary

Rural poverty and urbanization threaten South Africa's food security. According to Emeritus Professor Leon Hugo and post-graduate student Jean Hugo, agritourism offers a solution, providing small-scale farmers with an additional income stream while promoting sustainable farming and boosting local economies. Traditional farmers often lack the resources and capacity to compete with large-scale farms and farmers. Small-scale agriculture, as it stands, cannot meet these demands, nor will it be able to do so soon. Therefore, diversifying income streams is crucial to fill the gap as the agricultural sector works towards achieving viability and sustainability. Tourism is also a vital part of South Africa's economy. In 2020, one in five new jobs created was in tourism. Small-scale farming must explore alternative and supplementary income-generating activities while developing a productive regenerative farming sector. ("Agritourism: Lifeline for small-scale farmers amid rural poverty")

The research results in this chapter have shown that under the National Water Act (Act 36 of 1998), only WUAs may apply for a water license and be granted the right to use water under specified conditions. Compulsory licensing, in terms of Sections 43-48 of the NWA, is a mechanism through which all the water use authorizations in an area are reconsidered to, amongst other things, achieve a fair allocation of water from a resource that is under stress. That will be achieved by transforming small-scale farmers from subsistence to an innovative, commercially oriented, modern agricultural practice. The potential of agriculture to grow and increase its contribution to the growth of the economy and employment has been widely acknowledged. The support would enable small-scale farmers to improve their production capacity and, most importantly, their participation in the food value chain and improve market access.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

Introduction

This study aimed to determine how equitably water from the Nwanedi River is allocated among small-scale farmers and the effectiveness of the water allocation policy, as stated by the National Water Act. The study also examined the economic development of Nwanedi small-scale farmers. The study aimed to achieve this through the following three objectives:

- Is the water allocated to small-scale farmers being allocated as per the water allocation policy of the Republic of South Africa?
- What challenges do small-scale farmers face regarding water allocation?
- How do the small-scale farmers contribute to the economic development growth of the Nwanedi area?

6.1 Summary of Findings

The struggle for water in the Nwanedi irrigation scheme is a real challenge for small scale farmers. Due to water shortages, small-scale farmers struggle to participate fully in commercial food systems. The water needed for irrigating crops differs depending on the crop type and other local characteristics. Water allocation by small-scale farmers along the Nwanedi River is a vital resource for agriculture; without regulation, water can be overused by those who have first access to it, resulting in user conflicts.

The Nwanedi River is the only source of water for small-scale farmers. Most farmers abstract water illegally from the Nwanedi River as they do not have valid licenses. It is, therefore, tough to determine the water quantity each small-scale farmer receives. Successful water allocation and control by small-scale farmers along the Nwanedi River relies on the effective registration of farmers through compulsory licensing to ensure a fair balance between all the different water demands. However, this was not the case in the Nwanedi Irrigation Scheme.

By establishing WUAs, small-scale farmers may apply for a license and be granted the right to use water under specified conditions. Through the establishment of the WUAs, the remaining 55% of the water available, which was not equitably shared amongst the small-scale farmers, could be shared equitably.

For small-scale farmers to access secure markets and high-value markets, they must be able to comply with specific market requirements within the value chain. With reduced water allocations small scale farmers struggle to access markets despite the assistance of the Nwanedi development project.

6.1.1 Water allocations challenges and consequences

The catchment is in a water deficit state due to overdevelopment of the irrigation sector in the area. Insufficient rains and the over-allocation of water resources to other competing sectors have caused a water shortage in the catchment areas covering Nwanedi and Luphephe dams. The inequity in water allocation has created an imbalance amongst small-scale farmers in the Nwanedi area, leading to poor performance in the local economy. Water allocation has not been managed with sustainability, efficiency, and equity.

Small-scale farmers depend only on the water from the Nwanedi River for irrigation. Some farmers have installed water pressure pumps in the river and abstract the water directly to their irrigation scales without storage. Due to a lack of monitoring or accurate withdrawal data, over abstraction of water can cause issues with the river flow and water availability in the river for others. Small-scale farmers do not have boreholes to supplement the river's water; they only have water from the Nwanedi River and the water received during rainfall.

Small-scale farmers are increasingly suffering from water shortages for their crops due to either the lack of water permits and or poor rainfall patterns. Poor water infrastructure, such as irrigation systems and water storage facilities, minimizes the potential for vegetable/ crop production and maximizes post-harvest losses. Climate change is likely to further decrease rainfall patterns in this area, increasing the likelihood of prolonged droughts.

Small-scale farmers' non-participation in water management activities such as WUAs prevents their inputs from being considered in water-related decision-making solutions. The lack of comprehensive policies and inadequate government support tailored to the specific needs of small-scale farmers deprive them of development.

6.1.2 Nwanedi Small-Scale Farmers are not Allocated Water According to the Republic of South Africa's Water Allocation Policy

Currently, the allocation of water to small scale farmers is being impacted by the failure of government policy and associated institutional arrangements. On the institutional front, the Act provides for; the establishment of Catchment Management Agencies (CMAs); the transformation of existing irrigation boards into water user associations, and the possible establishment of an agency to manage the national water resources infrastructure. Neither of the first two processes has been completed.; only two out of the proposed nine Catchment Management Agencies have been established since 1998, and the transformation of irrigation boards has been slow. Leadership challenges at the ministerial and director-general levels have compounded the department's inability to implement the new legislation.

The National Water Act (Act 36 of 1998) urges rural communities and small-scale irrigation farmers to form WUAs. According to the NWA, WUAs are permitted to apply for a license and be granted the right to use water. Individually, at the household level, rural people are automatically granted a free and unregistered right to “reasonably” use water for irrigation. Schedule 1 of the National Water Act allows people to use river water for gardens or household animals. It also covers small-scale, non-commercial water use for food or household security.

The research found that no Water User Association was formed in the Nwanedi Catchment Management Area (NCMA). However, small-scale farmers have formed a cooperative association called Nwanedi Masisi Farmers Primary Co-operative. The cooperative prioritised local economic growth by taking the products produced to markets. The co-operative however cannot apply for water right as the Water Allocation Policy does not permit them to apply for water licenses.

6.1.3 The Small-Scale Farmers Contribute to the Economic Development Growth of the Nwanedi Area

Due to water shortages, Nwanedi small-scale farmers provide limited economic development in the Nwanedi area. They struggle to participate fully in commercial food systems due to limited water. The small-scale farmers have formed the Nwanedi Masisi Farmers Primary Co-operative. The co-operative assists the small-scale farmers with their products, marketing them within and outside the Nwanedi area and to those who walk in to buy directly from the farms. Due to drought conditions, the Nwanedi irrigation area has been forced to reduce production by 50% because there is insufficient water. There is a high demand for high-value agricultural products, particularly outside the Nwanedi area, while small-scale farmers are forced to reduce their production by 50%.

Nwanedi Agricultural Development, now called Nwanedi Agricultural Agri-Park Development, has been developed within the Nwanedi village and is meant to unlock market opportunities for all small-scale farmers. The development has created an agricultural economic sector and employment opportunities within the local communities. Employment opportunities have increased from 03 to 09 permanent employees per farmer through the Nwanedi project that the Nwanedi Agricultural Agri-Park Development has implemented to install the irrigation systems.

The Nwanedi Irrigation Scheme is included in the established agricultural programme called *Fetsa-Tlala*, which is meant to improve the livelihood and income of rural communities. The Agri BEE Fund was conceptualized as a support intervention to enable the participation of African-owned businesses previously excluded from mainstream economic activities. The objectives of the Fund are to promote the agro-processing of black people in all agriculture activities by providing funding for equity in

economics. For small-scale farmers to be incorporated within the value chain, they must be able to comply with specific market requirements, such as good quality of their products, which is not achieved due to the limited water available for irrigation.

6.2 Recommendations

Findings from this study indicate that water is not allocated equitably amongst the small-scale farmers along the Nwanedi River, which affects their production. Recommendations are provided to assist equitable water allocation for small-scale farm production.

Department of Water and Sanitation

As the custodian of all water resources, the Department of Water and Sanitation must emphasize the beneficial use of water in the best interests of all South Africans. The department should ensure that water is available from the small-scale farmers per schedule 1 of the National Water Act 36 of 1998 to the biggest and most wealthy industrial and commercial agricultural users. Water needs to be available in a manner that will be sustainable and help the economy of its beneficiaries grow. This must be done in the Nwanedi Catchment Management Area, where the Nwanedi River is already in deficit due to the overdevelopment of agricultural activities and its environmental needs that have been abandoned.

Water resources management has often been challenging to manage and implement per the National Water Act. The involvement of the relevant stakeholders in managing water resources is key to the water allocation process. That can be achieved through sound and appropriate technical, economic, and environmental approaches. For water to be allocated equitably to small-scale farmers, the Department of Water and Sanitation must enforce compulsory licensing so that small-scale farmers have a deeper insight into the details and participate more fully in the consultations and discussion processes.

Small-scale farmers will need strong support to use the water allocated to them productively. That support will require the Department of Water and Sanitation to involve the government and private sectors, such as local government, NGOs, development agencies, etc., to assist small-scale farmers in getting water for productive use. With the support of DWS and other institutions, small-scale farmers in the Nwanedi Irrigation Scheme must be encouraged to establish the Water Users Association to apply for water licenses since the WUAs have been authorized by the National Water Act to apply for water licenses. Once small-scale farmers have water licenses or water permits, poverty levels could be reduced and there could be an increasing in food security as the allocated water will be of productive use.

The primary intention of the National Water Act is to devolve decision-making on managing water resources to the lowest practicable level. The Department of Water and Sanitation (DWS) currently has the primary responsibility of water allocation and, as such, should include socio-economic, cooperative governance, and stakeholder participation processes as part of the compulsory licensing process. Mechanisms to facilitate licensing evaluation procedures and to speed up the time it takes to authorize water use should be determined. The extent of the stress will consider the prioritization for mandatory licensing, the number of outstanding applications, and the extent of inequitable allocations in the catchment. The system must monitor more than just the inequities in water allocations; it also outlines progress toward beneficial use in small-scale farming.

Economically efficient allocation will increase the value of water across all sectors. Efficient allocation will also occur in a competitive, freely functioning market when supply is in equilibrium with demand. Although economic efficiency is crucial, decision-makers must consider additional financial issues. Focusing first on the equity implications of an allocation, costs and benefits are usually specified using values representative of society.

The reasons why water has no price are often related to the historical, socio-cultural, and institutional context in which water is used and managed. The worthy cause of this economically inefficient water use is the failure of institutions involved with the allocation and management of water. Compulsory licensing will be implemented through awareness and capacity-building programs targeting the economic water value chain. Awareness programmes should highlight the license evaluation process.

Department of Land Reform and Rural Development

The land reform programme currently being implemented, especially the land tenure component, is not evolving as quickly as the water rights reform (Van Zyl et al., 1996; Lahiff, 1999; Kirsten et al., 2000). The Nwanedi Irrigation Scheme forms part of the former Venda homeland. It is communal land, and small-scale farmers are provided irrigation land through the Permission to Occupy system (PTO) by the traditional authority. The PTO system has gradually shifted from an actual land entitlement to a convention, as allocation records in most rural areas are no longer kept. Nwanedi small-scale farmers do not exactly know what their current land rights are. At the same time, water rights are based on a convention by being replaced as an entitlement (licensing). The land rights transactions in casual rental, lease, or sale remain highly dependent on the water rights attached to that land. Based on the above statement,

emerging commercial farmers such as Nwanedi small-scale farmers are encouraged to take over both rights from subsistence farmers.

The government has undertaken to reduce rural poverty and has adopted a land reform programme in line with new water legislation. The riparian rights system resulted in commercial white land-owning farmers having unconstrained water access, partly due to a tenuous distinction between private and public water and streams (Hamann & O'Riordan, 2000). Despite certain legal restrictions in the new water legislation, the riparian owner could take as much water as needed. In commercial agriculture, the irrigation boards that administrate water allocation are generally heavily biased towards the needs of farmers. A report by the International Programme for Technology and Research in Irrigation and Drainage (2000) considers that small-scale irrigation usages are to be classified under Schedule 1. The report states that the Nwanedi small-scale farmers are encouraged to be classified under Schedule 1.

The Nwanedi Masisi Farmers Primary Co-operative

The study has shown that Nwanedi small-scale farmers play an important role by providing stable food in their surrounding area. They improve rural income for most households, but their contribution to household income is poorly administered. These farms contribute to the economy, food security, and minimizing poverty by using irrigation water not easily accessible by small-scale farmers. The establishment of Water User Associations will assist in unlocking most of the challenges faced by the Nwanedi small-scale farmers, not only in the application of water licensing but also in providing support in financial management.

Small-scale farmers struggle financially to have sustainable water infrastructures such as boreholes to supplement the water from the Nwanedi River and storage dams to store water for usage during drought seasons. The Nwanedi Masisi Farmers Primary Co-operative and other relevant stakeholders are urged to develop proposals to request funding for the procurement of water infrastructures. Due to drought conditions, the Nwanedi irrigation area has been forced to reduce production by 50% because of insufficient water, and the study shows that growth cannot be achieved without increasing productivity. Therefore, Water conservation and demand management must be conducted through rain harvesting and irrigation systems that conserve water.

The poor quantity and quality of crops produced threaten small-scale farmers' ability to sell in large markets; quality remains the driving force in accessing high markets. The government can assist small-scale farmers in achieving these through subsidies and grants by providing them with resources such as seeds, fertilizers, water storage equipment, irrigation equipment, etc., and marketing strategies to small-scale farmers.

With supporting small-scale farmers, employment opportunities will be created more in the Nwanedi area and its surroundings.

Other stakeholders

Capacity-building interventions that enable small-scale farmers to gain the knowledge they need to run the farms efficiently and productively must be prioritized. Small-scale farmers need capabilities in all key aspects of farming, including the ability to apply for funding. The government also needs to ease requirements for small-scale farmers to access enough capital to invest in the water and energy infrastructure required for irrigation systems. Subsidies on their electricity tariffs could partly alleviate their situation.

It could also be helpful to small scale farmers to explore possibilities of providing alternative and cost-effective power sources such as off-grid solar and wind energy supply systems. For instance, solar-based irrigation pumps are already being used in other parts of the world with a reasonable degree of success, and there is no reason why small-scale farmers along the Nwanedi River should not explore this option. Similarly, enabling small-scale farmers to augment their water supplies through rainwater harvesting approaches is also a viable option.

6.3 Conclusion

Findings from this study indicate that water is not allocated equitably amongst the small-scale farmers along the Nwanedi River, which affects their production. The main challenges faced by small-scale farmers are the imbalance in water allocation, poor agricultural infrastructures such as irrigation equipment, and climatic variability.

The Position Paper on Water Allocation Reform outlines principles for allocating water and more apparent objectives for distributing water in any catchment. Compulsory Licensing is a mechanism created in the National Water Act to allow DWS to review all water use in a catchment and to reallocate water. Every license has conditions that state how long it is valid and how best to use the water allocated. The following are recommendations for different and relevant institutions to assist equitably water allocation for small-scale farm production. Based on the findings obtained from this study, it is recommended that small-scale farmers participate in WUAs so that they can be assisted and supported in getting water licenses to abstract water from the Nwanedi River for their farms. As part of the support and assistance the DWS should provide an induction to small-scale farmers about water permit applications. Enforcement and monitoring of the conditions tied to the water permit should also be implemented for long term water security in the Nwanedi Irrigation Scheme.

REFERENCES

Adom, R.K. and Simatele, M.D., (2022). The role of stakeholder engagement in sustainable water resource management in South Africa. In *Natural Resources Forum* (Vol. 46, No. 4, pp. 410-427). Oxford, UK: Blackwell Publishing Ltd.

Aeinzen-Dick, R and Mendoza, M. (1996). *Alternative Water Allocation Mechanisms: Indian and International Experiences*. Economic and Political Weekly: A Sameeksha Trust publ. - Mumbai, ISSN 0012-9976, ZDB-ID 8626583. - Vol. 31., 13, p. A25

Annandale, JG, Stirzaker, RJ, Singels, A, Van Der Laan, M and Laker, MC. (2011) Irrigation scheduling research: South African experiences and prospects. *Water SA* Vol. 37 No. 5 WRC 40-Year Celebration Special Edition.

Ariabod, A., Moghaddasi, R., Zeraatkish, Y. and Nejad, A.M., (2019). Governance and agricultural growth: Evidence from selected developing countries. *Economic Journal of Emerging Markets*, pp.73-80.

Armitage, R.M., (1999). *An economic analysis of surface irrigation water rights transfers in selected areas of South Africa*. Water Research Commission.

Babbie, E. and Mouton, J. (2001). *The Practice of Social Research*. South Africa Oxford University Press, Cape Town.

Backeberg, G.R., Bembridge, T.J., Bennie, A.T.P., Groenewald, J.A., Hammes, P.S., Pullen, R.A. and Thompson, H. (1996). *Policy proposal for irrigated agriculture in South Africa*. Water Research Commission Report No. KV96/96, Pretoria.

Barnes, J.M., (2003). *The impact of water pollution from formal and informal urban developments along the Plankenbrug River on water quality and health risk/JM Barnes* (Doctoral dissertation, Stellenbosch: Stellenbosch University).

Basson GR (2006). *Considerations for the Design of River Abstraction Works in South Africa*. Water Research Commission Report. WRC Report No. TT 260/06., Pretoria.

Bernauer, T., (2002). Explaining success and failure in international river management. *Aquatic Sciences*, 64, pp.1-19. VL 64. DOI - [10.1007/s00027-002-8050-4](https://doi.org/10.1007/s00027-002-8050-4)

Bjornlund H, Van Rooyen A and Stirzaker R (2016). Profitability and productivity barriers and opportunities in small-scale irrigation schemes. *International Journal of Water Resources Development* 33(5) 690-704.

Boland, A.M. and Toulmin, M., (2010). *Integrated water management in the Port Phillip and Western Port (PPW) region*. RM Consulting Group, Camberwell, Victoria, Australia.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approach* (3rd ed.). Sage Publications, Inc.

Chikozho, C., Managa, R. and Dabata, T., (2020). Ensuring access to water for food production by emerging farmers in South Africa: What are the missing ingredients?. *Water SA*, 46(2), pp.225-233. DO - 10.17159//wsa/2020.v46.i2.8237.

Denison, J. and Manona, S. (2007). *Principles, Approaches, and Guidelines for Participatory Revitalizing Smallholder Irrigation Schemes*. The Water Research Commission. WRC Report No. TT 309/07. Pretoria:

Department of Agriculture (2004). Broad-Based Black Economic Empowerment Framework for Agriculture (Agri-BE) Available from <http://bee.sabinet.co.za/charters/agribee.pdf>.

Department of Agriculture, Forestry and Fisheries (2015) *Irrigation Strategy for South Africa*. Department of Agriculture, Forestry and Fisheries, Pretoria.

Development Bank of South Africa. (2011). *Seeding change: A proposal for renewal in the South African food system*. Development Planning Division Working Paper Series No. 16, DBSA Midrand.

Dresser, R., (2016). *Silent partners: human subjects and research ethics*. Oxford University Press.

Du Plooy-Cilliers, F., Davis, C. and Bezuidenhout. (2014). *Research Matters*. Juta press, South Africa.

DWA (1999). *Water-Use Licensing: The Policy and Procedure for Licensing Stream Flow Reduction Activities*. Final Draft. DWA, Pretoria.

DWA (2004). *The National Water Resources Strategy*. DWA, Pretoria.

DWAF (2005). *Framework for the water allocation reform in South Africa. Planning document*, DWAF. January 2025. Pretoria.

DWA (2005). *A Draft Position Paper for Water Allocation Reform in South Africa: Towards A Framework for Water Allocation Planning* (Discussion Document). DWA, Pretoria.

DWA (Undated). *Small Scale Farmer Development in the Context of Water Reform*. Available from <http://www.DWA.gov.za/WAR/documents/WARSmallFarmers.pdf>.

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

Gregersen, H.M., Ffolliott, P.F. and Brooks, K.N., (2007). *Integrated watershed management: Connecting people to their land and water*. CABI.

Hamann, R., Booth, L. and O'Riordan, T., (2000). South African environmental policy on the move. *South African Geographical Journal*, 82(2), pp.11-22.

Hussain, I. and Hanjra, M.A. (2004). Irrigation and poverty alleviation: a review of the empirical evidence. *Irrigation and Drainage*, 53(1): 1-15.

Intergovernmental Panel on Climate Change (IPCC) (2014). *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects*. Cambridge University Press, Cambridge.

Jacobs, J.M. and Vogel, R.M., (2000). Closure to “Optimal Allocation of Water Withdrawals in River Basin”. *Journal of Water Resources Planning and Management*, 126(1), pp.38-38.

Jagannathan, NV, Subramanian, A, Meinzen-Dick, R (1997). *User organizations for sustainable water services*. World Bank technical paper. Vol. 354. ISBN: 0821338552

Kairu, E., and Mwangi, S. (2003). *A Review of the Performance of Irrigation Schemes in Kenya: Lessons for Future Development*. Paper presented at the Kenya Agricultural Economics Society Annual Conference, 22-24 September 2003, Nairobi, Kenya.

Kamara, A., Conteh, A., Rhodes, E.R. and Cooke, R.A., (2019). The relevance of smallholder farming to African agricultural growth and development. *African Journal of Food, Agriculture, Nutrition and Development*, 19(1), pp.14043-14065.

Kirsten, J.F. and Van Zyl, J., (1998). Defining small-scale farmers in the South African context. *Agrekon*, 37(4), pp.551-562.

Kraal, M.J., and Smith, G.W. (2010). Community-Based Approaches for Water Allocation in South Africa. *Journal of Water Resource and Protection*, 2(5), 355-368.

Letsoalo, S.S. and Van Averbek, W., (2013). *Water management on a smallholder canal irrigation scheme in South Africa*. In *Water Governance for Sustainable Development* (pp. 117-134). Routledge.

Magingxa, LL and Kamara, AB (2003). Contributed Paper Presented at the 41st Annual Conference of the Agricultural Economic Association of South Africa (AEASA), October 2-3, 2003, Pretoria, South Africa.

Managa, Lavhelesani and Chikozho, Claudious. (2023). *Ensuring Access to Water for Emerging Small-Scale Farmers in South Africa: A Water Reform Policy Perspective*. HSRC Press.

Meinzen-Dick, R. and Mendoza, M., (1996). *Alternative water allocation mechanisms: Indian and international experiences*. Economic and Political Weekly, pp.A25-A30.

Mnyaka, Sinazo. (2018). *Assessment of the contributions of water allocation reforms to achieving equitable access to water by smallholder emerging farmers in the Breede-Gouritz catchment management agency*. Environmental Science, Agricultural and Food Sciences.

Morse JM. (1991). Evaluating Qualitative Research. Qualitative Health Research.;1(3):283-286. doi:10.1177/104973239100100301.

Mul, M.L., Kemerink, J.S., Vyagusa, N.F., Mshana, M.G., Van der Zaag, P. and Makurira, H. (2011). Water allocation practices among smallholder farmers in the South Pare Mountains, Tanzania: The scale issue. *Agricultural water management*, 98(11), pp.1752-1760.

National Water Act, 1998 ACT 10 provides for fundamental reform of the law relating to water resources, repealing specific laws and providing for related matters.

NWANEDI MASISI FARMERS PRIMARY CO-OPERATIVE LIMITED is a Close Company business incorporated in South Africa on June 11, 2009.

Oelofse, A. and Van Averbek, W. eds., (2012). *Nutritional value and water use of African leafy vegetables for improved livelihoods*. Pretoria, South Africa: Water Research Commission.

Ostrom, E., (1990). *Governing the commons: The evolution of institutions for collective action*. Cambridge university press.

Pegram Guy, Li Yuanyuan, Le Quesne Tom, Speed Robert, Li Jianqiang, Shen Fuxin. (2013). *River basin planning*. Book: ISBN 9789230011529.

Phakula, S., Landman, W.A., Engelbrecht, C.J. and Makgoale, T., (2020). Forecast skill of minimum and maximum temperatures on sub seasonal-to-seasonal timescales over South Africa. *Earth and Space Science*, 7(2), p.e2019EA000697.

Rawlins, J., (2019). Political economy of water reallocation in South Africa: Insights from the Western Cape water crisis. *Water Security*, 6, p.100029. DOI: [10.1016/j.wasec.2019.100029](https://doi.org/10.1016/j.wasec.2019.100029)

Roa-García, M.C. (2014). Equity, efficiency, and sustainability in water allocation in the Andes: Trade-offs in a full world. *Water Alternatives* 7(2): 298-319.

Roa-García, M. C. and Brown, S. (2015). 'Assessing equity and sustainability of water allocation in Colombia', *Local Environment*, 22(9), pp. 1080–1104, DOI: [10.1080/13549839.2015.1070816](https://doi.org/10.1080/13549839.2015.1070816).

Seetal A.R. (2005). *Progress With Water Allocation Reform in South Africa*. Paper Presented at the OECD Workshop on Agriculture and Water: Sustainability, Markets, and Policies Held 14-18 November 2005: Adelaide & Barmera.

Seetal A. and Van Aswegen J. (2006). *Water Allocation Reform regarding Riparian Rights and Licensing to bring about Sustainable Livelihoods*. Presentation to the Parliamentary Portfolio Committee on Water Affairs & Forestry 23 August 2006.

Speed, R ,Yuanyuan,I, Zhiwei,Z, Le Quesne, T and, Pegram, G. (2013). *Basin Water Allocation Planning: Principles, Procedures, and Approaches for Basin Allocation Planning* (Asian Development Bank, GIWP, UNESCO, and WWF-UK)

Stats SA fourth quarter Quality of Life Survey 2019 (released on 11 February 2020).

Streefkerk, R. (2020) Qualitative vs. Quantitative Research. Scribbr. <https://www.scribbr.com/methodology/qualitative-quantitative-research/>

Streubert, H., & Carpenter, D. (1999). *Qualitative Research in Nursing: Advancing the Humanistic Perspective* (2nd ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Swatu K.L.A. (2010). The state and water resources development through the lens of history: a South African case study. *Water Alternatives* 3 (3), 521–536.

Sylvain R Perret, (2002). Water policies and smallholding irrigation schemes in South Africa: history and new institutional challenges, *Water Policy*, Volume 4, Issue 3, Pages 283-300, ISSN 1366-7017, [https://doi.org/10.1016/S1366-7017\(02\)00031-4](https://doi.org/10.1016/S1366-7017(02)00031-4).

Syme, G.J. and Nancarrow, B.E., (2006). Achieving sustainability and fairness in water reform: A Western Australian case study. *Water international*, 31(1), pp.23-30. DOI: [10.1080/02508060608691911](https://doi.org/10.1080/02508060608691911)

Thompson, H., (2006). *Water Law, a Practical Approach to Resource Management & the Provision of Services*. ISBN 10: 0702167320 / ISBN 13: 9780702167324.

van der Zaag, P. and Savenije, H.G., (2004). *Principles of integrated water resources management*. Delft, The Netherlands: Unesco-IHE.

van der Zaag, P., (2007). Asymmetry and equity in water resources management; critical institutional issues for Southern Africa. *Water Resources Management*, 21, pp.1993-2004. DOI: <https://doi.org/10.1007/s11269-006-9124-1>.

van der Zaag, P Seyam, I.M. , and. Savenije, HHG (2002). Towards measurable criteria for the equitable sharing of international water resources, *Water Policy*, Volume 4, Issue 1, Pages 19-32, ISSN 1366-7017, [https://doi.org/10.1016/S1366-7017\(02\)00003-X](https://doi.org/10.1016/S1366-7017(02)00003-X).

van Koppen, B., Mukuyu, P., Murombo, T., Jacobs-Mata, I., Molwantwa, J., Dini, J., Sawunyama, T., Schreiner, B. and Skosana, S., 2024. Principles and legal tools for equitable water resource allocation: prioritization in South Africa. *International Journal of Water Resources Development*, pp.1-23. DOI [10.1080/07900627.2023.2290522](https://doi.org/10.1080/07900627.2023.2290522)

Walker, S., Bello, Z.A., Mabhaudhi, T., Modi, A.T., Beletse, Y.G. and Zuma-Netshiukhwi, G., (2012). Calibration of AquaCrop model to predict water requirements of traditional African vegetables. In *II All Africa Horticulture Congress 1007* January (pp. 943-949).

Wang, H. and You, J., (2016). Progress of water resources allocation during the past 30 years in China. *Journal of Hydraulic Engineering*, 47(3), pp.265-271.

Warsaw, P., Archambault, S., He, A. and Miller, S., (2021). The economic, social, and environmental impacts of farmers markets: Recent evidence from the US. *Sustainability*, 13(6), p.3423.

World Bank (2023). *Resilient and Sustainable Water in Agriculture (P175747)*

Zwart, R., and Van der Laan, M. (2008). Understanding the role of community-based natural resource management: Policy implications for the water sector in South Africa. *African Journal of Water Science and Technology*, 3(1), 1-9.