

**DEVELOPMENT OF A TOOLKIT FOR
SUSTAINABLE REVITALIZATION OF
SMALLHOLDER IRRIGATION SCHEMES: FREE
STATE PROVINCE**

By

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Thesis submitted in fulfilment of the requirements for the degree
PHILOSOPHIAE DOCTOR (SUSTAINABLE AGRICULTURE)
in the
FACULTY OF NATURAL AND AGRICULTURAL SCIENCES
Centre for Sustainable Agriculture, Rural Development and Extension

University of the Free State

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July 2023

DECLARATION

I, Hendrik Frederik Grobler, declare that the dissertation hereby submitted by me for the Philosophiae Doctor in Sustainable Agriculture (PhD) degree at the University of the Free State is my own independent work and has not previously been submitted by me at another university/faculty.

[ Hendrik Frederik Grobler]

Date: 28 July 2023



“Let us elevate the soft issues to the top, the stonework will be fine.”

Hennie Grobler

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LIST OF ACRONYMS AND ABBREVIATIONS

APAP	Agricultural Policy Action Plan
ARC	Agricultural Research Council
BBBEE	Broad-Based Black Economic Empowerment
BOK	Body of Knowledge
CASP	Comprehensive Agricultural Support Programme
CPA	Community Property Association
CRDP	Comprehensive Rural Development Plan
DAFF	Department of Agriculture, Forestry and Fisheries
DALRRD	Department of Agriculture, Land Reform and Rural Development
DPME	Department of Planning, Monitoring and Evaluation
DRDLR	Department of Rural Development and Land Reform
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
DWUID	Directorate: Water Use and Irrigation Development
ECSA	Engineering Council of South Africa
EE	Empowerment Evaluation
EDD	Economic Development Department
FAO	Food and Agriculture Organization
FIDPM	Framework for Infrastructure Delivery and Procurement Management
FS-DARD	Free State Department of Agriculture and Rural Development
FLSI	Farmer-Led Smallholder Irrigation
FPSU	Farmer Production Support Unit
Ha	Hectares
HDI	Historically Disadvantaged Individual
IAE	Institute for Agricultural Engineering
ICID	International Committee on Irrigation and Drainage
IDMS	Infrastructure Delivery Management System
IMT	Irrigation Management Transfer
IRWH	In-field Rainwater Harvesting
ISSA	Irrigation Strategy for South Africa
IWMI	International Water Management Institute
LDC	Less Developed Country

MMM	Mangaung Metro Municipality
MTSF	Medium Term Strategic Framework
MUS	Multiple Use Services
NDA	National Department of Agriculture
NDP	National Development Plan
NGO	Non-Government Organization
NGP	New Growth Path
NPC	National Planning Commission
NWRS	National Water Resource Strategy
PI	Principal Investigator
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PPP	Public Private Partnership
RESIS	Revitalization of Smallholder Irrigation Schemes
SAII	South African Irrigation Institute
SANS	South African National Standards
SIP	Strategic Integrated Projects
SIS	Smallholder Irrigation Schemes
SONA	State of the Nation Address
SOPA	State of the Province Address
USA	United States of America
WRC	Water Research Commission

EXECUTIVE SUMMARY

The “complex of activities” involved in smallholder irrigation schemes has led to the collapse of three such schemes in the Free State Province. This has happened over the past two decades, although best management practise guidelines for the sustainable revitalization of smallholder irrigation schemes were available to farmers, researchers, and policymakers. The problem is that farmers are not in control of the revitalization process, meaning they are not in control of their own destiny.

The objective of this study was to find out why best management practice is not followed and then to provide a toolkit to allow smallholders to take charge of their destiny. Thereby ensuring an equal base between developers and the “to be developed”. Applied research tools found that smallholder irrigation farmers in the Free State Province possess a crop farming culture.

The study was conducted in three smallholder irrigation schemes (Sediba, Woodbride, and Feloana) in the Thaba Nchu area of the Free State province. The research methodology was a mixed-methods design. The primary research methodology applied is evaluation research. Three different types of evaluation research are described as implementation (process) evaluation, experimental and quasi-experimental and qualitative (naturalistic) research methods. Qualitative methods include empowerment evaluation methods. This study opted for the latter. Qualitative evaluation research methods were used to describe and evaluate the performance of programmes in their natural setting and focus on the process rather than the outcome. This study assessed the current process of revitalising smallholder irrigation schemes. Empowerment Evaluation (EE) uses evaluation concepts and techniques to foster improvement and self-determination. Stuart Theobald wrote that decolonising science is not that far reached. He believes shifting to decolonising science is a paradigm. This aligns with this study's paradigm; indigenous knowledge needs to be valued. This study listened to the African farmer himself. Both the qualitative and empowerment evaluation approaches are used.

The best attributes of these two approaches were explored to compile a system whereby best practice in the revitalization of smallholder irrigation is enhanced. Government and Non-Government Organisations (NGOs) are believed to overshadow the smallholder farmer as an individual, but more so as an organised commodity group. Four data collection instruments were used; these included open-ended questionnaires with industry leaders (tribal authorities,

academics, government officials, policymakers, sponsors, and NGOs) and farmers, observations (walk crop fields and satellite images) and reviewing of the knowledge base (programmes, policies and guidelines).

Statistical results of this study indicate a strong correlation between knowledge and productivity as perceived by participants. This perceived view of farmers was strengthened by previous experiences through fifteen years of research on In-field Rainwater Harvesting (IRWH) amongst the same communities. The literature review also indicated that a standardised best management practice is currently unavailable. This research study demonstrated that related professions could standardise best management practice guidelines through voluntary consensus processes.

Together with a strong mandate provided by the government to establish smallholder farmers, the proposed toolkit will create a better chance for smallholder irrigation schemes to be sustainable. A standardised best management practice toolkit will assist researchers, practitioners, policy makers, farmers, and communities in increasing productivity on smallholder irrigation schemes in the Free State Province.

The following recommendations are proposed through this research study:

- The knowledge base of smallholder irrigation farmers needs to be strengthened. This can be achieved through a combination of provision of a complete toolkit and training on the value and use of such a toolkit. It will result in a marked improvement in productivity on the smallholder irrigation schemes.
- Smallholder irrigation farmers in the Free State Province must organise themselves into a commodity group. This initiative must be spontaneous but can be supported by government. It will result in farmers owning the process of revitalization.
- RESIS should be considered a once-off event. It will align all available resources towards a focused intervention within an agreed time frame. It will increase urgency amongst all role players in the revitalization process.
- Revitalization of smallholder irrigation schemes needs to be removed from infrastructure-based professionals to developmental-orientated professions and agencies. Identified gaps in the body of knowledge (BOK) directed much attention towards soft issues. In most cases infrastructure was delivered within industry norms,

meaning that infrastructure-based professionals will augment the developmental effort lead by professionals in the developmental-orientated professions.

- The industry needs to develop a complete Best Management Practice Guideline in the form of a Toolkit. The industry includes government, NGOs, sponsors, researchers, practitioners, farmers, and a proposed commodity group representing RESIS farmers in the Free State Province and even farmers in all nine provinces in South Africa. The approach used by the international project management profession is proposed as a framework for a complete toolkit for revitalization.
- Compiling such a Best Management Practice guideline, or toolkit, requires a purposefully planned and “voluntary consensus” process. Existing organisations such as ICID, SAI, WRC, ARC or a relevant government department can facilitate and administer such an industry-based process.
- An existing BOK is proposed as an example for compiling a framework for best management practices or toolkits.
- The knowledge base and crop production methods of IRWH and RESIS be shared and integrated.
- Further research be conducted to investigate the impact of leadership quality on the decision-making powers of smallholder irrigation schemes.

Keywords: Revitalize, Sustainable, Smallholder Irrigation, Standardise

ACKNOWLEDGEMENTS

The contribution of the following organisations and people are gratefully acknowledged:

- ✓ Promotor: Prof. Johan van Niekerk
- ✓ Co-promotor: Dr. Cobus Botha
- ✓ Dr. Ismari van der Merwe
- ✓ Dr. Jan Swanepoel
- ✓ Research Instruments: Dr. Nola Redelinghuys
- ✓ Statistical Analysis: Kirsty-Leigh Green
- ✓ Statistical Analysis: Melanie de Bruyn
- ✓ Administration: Renee Coetzee
- ✓ Extension Officer: Edgar Monokoane
- ✓ Extension Manager: Bossie Kotze
- ✓ FS-DARD District Director (MMM): John Kegakilwe
- ✓ Irrigation Engineer: Paul Eloff
- ✓ Translator and Facilitator: Sinethemba Mbhulelo
- ✓ Department of Agriculture and Rural Development (Bursary)
- ✓ University of the Free State (Bursary)
- ✓ My wife Anli Grobler
- ✓ My son Rudolf Grobler
- ✓ My late father Piet Grobler (My Mentor in People-Centred Development Approaches)

In conclusion, my sincere thanks and much appreciation and respect to everyone who contributed to this study, including those whose names are not written in this thesis. Your efforts were not effortless but will bring change in the lives of many people within the communities investigated.

CHAPTER 1: INTRODUCTION

1.1. THE GLOBAL PICTURE

Crop production under irrigation practices has a significant impact on economies in different parts of the globe. According to the Food and Agriculture Organisation (FAO) (2017), 307.6 million ha worldwide is equipped for irrigated agriculture. Only about 83% of this area is irrigated. A total of 62% of the equipped area is irrigated from surface water and 38% is irrigated with means of groundwater. This information was confirmed in the Update of the Digital Global Map of Irrigation Areas, Version 5 (Siebert *et al.*, 2013). Irrigated agriculture produces approximately 40% of the world's food on less than 20% of the total arable land (Doll & Siebert, 2000).

1.2. THE AFRICA STORY

In Africa, the total area equipped for irrigation is 13.5 million hectares (ha). The countries with the largest area under irrigation is Egypt (3.5 million ha), Sudan and South Sudan (1.9 million ha), South Africa (1.5 million ha) and Morocco (1.5 million ha) according to Siebert *et al.*, (2013). The Kenya case shows the importance of small-scale irrigation producers in Africa. According to Ngigi (2002), the area under irrigation for small-scale producers (34 650 ha) and commercial private irrigation (40 700 ha) is almost equal, whilst large-scale irrigation managed by government was only 9 000 ha.

1.3. THE SOUTH AFRICAN SCENE

It is estimated that approximately 60% of all water withdrawals in South Africa is for agricultural purposes (DWA, 2013). A portion of this water is utilised to irrigate approximately 1.6 million ha of cultivated land. Because an accurate figure is unavailable, the Water Research Commission (WRC) has engaged in a study to estimate cultivated areas under irrigation at any given time. This study (Van Niekerk *et al.*, 2018) is titled "An earth observation approach towards mapping irrigated areas and quantifying water use by irrigated crops in South Africa". However, the Abstracts of Agricultural Statistics (DAFF, 2016) estimate the total area under irrigation to be 1 354 128 ha. Denison and Manona (2007) estimated that approximately 31 000 smallholder irrigators were cultivating about 50 000 ha. This means that the number of smallholder and large-scale irrigators are in the same region (31 000 versus 28 000). However, on average a smallholder irrigator farms on 1.5 ha and the large-scale farmer cultivates 42 ha. The Irrigation Strategy for South Africa (ISSA) adopted by the Department of Agriculture,

Forestry and Fisheries (DAFF) (2015) main objectives are to increase equity to access irrigation water to historically disadvantaged individuals (HDI's). The Operation Phakisa strategic document for agriculture (2016) confirmed this objective and intended to “unlock” water for black farmers. This document, the outcome of a laboratory workshop, should be seen as an extension of all current government strategies related to agriculture.

The importance of smallholder irrigation is based on the poverty levels in most rural areas in South Africa and the potential of irrigated agriculture to increase crop production and food security in these communities. The study by Denison and Manona (2007) found that between 81% and 85% of people in the three selected villages in the Eastern Cape live below the lower-bound poverty line. In simple terms, between 10% and 25% of people cannot access any type of toilet. The same study found that in Kwazulu-Natal, less than 3% of the available runoff in the wider resource boundaries of the three selected villages was utilised. At the village of Lutengele, the major Umzimvubu River is under-utilised. Whilst the New Growth Path (NGP) (Economic Development Department, 2010) targets the establishment of 300 000 smallholder farmers by 2020, the ISSA identified 111 752 ha irrigation fields to be revitalized and 34 863 ha of new irrigation which can be developed. Most of the areas to be revitalized are in rural areas previously located in the “Homeland” areas created during the previous political system in South Africa.

During the era of Apartheid, agricultural service organizations in South Africa were designed along racial lines, resulting in smallholder farmers' needs not being adequately addressed (Machethe *et al.*, 2004). Denison and Manona (2007) adopted their definition of a smallholder unit; the term “recognises a characteristic of small farm size and a partially developed link to the larger economic system”. A second blow, in addition to the impact of Apartheid, on smallholder irrigation schemes, was given when the new democratic government came into being. Sadly, the existing supporting structures in the former homelands were dismantled and not replaced with similar supporting structures (Stevens & Van Koppen, 2015). In addition, the National Planning Commission (NPC) concluded in the Diagnostic Report that “we have made insufficient progress in reducing inequality” (NPC, 2011).

Most smallholder irrigation schemes in South Africa have collapsed (Denison & Manona, 2007). According to these authors, approximately 50 000 ha of irrigable crop fields are in communal areas in South Africa. This is about 3% of all crops under irrigation in the country,

cultivated by white and black farmers. This process of collapse unfolded before 1994 and has continued after that. This information is well documented through a national database compiled of 317 smallholder irrigation schemes in the whole of South Africa (Denison & Manona, 2007). Scheme activity in terms of area cultivated in different provinces was estimated and is indicated in Table 1.1.

Table 1.1: Active Irrigation in Communal Areas Per Province

Province	No. of Schemes	No. active	% No. Active	Area active (ha)	% Area Active
Limpopo	183	105	57%	17 452	62%
Eastern Cape	75	51	68%	3 869	40%
Kwazulu-Natal	36	35	97%	3 097	47%
Mpumalanga	8	8	100%	556	56%

(Source: Denison & Manona, 2007).

Table 1.1 clearly shows the under-utilisation of available water, irrigation fields and infrastructure in communal areas in South Africa. Only the provinces with substantial communal areas are listed in Table 1.1. The table does not indicate yield as a percentage of possible yield per se. On top of low utilisation, it is most likely that yields in communal areas are also not optimal. Some reasons for this trend of collapsed smallholder irrigation schemes are listed below (Van Averbek, 2008):

- ✓ Poor infrastructure
- ✓ Limited knowledge of crop production
- ✓ Limited farmer participation in water management
- ✓ Ineffective extension and mechanisation services
- ✓ Lack of reliable markets, and
- ✓ Lack of effective credit services

1.4. REVITALIZATION OF SMALLHOLDER IRRIGATION SCHEMES IN THE FREE STATE PROVINCE.

The national database also identified three smallholder irrigation schemes in the Free State Province which are the focus of this study. The study notes (Denison & Manona, 2007) that scheme data for the Free State Province is incomplete, but the Report on the irrigation potential of Thaba Nchu Dams (Du Randt & De Lange, 2008) indicates the very same trend captured in

Table 1.1 and the findings by Van Averbeke (2008). During the past ten years, different organisations have tried to improve crop production on the three irrigation schemes in this tribal area. This includes the Free State Department of Agriculture and Rural Development (FS-DARD), the Department of Social Welfare and the Department of Rural Development and Land Reform (DRDLR). These efforts failed because it did not address the whole scheme (dams, canals, storage, and mechanisation), was not well coordinated amongst all role players, did not receive adequate budgets, and did not follow best practice. These reasons can, however, not be extrapolated as such because these interventions were not good efforts at all. For instance, in 2009, FS-DARD installed a 1 ha diesel-powered sprinkler system at the Sediba Scheme, which was never appropriately commissioned to date. This slight improvement should be judged in terms of the size of the scheme, which was previously developed for approximately 120 ha.

Major initiatives have been undertaken after 1994 to revitalize collapsed irrigation schemes in South Africa to compliment several government programs. National and provincial governments have rolled out different programs over the past 20 years to revitalize hundreds of irrigation schemes (Van Averbeke, 2008). Despite various efforts to revitalize smallholder irrigation schemes, little success has been achieved. In some cases, schemes revitalized during the past decade have collapsed again. This phenomenon has been studied extensively by local and international researchers, Non-Government Organisations (NGO) and the government. Most researchers and implementers agree that developmental principles, such as the participatory approach, can be applied in the planning and rolling out of revitalization or rehabilitation of smallholder irrigation schemes. In the meantime, general guidelines and best practices have appeared and settled, but still with limited success.

From experience, enough evidence was gathered to indicate that government policy in the Free State Province does not create an environment where all role players acknowledge revitalization guidelines. There is no single policy, guideline, resolution, or standard operating procedure endorsed by FS-DARD executive management which instructs implementers to follow the best practice or any other structured method to guide the revitalization of smallholder irrigation schemes in the province. At least some individual government officials did promote the use of available best practise and guidelines in South Africa as indicated by Grobler and Mokone (2015). Therefore, government policy does not level the ground for all role players and prescribe that farmers should oversee their destinies as proposed by Fetterman

(2001). Therefore, government policy does not require communities to commit themselves and their assets to the effort as propagated by Kretzmann and McKnight (1993). Government policy does not involve farmers in all decisions affecting their future. Government policy does not prioritise capacitating farmers to be equal partners in the development initiative.

To summarise, the province does not have a comprehensive policy document on the irrigation sector in general, specifically on smallholder irrigation. Policy exists for general agricultural development activities but not for irrigation revitalization, which has been proven to be a complex development activity. A critical policy document that does exist, and is applied and being audited, is the Standard Operating Procedure (SOP) for the conditional grant funding linked to the Comprehensive Agricultural Support Programme (CASP) managed by the Department of Agriculture, Forestry and Fisheries (DAFF). Currently, CASP is the primary funding source for the revitalization of smallholder irrigation schemes in South Africa. It could have been beneficial if the revitalization of smallholder irrigation could have been formalised as is the case for the LandCare programme. Funding for the LandCare Programme is directly linked with all prescripts and outcomes of the programme.

The government intends to revitalize the three schemes in the Thaba Nchu area (FS-DARD, 2018) very soon, and there is a high possibility that the investment may be fruitless or will have a limited impact if the farmers are not positioned to take control of their destiny. This study intends to make a positive contribution and wishes to avoid the above situation.

Government programmes introduced recently on the national platform may, however, positively impact on smallholder farming (including smallholder irrigation farming) as a focussed crop production method. Such new policies and programmes include the Medium Term Strategic Framework (MTSF) (Government of South Africa, 2014b); the New Growth Path (NGP) (Economic Development Department, 2010); the National Development Plan (NPC)(2011); the National Water Resource Strategy (NWRS2) (DWA, 2013); the Irrigation Strategy for South Africa (ISSA) (DAFF, 2015); Operation Phakisa for Agriculture, Rural Development and Land Reform (DPME, 2016) and several programmes in the rural development arena such as the ambitious AgriPark programme of the DRDLR. The challenge, in short, is to implement and measure the clear targets set by government. In other words, to let all these policies and programmes have the intended results.

Hence, success will require a well-coordinated effort and a shared vision by decision-makers, support agencies and the farmers. All necessary knowledge, information, expertise, and the political will to make smallholder irrigation work in South Africa are currently present. According to Sinyolo, Madhura and Wale (2014), investment in smallholder irrigation schemes is justifiable. The authors provided empirical evidence that the overall welfare of an irrigator is much better than that of the non-irrigator in the village or scheme. For instance, about 75% of the non-irrigators were classified as poor compared to 55% of the irrigators. This case study was conducted in the Tugela Ferry irrigation scheme in Kwazulu-Natal.

The biggest problem to solve is how to follow available best practices consistently. The Limpopo Province, during the past 20 years, moved from Water Care to Revitalization of Smallholder Irrigation Schemes (RESIS) to RESIS “Recharge” (Van Averbek, 2008). The three initiatives had good intentions, proper planning, and budgets. Still, the province has experienced huge challenges regarding the revitalization of the 126 irrigation schemes. It seems that the problem is more extensive than was perceived and that the effort must be perfected. Although the objective was to allocate 30% of the budget to capacitate farmers, this outcome was not achieved. DRDLR, in collaboration with Impact Economix implementation Evaluation conducted an implementation evaluation of the Comprehensive Rural Development Programme (CRDP) for the Presidency (DRDLR, 2013). This evaluation document recommends a radical approach to agrarian reform by actively supporting the creation of smallholder farmers. In this report, government acknowledged that the standard way of doing things had not produced the required results.

A system or check list, in which success can be guaranteed and a proper development road map for each smallholder irrigation initiative can be enforced, is required. The smallholder irrigation farmer needs to be empowered successfully. The sector needs to get it right. The question which remains is how? Who needs to be responsible for this initiative, the developer, or the farmer?

This study will classify farmers and farming activities as smallholder or subsistence. Farmers may consume much of the production themselves through human consumption and feeding their animals. Historically farmers were also producing fodder and pasture for their animals, such as sheep, pigs, beef cattle and dairy cows (Monokoane, 2015). Although this study will focus on these categories of farmers, there should still be justification for any economic investment from the government's point of view.

It is, however, ironic, and sad that it reached a point where smallholder irrigation in South Africa is currently in such a bad situation. This is said in the light that irrigation practices occurred in various parts of Africa, even Southern Africa, during the early and late Stone Age periods (Tempelhoff, 2006). This includes countries such as Uganda, Kenya, Ethiopia, and Tanzania. A good example in Southern Africa is found in the Nyanga District in the north-eastern parts of Zimbabwe. Some of the aqueducts run as far as 3 km from the water source across several hills to the crop fields. It was cultivated between the 16th and 19th century, which was pre-colonial (Tempelhoff, 2006). Simple practices, such as terracing, which could have been irrigated, are found in South Africa in provinces such as Mpumalanga and the Free State.

1.5. PROBLEM STATEMENT

The first problem for the government is that communities do not utilise available resources optimally as indicated in Table 1.1 (Denison & Manona, 2007). This includes natural resources as well as existing infrastructure. Because of the ever-increasing global population, there is huge pressure on available resources. Globally, there is clear evidence of a threatening land shortage (Smyth & Dumanski, 1993). The scarcity of these resources determines the magnitude of the problem. From the government perspective the problem is not the lack of food production because the province and the Republic are net exporters of agricultural produce. The second problem for the government is that it was and is not able to capitalise on a possible solution for providing food security and reducing poverty in a very specific category of society. It is that part of society which happens to be black and living in communal rural areas previously established under the “Homeland” system in the era of Apartheid. The Constitution of the Republic of South Africa guarantees fair access to natural resources (Article 24) and sufficient food and water (Article 27(1) (b)) to its citizens. The first and second problem, therefore, constitutes a conflict situation. The first problem requires a purely economic solution, while the second requires a socio-economic solution.

The first problem for the farmer/community member is that they need to feed their family. The second problem for the farmer/community member is that they need to utilise resources in a communal set-up to produce food for their family. The irrigator in the communal setup does not own the land and cannot use the land as collateral. Again, the first problem is a purely economic problem, and the second is a socio-economic problem. The primary and secondary problem, therefore, constitutes a conflict situation.

Similarly, there are also conflicting targets set by government. The NGP has set a target to establish 300 000 smallholder farmers (EDD, 2010). New targets set by government in both the 2018 State of the Nation Address (SONA) (Ramaphosa, 2018) and the 2018 State of the Province Address (SOPA) in the Free State province was for government to establish a certain number of commercial farmers (Magashule, 2018).

The problem, therefore, for the government is twofold. It is an inability to have communities utilise available resources and a lack of clear policy targets on whether to establish smallholder farmers or commercial farmers and how. In short, government struggles to solve both the economic and socio-economic problems in the attempt to revitalize and sustain smallholder irrigation schemes in the Free State and South Africa. The ultimate would be to solve both problems simultaneously. In the vision received by the prophet Ezekiel, where water will flow from the temple all the way to the Dead Sea, much more benefits are promised than just economic benefits. It also includes promised benefits such as technological benefits (drainage, fertility, biodiversity), socio-economic benefits (job creation, poverty reduction, healing), and livelihoods (beautiful surroundings and tasteful fruits). Many studies have been conducted to produce best practices and guidelines for revitalization of smallholder irrigation schemes, but with little effect.

All these studies, which contain scientific recommendations, are not useless. They are of great value indeed. But something is missing. The above pictures the complexity of the problem. The magnitude of the problem is clearly indicated by the National Database (Denison & Manona, 2007) and Table 1.1. Almost all smallholder irrigation in South Africa has either collapsed or experienced serious problems. This situation is affecting approximately 31 300 families nationwide. This is also the case of smallholder irrigation in the Free State Province. The problem is currently escalated because of serious challenges facing the fiscus. Corruption also made critical departments such as the Department of Water and Sanitation (DWS) ineffective and on the brink of bankruptcy (Schoeman, 2018).

A possible solution to the problem painted above is to give farmers more authority in the process of revitalization of smallholder irrigation schemes. Most revitalization best practises and guidelines are based on a participatory approach. This was meant to give farmers more authority. Even pure developmental principles acknowledge the participatory approach. In

extreme cases, the people should have the right to reject any proposed development (Davids & Theron, 2014). To assist in this process, they need to know what will happen to them. And because their livelihood is on the verge of a major change, they must also know their rights and responsibilities. Even the cancer patient wants to know what will happen to them, from A to Z.

Together, all role players must paint a clear and complete picture of the sequence of events required to create sustainable change or improvement. The farmers should not get lost. They should be able to navigate themselves. On 12 March 2018, the head lady of Woodbridge had a hard time convincing the community to sign the Project Implementation Plan (PIP) compiled by FS-DARD (2018). When the author gave her a lift to town after the meeting, she commented “this is not what we have asked for”.

The idea is not to partition with existing best practice and guidelines but to augment it with something which can bring all strings together. The farmers need a road map for the revitalization journey. But the roadmap should give them authority. The research problem, research question and hypothesis relationship can be explained in Table 1.2 below. It indicates that the community or irrigation farmers may be perceived as inferior to outsiders. Even if it is true, we must move away from this situation. Together with the mind map (Figure 1.1), it shows that travel documents are issued to one person but from different entities or countries. The country which will be visited can state conditions for entering.

Similarly, the community can state conditions for the developer or sponsor of development. The mind map (Figure 1.1), therefore, integrates two concepts— the Passport/VISA concept and the navigation concept. While navigating the big ocean, the community can be in control and, at the same time, observe all support and guidance from the government, the developer, or the sponsor.

Table 1.2: Relationship Between the Research Problem, Research Question and Hypothesis

PROBLEM				SOLUTION (Revitalization of smallholder irrigation schemes with “internal support”)							
	Basic Need			No	Basic Tool	System Approach	Hypothesis	Parallel		Formality	
LOST “on a small boat in the ocean....”	Know you are lost	Farmers are lost in processes	Research Problem	1	Compass	Position	VISA (Community: “Inferior”) <ul style="list-style-type: none"> Country to be visited. Does not know the visitor. Sceptical about the visitor. Trust is earned. Need the money of the visitor. Can be exploited. Has potential. Needs development. Financially weak. Not in control. Does not travel. Lessons learned from one site only. Research object. Less educated. Bottom-up. Can be tempted by illegal stuff. Need more power. Need to organise themselves in a united front. Need to provide hospitality. Need to make all decisions. Need a knowledge base. Need a road map. Owner of the space. 	PASSPORT (Sponsor: “Superior”) <ul style="list-style-type: none"> Country of visitor. Am the visitor. To create trust. Is willing to spend money. Can exploit. See potential. Can develop. Financially strong. Control freak. Experienced traveller. Lessons learned from various sites. Researcher. Educated. Top-down. Can import illegal stuff. Need to transfer more power. Need to acknowledge the community organisation. Need to enjoy the visit. Need to guide decisions. To provide a knowledge base. To share a road map. Invaders of the space. 	How?	Assess	Research Question
	Want to find home			2	Sight	Target				Goals and objectives	
	Do not know how			3	Map	Navigate				Body of knowledge	
	Need help			4	Rudder	Steer				Decision Support System	

Mind Map

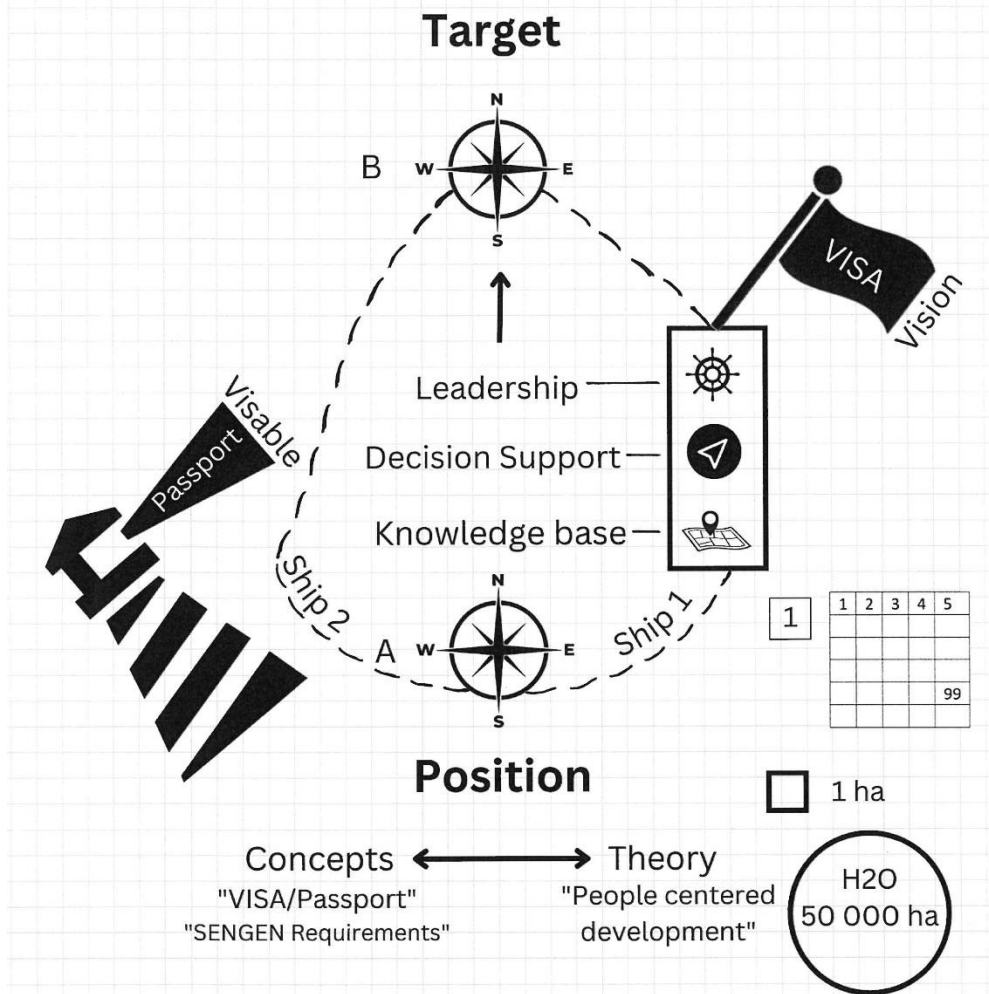


Figure 1.1: Analytical Diagram Showing the Hypothesized Relationship Between Knowledge, Decision Support System, Leadership, and Improved Decision-Making Powers to Equal Government and/or Powerful Institutions.

1.6. RESEARCH QUESTION

The main research question is if farmers can improve production levels through enhanced decision-making powers in revitalising smallholder schemes in the Free State Province.

1.7. HYPOTHESIS

The hypothesis to be proved correct or incorrect in this thesis is that the revitalization and sustainable production of smallholder irrigation schemes in the Free State Province will improve drastically through better decision-making powers of farmers.

1.8. JUSTIFICATION OF THE RESEARCH

The study explores the relevant knowledge base and analyses site observations to make a meaningful contribution to the following issues:

- Allow communities to discover their assets themselves.
- Indicate that community assets have economic value.
- Contribute to assisting policymakers in improving relevant policy.
- Identify strategic intervention measures which are implementable, and which can have a notable increase in crop production and quality of livelihoods on smallholder irrigation units and schemes in the Free State Province and to
- Make residents less dependent on social grants.

1.9. AIM AND OBJECTIVES.

This study investigates the relationship between the policy environment relevant to smallholder irrigation farmers in the Free State Province and the possibility of identifying intervention measures to increase the productivity of these crop production units and schemes. This may include establishing the farmer as an equal partner in the economic or development effort. This will require farmers to have a clear picture and better understand the revitalization process.

The over-arching rationale of the study is to identify an intervention strategy (Toolkit) to significantly improve crop production for smallholder irrigators in the Free State Province.

This study intends to improve crop production on these irrigation schemes as a common goal which may have; as a result, two positive impacts:

- ✓ Improved livelihoods of smallholder irrigator farmers on three irrigation schemes through improved food security.

- ✓ Improved economic contribution through agricultural production and less dependency on social grants of 150 farmers.

The main research question and subsidiary research questions are summarised in Table 1.3.

Table 1.3: Summary of the Research Question, Hypothesis and Rationale

Research question	Hypothesis	Rationale for question
Main Research Question		
The main research question is how farmers can improve production levels through enhanced decision-making powers in the revitalization of smallholder schemes in the Free State Province.	The hypothesis to be proved correct or incorrect in this thesis is that the revitalization and sustainable production of smallholder irrigation schemes in the Free State Province will improve drastically through better decision-making powers of farmers.	The three-tier government in South Africa represents a colossal system on its own. It includes a constitution, legislature, legal system, government departments, strategies, policies, performance plans, budget frameworks, assets, resources and political power. On the other hand, smallholder irrigation farmers have very little apart from land, water, indigenous knowledge, and labour. Currently, government and smallholder irrigation farmers in the Free State Province are not equal partners, leading to a top-down approach in any production improvement or revitalization attempt. Partners can look different but should be equal. The main reason farmers are not equal to the government is that they do not understand the revitalization process and can, therefore, not contribute reasonably to a decision-making process.
Subsidiary Research Questions		
What is the relationship between the knowledge base and productivity, as demonstrated on crop fields on these schemes?	That there is a direct relationship between the knowledge base and productivity of smallholder irrigation schemes in the Free State Province.	Suppose a direct relationship between the knowledge base and productivity of farmers can be proved. In that case, it will assist in identifying and formulating possible solutions to the problem.

<p>Which possible decision support system toolkit can be introduced to empower smallholder irrigation farmers to improve decision-making and productivity?</p>	<p>That a decision support system toolkit which will put organised irrigation farmers on the same level as the Government/NGO block will drastically improve decision-making powers and productivity on smallholder irrigation schemes in the Free State Province.</p>	<p>The preliminary literature review indicated an overwhelming attempt by the government/NGO block to support the revitalization of smallholder irrigation schemes. At the same time, it identified a shocking void on the irrigation farmers' side which can equal the heavy weight. For instance, the 50 000 smallholder irrigation farmers in South Africa are not organised in a commodity group, so are the 150 – 200 smallholder irrigation farmers in the Free State. A new approach that will put the irrigation farmer on the same level as the Government/NGO block is required. In this new approach, irrigation farmers must be empowered through a decision support system and a knowledge-based tool kit. They need to have a veto right as well. A participatory approach is part and parcel of the exercise but not the complete solution.</p>
<p>What is the relationship between the level and quality of leadership and productivity, as demonstrated on crop fields on these schemes?</p>	<p>That there is a direct relationship between the level and quality of leadership and decision-making powers of farmers, as demonstrated by the current low level of productivity of smallholder irrigation schemes in the Free State Province.</p>	<p>If a direct relationship between the level and quality of leadership and decision-making powers of farmers can be proved, it will assist in identifying and formulating possible solutions to the problem.</p>

1.10. CONCLUSION

The research problem has been explained in detail in this chapter. It is widely accepted that smallholder irrigation schemes in the Free State and in all other provinces in South Africa have collapsed over a period. The mystery remains on how this could have happened under the following circumstances:

- Government is massive and well-defined (PASSPORT).
- Much research has been conducted on the revitalization of smallholder irrigation schemes.
- Many resources have been allocated for the revitalization of smallholder irrigation schemes in the Free State and most provinces in South Africa.
- Natural resources are readily available.

The research study was planned to find explanations for the above status quo and propose a solution. The thesis is structured as follows:

- Chapter 1 provides the background of the status of smallholder irrigation schemes in the Free State Province and where it fits in the global picture. It also pins down the research problem, aims and objectives of the study.
- Chapter 2 explores the evolution of a body of knowledge around revitalising smallholder irrigation schemes in the Free State Province, South Africa and elsewhere. Revitalization means stagnation or failure. The chapter also discusses possible theories which can support the ultimate solution to the problem.
- Chapter 3 explains the research road map. It includes the research design and methodology. It introduces the reader to the research sites and characteristics. It further discusses the selected research instruments, ethical issues, field work conducted, and statistical analysis.
- Chapter 4 presents and discusses the results of the study. This chapter delves deep into possible gaps in the current body of knowledge and explores existing best management practices in related disciplines that are effective. This chapter further indicates the meaning and relevance of the study.

- Chapter 5 concludes the research study. This chapter discusses general but also very pertinent implications and recommendations. It also demonstrates the study's contribution to the current knowledge base of the study field.

CHAPTER 2: LITERATURE REVIEW

In 1994 South Africa became a true democracy. The revitalization of smallholder irrigation schemes took place before 1994 but took off post-1994. A range of studies around the revitalization of small-scale farmers or smallholder irrigation in South Africa is available. These studies were mainly initiated by the Water Research Commission (WRC) and conducted by different organisations. Most of these studies focus on the smallholder farmer in the communal land tenure setup. This proposal prefers the “smallholder” terminology mainly because one of the most important indicators of the current government uses this name for this category of farmers (New Growth Path, Economic Driver 2). A preliminary review will discuss references according to a timeline to show the progress made on the research topic.

2.1. CURRENT STATE OF KNOWLEDGE

1993: Kretzmann and McKnight (1993) focussed on rebuilding troubled communities. They sought to learn from neighbourhood leaders in troubled communities in the United States (US). According to these two researchers, there are only two alternatives, namely (1) the traditional needs-driven dead-end path and (2) the capacity-focussed development path. They promote the latter in arguing, with historical evidence, that “significant community development takes place only when local community people are committed to investing themselves and their resources in the effort”. This study will therefore focus on how to match the commitment of resources of the two partners to the revitalization effort on smallholder irrigation schemes in the Free State.

1993: Principles of sustainable agriculture is based on a World Soil Resources Report titled “An international framework for evaluating sustainable land management” (Smyth & Dumanski, 1993). The five pillars of sustainable agriculture are identified in this framework document and are relevant for evaluating sustainable land use under irrigation practices. The framework was adopted worldwide, and various faculties at universities all over the world were established to serve the framework.

1994: Empowerment Evaluation (EE) was introduced at the American Evaluation Association conference by David M. Fetterman in 1994. He is also the author of the book “Foundations of empowerment evaluation” (Fetterman, 2001). The theoretical foundation of empowerment evaluation is self-determination, the ability to “chart one’s own course in life”. This study intends to explore empowerment evaluation to either augment the participatory approach in

revitalising smallholder irrigation schemes or use it as a stand-alone methodology to increase the success rate of these schemes.

1994: White Paper on Reconstruction and Development. This historical document (Government of South Africa, 1994) was tabled by the first Parliament of democratic South Africa on 14 November 1994 and published in Government Gazette 16085 on 23 November 1994. This white paper had the intention to reverse the previous separate development ideology of the Apartheid government into an integrated development approach.

1996: The Constitution of the Republic of South Africa (Government of South Africa, 1996a) guarantees fair access to natural resources (Article 24) and sufficient food and water (Article 27(1) (b)) to its citizens. According to Article 27(2), the state was compelled to write the “National Water Act”.

1996: An early piece of legislation (Government of South Africa, 1996b) of the new South Africa was the Communal Property Association Act (Act 28 of 1996), better known as the CPA Act. This legislation enhances land use and investments coupled with land properties. It is also applicable to “Tribal” land.

1996: A scientific/strategic document called the “Policy proposal for irrigated agriculture in South Africa” was published in 1996. The authors (Backeberg *et al.*, 1996) are amongst the most experienced scientists in irrigation agriculture in South Africa. It was published as a Water Research Commission Report (KV96/96) when South Africa was being re-engineered, and many people were thinking and sleeping anew. One of the main findings was the lack of appreciation by irrigation authorities for socio-economic parameters in smallholder irrigation.

1998: The National Water Act of 1998 (Act No. 36 of 1998) is considered a very good piece of legislation. It has reformed the water environment drastically. Water is no longer owned by the individual but is viewed as a national resource. Individuals can obtain an entitlement to a specific water use for a particular period. The National Water Act 36 of 1998 (Department of Water Affairs [DWA], 1998) put responsibilities upon users in terms of effective use and conservation. These responsibilities are also applicable to smallholder farmers.

2000: An early publication by the Water Research Commission (WRC) titled WRC Report 774/1/00, “Developing sustainable small-scale farmer irrigation in poor rural communities: guidelines and checklists for trainers and development facilitators”, paved the way for a score of studies, reports, and guidelines by the institution over more than 15 years. This document (De Lange *et al.*, 2000) led to the implementation of the programme “Revitalization of Smallholder Irrigation Systems” (RESIS) in the Limpopo Province. “RESIS”, as a programme, has since been promoted by DAFF and implemented by other provinces.

2000: A review of planning and design procedures applicable to small-scale farmer's irrigation projects was reported by Crosby *et al.* (2000). It is published as a Water Research Commission Report (Crosby *et al.*, 2000), Report 578/2/00, as a product of a funded project entitled “Evaluation of Irrigation techniques used by small-scale farmers”. A new approach called “Participatory Irrigation Planning (IPP) was introduced in this study. This implies that communities are invited to identify and solve problems.

2000: Another publication in 2000 was the “Guidelines for rehabilitation of small-scale farmer irrigation schemes in South Africa” (Bembridge, 2000) published by the Water Research Commission in WRC Report No. 891/1/00, The findings derived from four case studies indicated that plot sizes are too small to derive a living from agricultural activities alone. Future rehabilitation and public funding investment can be justified on poverty relief grounds, provided that all rehabilitation costs are subsidised.

2000: Döll and Siebert (2000) state in the paper “A digital global map of irrigated areas” that irrigated agriculture produces approximately 40% of the world’s food on less than 20% of the total arable land. This indicates the importance of irrigation in the world economy and the importance of using this precious resource sustainably.

2002: According to Ngigi (2002), the area under irrigation in Kenya for small-scale producers (34 650 ha) and private commercial irrigation (40 700 ha) is almost equal, whilst large-scale irrigation managed by the government was only 9 000 ha.

2003: The legislation regulating traditional leadership is contained in the “Traditional Leadership and Governance Framework Amendment Act, Act 41 of 2003”. This act (Government of South Africa, 2003a) does recognise traditional leaders and provides for the

functions and roles of traditional leaders. The act also provides for the establishment and function of traditional sub-councils. In addition, the act addresses possible partnerships between district and local municipalities and relevant traditional councils.

2003: The Broad-Based Black Economic Empowerment Act 53 of 2003. This legislation (Government of South Africa, 2003b) has dominated the South African economy since its inception. The aim was to allow all citizens, especially the previously disadvantaged, to participate fully in the economy of South Africa. Anthea Jeffery asks the question in her book (Jeffery, 2014) if this legislating is helping or hurting.

2004: A water shed policy document of the then National Department of Agriculture (NDA) was the “National guidelines for integrated management of agricultural water use”. The main aim was to transfer the management of smallholder irrigation schemes to farmers and to broaden opportunities for multiple uses of agricultural water in rural communities (NDA, 2004).

2004: Report No. 1050/1/04 of the Water Research Commission confirms the need for the mentioned “National Guidelines on agricultural water use” published in the same year. The title of this document focuses on smallholder irrigation along the Olifants River in Limpopo Province. This report (Machethe *et al.*, 2004) indicated that numerous schemes collapsed after the withdrawal of government support. It also concluded that although the smallholder farmer experiences fewer problems around food security, it does not contribute that much towards household income.

2005: Van Averbek and Mohamed (2005) explore smallholder irrigation farmers' flexibility to change from one farming style to the other in the paper “Smallholder farming styles and development policy in South Africa: The case of Dzindi Irrigation Scheme” published in 2005. Farming style theory was applied to this case study in Thumelela Municipality, Limpopo Province. The purpose of this study was to improve smallholder development policy. It was found that farmers' response in different farming styles to policies aimed at their empowerment is un-likely to be uniform. This is expected to dilute the impact of policy in support of “specific development trajectories.” This study failed to provide evidence that food farmers aspired to become profit makers.

2005: “Revitalization of smallholder rain-fed and irrigated agriculture, a guide for farmer trainers and facilitators” by Botha and De Lange (2005) assessed the available training material in this field and then developed new material according to the need of farmers. This project by the WRC was conducted in close collaboration with the Limpopo Department of Agriculture. This training material is needed from the identified 126 irrigation schemes to be revitalized in this province. It needs to be determined to what extent the government and agencies used these guidelines. The report is published by the WRC (Report No. TT254/1/05).

2005: In 2005, the Department of Water Affairs and Forestry (DWAF) released a critically important document called “A draft position paper for water allocation reform in South Africa, towards a framework for water allocation planning, a discussion document”. Since this document (DWAF, 2005) was shared with the water services sector as a discussion paper, no formal policy was adopted. Seven guidelines were listed to outline the intent and scope of water allocation reform in South Africa. All guidelines aim to address past imbalances in an orderly manner. As in the case of land reform, progress in water allocation reform is plodding. In the case of most smallholder irrigation schemes in South Africa, land and water rights are vested in communal ownership. Water allocation reform may address “ownership” of water rights or improve the impact of “entitlements”.

2006: Johann Tempelhoff presented an eye-opening paper called “The hidden power of water in the Southern African irrigation furrow” at the European Association for the Study of Literature, Culture, and the Environment (EASLCE) conference on Water: Literature, Culture and Environmental Perspectives. This paper indicates that indigenous tribes in Southern Africa have been practising irrigation for centuries. Tempelhoff (2006) argues that the degradation of natural resources in Southern Africa was primarily a result of the inability of colonial authorities and indigenous agriculturalists to agree on how indigenous strategies could be employed. The author further urges that advice given to Southern Africa’s agriculturalists should not be at the cost of “losing the remarkable cultural traditions that have been part of Africa’s agricultural history for many centuries”. This can also be viewed in light of the 2016 student uprising in South Africa and the call for decolonizing academic organisations.

2006: In the study “A model to assess the risk profile of land reform projects”, the author (Grobler, 2006) reasoned that whilst there is a score of risks involved in land reform projects, the early identification of opportunities can counter the effect of all these latent risks.

2007: A study that is widely acknowledged amongst academics and practitioners is the study by Jonathan Denison and Siyabu Manona (Denison & Manona, 2007). The study consists of two volumes titled “Principles, approaches, and guidelines for the participatory revitalization of smallholder irrigation schemes. Volume one is a rough guide for practitioners and volume two addresses concepts. The author deemed it necessary to check if this study did apply general concepts of participatory approaches. Therefore, he scrutinized the study against general developmental principles explained in the textbook “Development, the state and civil society in South Africa” by Davids and Theron (2014). The author believes that generally accepted Denison and Manona included developmental approaches. Immediately the question arises of why smallholder irrigation schemes are still failing if well-studied guidelines are available.

2008: Another valuable study conducted in Limpopo Province is titled “Best management practices for small-scale subsistence farming on selected irrigation schemes and surrounding areas through participatory adaptive research in Limpopo Province” by Wim Van Averbek (2008). The study distinguished four eras in the history of the development of smallholder irrigation schemes which are:

- 19th Century: Peasant and Mission Diversion Scheme Era
- 1930 – 1960: The Smallholder Canal Scheme Era
- 1970 – 1990: The Independent Homeland Era
- 1990 – Irrigation Management Transfer and Revitalization Era

The study has also categorised nine different livelihood types of smallholder farmers and four farming styles. Whilst the Dzindi village is communal land, one of the proposed best management practises is a land exchange system with simple rules to allow individual farmers to obtain excess and more suitable irrigable land.

2008: A beneficial study of interest to the author was conducted at one of the three sites used as case studies of this study. The study focuses on rainwater harvesting, but the value for the current title is in the land register, and the land exchange system is investigated. In two villages, consensus still exist on who has extra to certain crop fields. In one of the villages, the situation was more complex. In the study, farmers agreed that land administration should be developed and strengthened and adopt an initial framework of rules (Manona & Baipethi, 2008).

2008: The WRC published results of a vital assessment study on In-field rainwater harvesting and conservation techniques: Assessing the impact of fifteen years of WRC-funded research in Thaba Nchu (Blignaut & Sibande, 2008). This study revealed a positive effect on the wellbeing of participants as well as improved knowledge. Participants of this impact assessment are, to a large extent, the author's target group in the light that rainwater harvesting, and smallholder irrigation may have many commonalities. It is argued that if IRWH techniques can benefit crop farmers in the same communities, then a toolkit for the sustainable revitalization of smallholder irrigation schemes can also have a tangible impact on crop production.

2008: The “Report on the potential of the Thaba Nchu irrigation dams” conducted for the then Free State Department of Agriculture assessed the potential of the natural and other resources at three different smallholder irrigation schemes in the Thaba Nchu tribal area, currently within the Mangaung Metropolitan Municipal (MMM) jurisdiction. The report (Du Randt & De Lange, 2008) concludes that adequate potential for irrigation exists and includes some recommendations for revitalising the three schemes. However, the soils have some restrictions that require improvement measures.

2008: De Lange (2008), in the Thaba Nchu Dams Project report on field visit findings and proposed development approach and socio-technical interfacing, motivates that farmer organisations need to be planned and formalised. She also recommends that the government assign and empower frontline support staff to participate in revitalization.

2009: Stimie *et al.* (2009) developed and evaluated training material for homestead gardens. This study is a well-planned and well-executed value-added exercise over four years. The objective was to learn from higher education institutions and vice versa. The Water Research Commission published the report “Agricultural water use in homestead gardening systems (WRC Report TT430/09).

2009: Report on an Irrigation Audit in the Free State Province (De Necker, 2009). This database study also lists the area under irrigation in the Thaba Nchu tribal area. The document also includes recommendations for the 60 irrigation farms or schemes in the Free State Province which were assessed. The audit stated the irrigation potential for the three smallholder irrigation schemes in the Thaba Nchu area is moderate. Fourteen criteria were used to

determine the potential of different irrigation sites for comparison purposes only. A matter of concern is that only ten out of sixty irrigation sites had class 1 soils.

2009: A very impressive programme adopted by the cabinet in 2009 is called the “Comprehensive Rural Development Plan” (CRDP) and serves as an overarching policy and strategy for the relevant department. The DRDLR uses this programme (DRDLR, 2009) as its core function for agrarian reform to create rapid and fundamental change in ownership and control over agricultural production necessities.

2010: A similar study to the one conducted in 2008 in Limpopo was conducted in two other provinces in South Africa. Findings were published in the Water Research Commission Report TT478/10. The study is titled “Best management practices for smallholder farming on two irrigation schemes in the Eastern Cape and Kwazulu-Natal through participatory adaptive research”. One of the major constraints identified in these two schemes was that farmer organisations were attempting to manage water infrastructure and farming operations simultaneously, contradicting established best practices. An important recommendation of the study (Mnkeni *et al.*, 2010) is that revitalization programs should focus on infrastructure issues and softer issues, such as capacitating farmers in basic crop production and irrigation management skills.

2010: Interventions, specifically through Land Tenure and Land Administration, to increase productivity on smallholder irrigation schemes were presented (Manona, Denison, Van Averbeké & Masiya, 2010) in September 2010 at a conference on “Overcoming inequality and structural poverty in South Africa”. This paper was presented by four of the most acknowledged researchers on smallholder irrigation. Manona *et al.* (2010) concluded that upgrading the land tenure in the proposed two new forms will improve land utilisation. The first is to upgrade from a permit system to a “rights-based system”. The second is strengthening the current tenure system with a local administration office.

2010: The high-level New Growth Path Framework policy document (Economic Development Department, 2010) aims to create job opportunities in South Africa. Economic driver two identifies 300 000 households who can benefit from smallholder schemes in the rural space. Therefore, this study will use “smallholder” rather than “small-scale” irrigation farmer.

2011: As part of the 40-Year Celebrations of the Water Research Commission (WRC), an informative paper was published in Water SA, “Smallholder irrigation schemes in South Africa: A review of knowledge generated by the Water Research Commission. This paper (Van Averbeke *et al.*, 2011) reviews the knowledge base and identifies possible gaps in research and practice. The central gap identified is the lack of research on other black irrigators operating outside irrigation schemes. Other gaps in the knowledge of smallholder irrigation scheme's social, human, and economic aspects are pointed out. Such research may be a good benchmark or reference for common problems and solutions for on-scheme and off-scheme smallholder irrigation enterprises.

2011: The NPC conducted a Diagnostic Report on different socio and economic sectors (NPC, 2011). The Diagnostic Report on Human Conditions concluded that “we have made insufficient progress in reducing inequality”. Collapsed smallholder irrigation schemes in the Free State province are a perfect example of this situation.

2012: Various training materials applicable to smallholder irrigation have been developed over the past 20 years. One such publication (Stevens *et al.*, 2012) is titled “Training material for extension advisors in irrigation water management”, compiled by Stevens, van Heerden, Buys and Laker. At the time of the study, about one-third of the 1 192 extension advisors in South Africa are involved with small and commercial irrigation farmers. One of the study's findings, which resulted in the training material, is that tertiary organisations do not adequately prepare irrigation extension advisors for their tasks. Therefore, one of the publication's objectives was to close this gap.

2012: Lessons learned from a proposed irrigation project in a different part of the Free State Province are captured in a poster (Van Rensburg *et al.*, 2012) presented at the 2012 conference of the International Committee for Irrigation and Drainage (ICID). The poster's title is Development of a sustainable irrigation scheme in South Africa: Lessons from the proposed Bozrah Irrigation Scheme (Van Rensburg *et al.*, 2012). Lessons learned highlighted “Acceptability” as one of the main success factors in any irrigation development. Project proposals should be acceptable to all role players, including beneficiaries, donors, and authorities.

2013: The National Treasury has adopted a standard to address quality and appropriate infrastructure development by the government. This standard prescribes an Infrastructure Gateway System (IGS), which includes the following terminologies, which are all related to the revitalization of smallholder irrigation schemes:

- Construction
- Refurbish
- Rehabilitation
- Extension
- Alteration
- Maintain
- Demolish
- Plant

The name of this standard is the “Standard for Infrastructure Delivery Management System (IDMS). A Framework Policy was adopted in 2019 by the National Treasury to strengthen the IDMS and to formalise linkages with other industry standards.

2013: From the National Water Act (Act 36 of 1998) stems the National Water Resource Strategy (NWRS2), which lists water allocation priorities. The third highest priority in this strategic document (DWA, 2013) addresses “poverty eradication and water use that will contribute to greater racial and gender equality”. These challenges are very prominent in smallholder irrigation schemes in rural areas in South Africa.

2013: Van Averbek (2013) sheds much light on possible farming system innovations and social resource innovation constraints in his study. The report lists “Policy recommendations” for canal irrigation in the Vhembe area. One crucial recommendation is that plot holders be encouraged to apply for free hold property ownership. The study investigated social and complex scientific issues such as soils and crop production at the same site.

2013: Within four years after the inception of the Comprehensive Rural Development Programme (CRDP) by the DRDLR (2009), the very same government department conducted an impact assessment (DRDLR, 2013) in conjunction with the presidency. This evaluation document recommends a radical approach to agrarian reform by actively supporting the

creation of smallholder farmers. This may also include the settlement of smallholder farmers outside communal areas.

2013: Government has adopted a Rural Development policy framework (The Presidency, 2013) to guide rural development. This document is very important for this study because the author will focus on the rural space and, more specifically, the communal setup. The framework lists the legislation which established the Bantustan environment. It then explains the proposed “Agrarian transformation strategy” and identifies a new development program on a catchment level. Irrigation development would be part of this program. The first component of this initiative is “Human resource development of communities along the riverbanks”. Other components include water management, crop management, livestock management and value-adding.

2013: A paper presented by Backeberg and Sanewe (2013) at a forum held by the International Commission on Irrigation and Drainage (ICID) stated that only a meagre percentage of South Africans, youth and others, are involved in entrepreneurial activities. Therefore, this paper recommends prioritising securing access to land and water and practical training for skills development by supporting individual capabilities. The author's view is that training courses should focus on the entrepreneurial attributes of smallholder farmers.

2013: A birds-eye view of irrigated areas worldwide is provided in the “Update of the Digital Global Map of Irrigation Areas to Version 5 (Siebert *et al.*, 2013)”.

2013: The Project Management Institute (PMI) based in the US published a guideline (PMI, 2013) to assist practitioners in following a comprehensive and systematic approach to achieving best practice goals in this specialised field. It also serves as a checklist for activities and standard terminology. Each activity package includes the required inputs as well as the expected outputs. One cannot proceed to the next activity package if the previous activity package is not completed or signed off. This study will explore the possibility of creating a similar Body of Knowledge (BOK) to revitalize smallholder irrigation schemes. It will invite the “junior” partner (farmer or farmer group) to the development initiative to ascertain the exact position of the project on a timeline or similar indicative graph or road map. It might also be a requirement that the farmer association will be the party which will authorise and sign off each

activity package. In this way, they may obtain the “VISA” discussed earlier. They will, therefore, “swipe” each activity package and be in control of their destiny.

2014: An extensive international study in development explores different types of cross-sector partnerships. Kindornay *et al.* (2014) explain and categorise the value of partnerships in the developmental arena in this research report. They focus on the impact of partnerships on the individual, society, and the organisation. This research report (Kindornay *et al.*, 2014) highlights that the smallholder irrigation farmer does not produce a crop in isolation from the inside and the outside world. The North-South Institute, an independent policy research body in Canada, conducted this study.

2014: An important case study was conducted at Tugela Ferry in Kwazulu-Natal. The paper was published in Water SA, titled “The impact of smallholder irrigation on household welfare: The case of Tugela Ferry irrigation scheme in Kwazulu-Natal, South Africa”. The case study (Sinyolo *et al.*, 2014) concluded that government investment in revitalising smallholder irrigation is justifiable and that other rural micro-projects be implemented in conjunction with the irrigation initiatives to reduce poverty significantly.

2014: A beneficial study focussing on water conservation developed a typology for emerging farmers. Six basic types of farmers were identified according to their ability to conserve water and their position on the food value chain. This typology might be helpful in other smallholder irrigation farmers' studies. The study title is “An investigation of water conservation in food value chains by beneficiaries of water allocation reform and land reform programmes in South Africa”. The report (De Lange *et al.*, 2014) included recommendations but had three different guideline documents aimed at three other role players in water conservation. The information also focused on the linkages between land and water reform.

2014: An implementation plan for the whole agricultural sector, including the commercial and emerging farmers, is the “Agricultural Policy Action Plan” and a five-year road map for agriculture. The policy document (APAP) was adopted in November 2014 by all role players in the industry. The document (DAFF, 2014) states that more than half of the smallholder households live below the poverty line. Although the number of extension officers visiting smallholder farmers has increased from 8% to 13% from 2009 to 2013, the support by the

government for this category of farmers is still inadequate. Irrigation smallholder farmers are only a portion of the total number of smallholder farmers.

2014: A compelling piece of legislation linked to any meaningful infrastructure development is the Infrastructure Development Act 23 of 2014 (Government of South Africa, 2014a). This legislation stems from two other important strategic plans: the National Development Plan (NDP) and the Strategic Integrated Projects (SIP) priorities. This legislation might be very relevant if the revitalization of all smallholder irrigation schemes (RESIS) in South Africa is collectively adopted as a SIP project. Contributions in this thesis could support this possibility. The criteria in Act 23 under which this can happen are the initial SIP priorities listed in Schedule 1 in the act (Productive rural and agricultural infrastructure) and Schedule 3: Item 11 (SIP 11: Agri-logistics and rural infrastructure). The Irrigation Strategy for South Africa (DAFF, 2015) does not explicitly refer to Act 23 but does refer to the relevant SIP priorities.

2014: Davids and Theron (2014) explain the evolutionary path of developmental practice and theory over time. They indicate the different approaches during post-war times and the present. Present approaches revolve around people-orientated theories. As explained above, the current best practice for smallholder irrigation development in South Africa does apply the most recent developmental theories. The author supports this approach but is concerned about using best practices by government agencies and NGOs.

The author will demonstrate that the government and NGOs, which currently constitute the drive for the revitalization of smallholder irrigation, are heavyweight, whilst the smallholder farmer is still a toddler. It is not a fair “fight”. Governments and NGOs have budgets, policies, structures, systems, human resources, knowledge, and expertise, while smallholder farmers have almost nothing. As confirmed by the Director of Water Use and Irrigation Development (WUID), in a personal interview, smallholder irrigator farmers are not even organised in a commodity group. As the focus of the study, the author will propose a toolkit available to smallholder farmers that will bring them to the same level as the “heavyweight”.

2014: Anthea Jeffery questions the value of Broad-Based Black Economic Empowerment (BBBEE) in South Africa. Her book (Jeffery, 2014) was published precisely ten years after the relevant piece of legislation was tabled in parliament. On page 384, she states that the promised benefits of BBBEE have not materialised, and at the same time, the costs have been sky-high.

On page 399, she believes BBBEE has constricted the Mining and Agricultural sectors to impact employment negatively.

2014: The Medium-Term Strategic Framework (MTSF) is Government's strategic plan for the 2014-2019 electoral term. It reflects the commitments made in the election manifesto of the ruling party. The MTSF (Government of South Africa, 2014b) sets out the actions Government will take and well-defined targets to be achieved. The 2014 MTSF addresses smallholder farmers as a focused group in society.

2015: The Department of Agriculture, Forestry and Fisheries (DAFF, 2015) adopted a long-awaited document in the irrigation sector in March 2015. This document is called the "Irrigation Strategy for South Africa". The document was adopted 21 years after a democratic South Africa was established and focuses on subsistence farmers. The strategy identifies (DAFF, 2015) objectives, priorities, responsibilities, and principles for initiatives undertaken to revitalize and expand irrigation schemes in South Africa. It does not focus on the entire irrigation sector, meaning the commercial and emerging sectors. This may be an omission, or the title should have indicated that the focus is on the emerging sector. The strategy is still valuable for this study and is right on time. The strategy proposes different intervention measures which will assist the government in achieving applicable objectives in the Medium-Term Strategic Framework (MTSF) and Strategic Integrated Projects (SIP). The document does not implicitly state that smallholder irrigation has failed at large but does indicate the number of hectares identified to be revitalized in South Africa.

2015: One month after the above South African policy document was finalised, the African Union Commission adopted a visionary document called Agenda 2063 (African Union Commission, 2015). One "Critical enabler" listed is of interest in this study. Critical enabler "e" is about "changing attitudes and mindsets". It is partly to strengthen Pan-African values of self-reliance, solidarity, hard work and collective prosperity. It is also partly to build on African successes, experiences, and best practices. Most of the references in the literature review identify best practices. The paradigm of this study (Afrocentric) is also aligned with the spirit of Agenda 2063.

2015: A few months after the "Irrigation strategy for South Africa" was adopted, a fascinating study report was published. This study builds on the six farmer typologies adopted by WRC

(Report No. 1958/1/14) to include different farming systems. An interesting new thinking from this study is the “expansion of the concept of irrigation development to one of agricultural water development”. The new concept (Denison *et al.*, 2015) integrates other water methods, such as water harvesting and Multiple Use Services (MUS).

2015: The International Water Management Institute (IWMI) publication is not very positive about the progress of certain high-profile smallholder irrigation development projects in South Africa (Stevens & Van Koppen, 2015). The report is concerned with partnerships with commercial farmer organisations. The author is not convinced that government can monitor these partnership agreements.

2015: The Free State Department of Agriculture and Rural Development (FS-DARD) authorised a document (Rekgonne Community Projects, 2015) called the “Project Implementation Plan: Revitalization of three Thaba Nchu Irrigation Schemes in September 2015. This report paved the way for funding, authorisation, and detailed planning of the revitalization of the three schemes. It proposed a four-year implementation plan and estimated the total cost of the initiative.

2015: Monokoane (2015) completed his study evaluating socioeconomic factors for the sustainable reuse of irrigation schemes in Thaba Nchu. Monokoane (2015) concluded that socioeconomic factors should receive special attention in any attempt for revitalization, whilst more than 70% of residents are unemployed. Grobler and Mokone (2015) compiled a document detailing project planners' needs as part of procurement processes. The document title is “Scope of work: Revitalization of three Thaba Nchu irrigation schemes”. The document took an approach whereby current best practice was to be followed in the planning process.

2016: The Department of Planning, Monitoring and Evaluation (DPME) initiated a laboratory and workshop type of engagement with industry, government, and society to expedite the achievement of targets set out in different government policies and strategies. Each government sphere was addressed at a time. The initiative relevant to this study is called Operation Phakisa: Agriculture, Rural Development and Land Reform (DPME, 2016). The main strategic objective of agricultural water is that all role players should work towards “unlocking water for irrigation farmers”. Fortunately, sufficient water is available at all three targeted

smallholder schemes at the Thaba Nchu Irrigation Schemes. The challenge at hand is ensuring water gets to the root zone in a communal set-up and improving the livelihood of smallholders.

2016: Ebenezer College in Zimbabwe demonstrates a working model for establishing smallholder farmers. In the magazine article “Lessons from our smallholder neighbours”, Jack Armour explains (Armour, 2016) his observations on visiting this organisation south of Bulawayo. The success is based on a three-year apprenticeship where farmers are moved to “businesspeople with a business mindset”. The learner at the college provides labour but also shares in the farm's profit. The author sees this as being a high form of shared responsibility.

2016: Fiscal Commission of South Africa: The 16/17 Submission to National Treasury. The submission (National Treasury, 2016) should inform the allocation of revenue by National Treasury to all levels of government. The commission is a government organisation which employs experts in the field of revenue allocation. The detailed document asks critical questions about the government's possible “return on investment” on capital projects. On investments in irrigation development in rural areas, the submission asks if upgrading a road in a rural area is better than an irrigation infrastructure. The author believes that any business plan on irrigation development should consider this broader view.

2016: The Abstracts of Agricultural Statistics (DAFF, 2016) estimate the total area under irrigation in South Africa to be 1 354 128 ha. This figure helps compare the extent of global, continental, and local irrigation with the irrigation projects selected for this thesis and smallholder irrigation in South Africa.

2016: The author of this thesis conducted preliminary interviews with government officials, NGO's and consultants actively involved with the revitalization of smallholder irrigation schemes in South Africa. Most interviewees confirmed that the revitalization of smallholder irrigation schemes is still failing. This preliminary conclusion is the motivation of this study. The main research question remains why these initiatives are still failing despite well-researched “best practice guidelines”. The preliminary interviews are summarized in Table 2.1 as follows:

Table 2.1: Summary of Preliminary Interviews

Institution	Do you personally think that RESIS in South Africa is successful?	Do you think that we need a totally new approach?
Director: Water Use and Irrigation Development, DAFF	50%, question	Yes, on social facilitation
Director: Rural Integrated Engineering (Ring)	No	Maybe
Irrigation Engineer: IAE, ARC	No	No
Irrigation Scientist, FS-DARD	No	No
Chief Engineer: Western Cape Department of Agriculture	Struggling	Yes
Director: Agricultural Engineering, Limpopo Department of Agriculture	No	Yes
Chief Engineer, Department of Agriculture, Mpumalanga	Partially	Yes
Deputy Director: Water Use and Irrigation Development, DAFF	No	Yes
Senior Researcher: Policy Research, IWMI	No	Yes, on implementation

The researcher agrees with most interviewees that a new approach for revitalising smallholder irrigation schemes is required. It is evident that collectively, these farmers can make a measurable contribution to local and regional economies. Most of these irrigation schemes are also located in poverty pockets (Denison & Manona, 2007).

2016: A report titled the “Dam Yield Report for three Thaba Nchu Dams”, compiled by a civil engineering company SMEC was included as a chapter of the Implementation Plan for Sediba, Feloana and Woodbridge Irrigation Schemes. This investigation report (SMEC, 2016) indicates that water available for irrigation in the three schemes is much less than calculated when these schemes were planned and expanded over several decades. The new figures, however, will make any new feasibility study much more accurate.

2016: A mind shift in smallholder irrigation farming published by the Water Research Commission is called “Appropriate entrepreneurial development paths in the transition from

homestead gardening to smallholder irrigation crop farming in the Eastern Cape Province of South Africa”. This report shares light on a new but critical aspect of farmer development (Ajuruchukwu, 2016). Results of In-field Rainwater Harvesting and Conservation (IRWH) Research conducted in the Thaba Nchu Area (Blignaut & Sibande, 2008) also reveal evidence that homestead gardeners are hesitant to move from the homestead to crop fields.

2017: As part of the “flagship” programme of the DALRRD, the AgriPark Programme, the Sediba Village was identified to be supported by a Farmer Production Support Unit (FPSU). The AgriPark Model includes a centralised hub in each of the forty-five district municipalities of South Africa. The MMM Agri-hub was identified to be in an industrial area in Thaba Nchu. Each Agri-hub may have several satellite sites, such as a Farmer Production Support Unit (FPSU). A planning document to initiate the Sediba FPSU was prepared on behalf of DALRRD by Urban-Econ. The feasibility report is called the “Business Case: Sediba Farmer Production Support Unit”. It does include the Sediba Irrigation Scheme, which will also benefit from the investment (Urban-Econ, 2017).

2017: A textbook, “Introduction to participatory community practice” by Schenk et al. (2017), discusses the principles of the above discipline. These principles must be understood and included in the proposed toolkit for the sustainable revitalization of smallholder irrigation schemes. These principles have a solid theoretical base and include the following:

- People centeredness
- Participation
- Empowerment
- Ownership
- Self-reliance
- Sustainability
- Learning process

2018: The State of the Nation Address (SONA) has always pointed to important political directives in the agricultural sector, and this time around, it focussed on a shift regarding the type of farmer who will benefit from government support (Ramaphosa, 2018). It mentioned the number of commercial farmers the government will establish annually for five years. The State of the Province Address (SOPA) has confirmed the shift in the State of the Nation Address

(SONA) to also refer to the number of black commercial farmers government intend to establish during the term of the current government (Magashule, 2018).

2018: “An earth observation approach towards mapping irrigated areas and quantifying water use by irrigated crops in South Africa” is a valuable breakthrough to the knowledge base for the irrigation sector in South Africa. This model (Van Niekerk *et al.*, 2018) can now calculate the area of crops under irrigation at any given time of a season. It can, therefore, also capture trends over time and at different climate conditions. Hopefully, the smallholder irrigator community can use this model to put themselves on the map.

2018: A textbook by Cloete *et al.* (2018) provides insight into various policy issues applicable to developmental projects such as revitalising smallholder irrigation schemes. It also promotes “Project Management” as a vehicle for implementing government policies and programmes. Several benefits of a new shift in project management approaches are listed.

2019: The draft document (Draft 7, Version 2) for producer support in the agricultural sector was issued in 2019 with the title “National Policy on Comprehensive Producer Development Support”. This draft document stipulates seventeen principles for such support to farmers. Although the policy document is not approved yet, it does assist in identifying gaps in the knowledge base for the revitalization of smallholder irrigation schemes (DAFF & DRDLR, 2019).

2019: A framework policy to strengthen all existing government infrastructure development and investment standards was published on 1 October 2019. It was issued as an internal communication through the National Treasury Instruction No. 3 of 2019-2020 as the “Framework for Infrastructure Delivery and Procurement Management” (FIDPM). It is a very strong policy document (National Treasury, 2019) originating in Clause 217 of the Constitution of South Africa.

2020: The relevant sponsor government department issued an engineering and construction close-out report (Eloff, 2019) of the completion of infrastructure development at Sediba Irrigation Scheme. The purpose of infrastructure development at Sediba is twofold. Firstly, it supports the Sediba Irrigation Scheme, and secondly, it constitutes the Farmer Production Support Unit (FPSU), which is part of the AgriPark Programme of DALRRD. The document

name is “The design and construction monitoring of Sediba Irrigation Scheme upgrading in Thaba Nchu within the Mangaung Metro Municipality: Free State Province”. According to the report, no significant challenges were encountered during construction. The only recommendation is that joint ventures need to be managed carefully. It is worth noting that the engineer did provide operating and maintenance manuals for complicated installations such as irrigation pumps and solar systems.

2020: A fascinating report published by the World Bank Group in 2020, Accelerated irrigation expansion in Sub-Saharan Africa, policy lessons from the global revolution in farmer-led smallholder irrigation. Farmer-Led Smallholder Irrigation (FLSI) is categorised as follows:

Examples:	Boreholes and river lift pumps
Size:	0.1-10 ha
Ownership and management:	Individual farmers, small group
Dominant institution:	Decentralised
Current status:	Booming in South and West Asia
Key Governance challenge:	Chaotic, unregulated growth

The World Bank Group (2020) describes the above category of smallholder irrigators as being a “Global Revolution”. The advantage is that farmers do not rely on a shared bulk water storage and supply system. It stresses that smallholder irrigation schemes have various challenges around group dynamics.

2020: The Water Research Commission (WRC) has made major improvements and updates to the Irrigation Design Manual, first published in 1996 and updated in 2020 (WRC, 2020a). In the new revision, the Irrigation Design Manual and the Irrigation Users’ Manual are updated extensively (WRC, 2020b). A major shift is from water conservation to water loss accounting. The Irrigation User’s Manual will assist commercial and subsistence irrigation farmers regarding water use efficiency and the most recent technologies. This aligns with the National Water Resources Strategy Two (NWRS2). The two manuals are contained in WRC Report No. TT819/1/20 and TT819/2/20.

2021: The South African Irrigation Institute (SAII), an industry non-profit organisation, published the “SABI Agricultural Norms for the design of irrigation systems” in July 2021.

This standard (SAII, 2021) focuses purely on technical norms for design assumptions and calculations.

2022: The Department of Water and Sanitation (DWS) had a recent publication which may impact the viability of any irrigation scheme, the draft National Pricing Strategy for Raw Water Use Charges (DWA, 2022) South Africa.

The knowledge base relevant to this study evolved over the past three decades, as shown in Figure 2.1. It is advantageous that from 2013 to 2022, many studies and reports were published directly related to the objectives of this study. It includes long-awaited documents such as the “Irrigation Strategy for South Africa” adopted by DAFF.

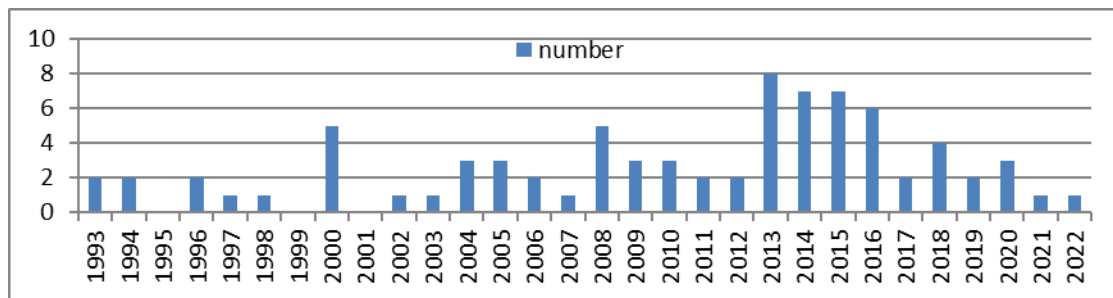


Figure 2.1: Number of References on a Timeline.

2.2. SELECTED PARADIGM

The chosen paradigm for the research study is subdivided as follows:

2.2.1. Ontology

The study will focus on smallholder farmers' environment and how they respond to it. Environment means the socio-economic rather than the physical environment, including natural resources. The focus is more on what will motivate the farmer to cooperate with a government programme rather than what crop type to plant. The approach of this study is that “no external reality exists independent of our beliefs and understanding” (Ritchie *et al.*, 2014). Farmers elect the government, and government serves farmers. Farmers elect a government with the belief that the government will, in turn, support farmers. This approach is called Idealism.

Furthermore, this study will view the world from a Collective Idealism perspective. This means that “the social world is made up of representations constructed and shared by people in a particular context” (Ritchie *et al.*, 2014). The smallholder irrigation farmers in the Free State produce crops under the communal land system; they are previously disadvantaged. They are not commercial farmers, and government policy mandates support them. They can be categorised in a particular context. This study understands that the above variables are interrelated, and that reality exists primarily because of what role players think and believe.

2.2.2. Epistemology

Epistemology concerns “ways of knowing the world and learning about the world” (Ritchie *et al.*, 2014). It focuses on issues such as how we can learn about reality and what is the basis of our knowledge.

This study does opt for deductive logic to learn from the world around us. This approach starts with a theory and then proposes a hypothesis which is then applied to observations in the world. The hypothesis can be confirmed or rejected (Ritchie *et al.*, 2014). It is anticipated that the hypothesis of this study is strongly confirmed. It is believed that providing smallholder farmers with a tool to make them equal partners in a development project will substantially improve sustainable crop production.

Another epistemology concept applicable to this study is the pragmatic theory of truth. It is accepted that beliefs are valid if they have practical utility (Ritchie *et al.*, 2014). This concept may be useful if the proposed “revitalization” tools are introduced successfully. Various measures, such as the participatory approach (Denison & Manona, 2007), have been studied, but a tool to guarantee compliance is still missing. A marked improvement in smallholder crop production under irrigation, with the introduction of new tools, may then confirm the suitability of the pragmatic theory of truth.

The study will combine existing knowledge so that it will have a more significant impact than separate knowledge packages in the study field. Hopefully, new knowledge can also be produced. The knowledge will be produced in the form of systems and processes. It is anticipated that knowledge gained would be translatable into different tools such as:

- A body of knowledge (A set of standard terminology and guidelines for the revitalization of smallholder irrigation schemes, like the PMBOK Guide compiled by the International Institute for Project Management)
- A comprehensive checklist for implementers
- An output evaluation tool
- A process evaluation tool

2.2.3. Methodology

A methodology is a disciplined approach to generating that knowledge. This approach is key to developing a toolkit for the sustainable revitalization of smallholder irrigation schemes in the Free State Province. With one toolbox, the mechanic can repair a variety of vehicles. But the toolbox was carefully developed over time by many mechanics over decades.

2.3. UNDERLYING THEORY

The revitalization of smallholder irrigation schemes worldwide, particularly in South Africa, is a socio-economic developmental endeavour. Therefore, the underlying theory of this study will explore development theory applicable to communities which are currently regarded not to be at an acceptable level of living standards according to acknowledged criteria. In this study, there is a particular element added to the mix. The community is fortunate to have usable natural resources at its disposal.

Development theory is relatively new to the academic world. Most concrete works have occurred since World War II (Davids & Theron, 2014). Two historical periods, merchant capitalism and colonialism, influenced some of the most important development theories that emerged after World War II. These theories are the modernisation, dependency, and humanist paradigms. The first period (merchant capitalism) lasts from the 16th to the late 18th century. Slavery was one of the most pertinent elements of the trade. Merchants sometimes operated independently from states or governments. In the second period (colonialism), European countries scrambled for colonies to protect their resource access. Colonialism provided more opportunities for independent capitalist merchants in turn. By 1914, European countries had subdued Africa to their benefit. Colonialism had several features (Webster, 1984) which are stipulated below:

- Colonies were a source of cheap raw materials.

- Colonies were a source of cheap labour.
- A system of law and order was imposed upon colonies which suited European countries.

In this study, the first bullet can be linked to the natural resources of each village, the second bullet to the current socio-economic challenges of each community, and the last bullet to current legislation and policies applicable to rural communities in a tribal setup. It is alarming how “familiar” old features can sound. This is seen in the light that the Bantustan system, which was well and alive in the Thaba Nchu Tribal Area, was only dismantled as recently as 1994 when South Africa elected its first truly democratic government (Monokoane, 2015). The most visible trait of the above features is that it constituted an obvious “top-down” method or approach. To restore both the impact and source of the impact of this period, one will most probably have to explore a method opposite to this “top-down” approach.

The fact is that merchant capitalism and colonialism had a massive impact on existing forms of production, land ownership, labour patterns and political structures of millions of people in Africa and on other continents (Davids & Theron, 2014). Because the population of this research study was exposed to both merchant capitalism and colonialism over centuries, the above impacts cannot be ignored.

The modernisation theory arose from various Western social sciences community contributions after World War II. This theory stems from the superior thinking that under-developed countries must follow western development methods to become “developed”. Rostow’s stages of growth is a practical application of the modernisation theory, which includes the following five stages (Moll, 1986):

- Stage 1: Traditional society.
- Stage 2: Preconditions for take-off.
- Stage 3: Take-off.
- Stage 4: Drive to maturity.
- Stage 5: Age of high mass consumption.

Once again, this theory or paradigm constitutes a “top-down” approach, where the top is superior. The under-developed were not consulted in the conceptualisation of the theory or in the desirability of such a theory to be applied to them. Rostow’s theory argues that foreign

capital can be used to remove any obstacle to the development of the less developed country (LDC). This study will explore how any investment in the revitalization of smallholder schemes should flow or end up in the community.

New Colonialism was a perfection of western capitalist foreign trade with less developed countries, a form of socioeconomic dominance in Africa and elsewhere. It was first examined by Nkrumah, the president of Ghana, in the early 1960s (Davids & Theron, 2014). This period was characterised by the formation of huge multinational companies that controlled production from raw materials, processing, and retail.

The dependency theory originated in Latin America during the early 1960s because of the failure of the modernisation paradigm to address the underdevelopment of the less developed countries (LDC). Paul Baran popularised dependency thinking, the United Nations Economic Commissioner to Latin America and through the advocacy of André Gunder Frank. These theorists reasoned that the underdevelopment of specific regions and countries is created and maintained. Similarly, resources are sucked from rural areas to benefit urban areas (Davids & Theron, 2014). To improve the situation, Mabogunje is quoted by Davids and Theron (2014), who stated that “they should choose for themselves what kind of external relations they should maintain during the development process and what types of external influence they would allow permeating their society”. This study interprets this comment as advocating a “bottom-up” approach. This study will examine the validity of the dependency theory in the three Thaba Nchu villages selected as the research population.

The Humanist Paradigm proposes a people-centred development approach. This theory became the buzzword during the 1990s. It is a micro approach focussing on people and the community. It is developed firstly for people and secondly by people (Davids & Theron, 2014). People should define for themselves what constitutes a “better life”. Participatory approaches are very much linked to the above views. Participatory approaches (Denison & Manona, 2007) are also proposed by most researchers on the RESIS programmes as it is branded in South Africa. This study will focus on “how” communities can ensure that this realises, specifically when an external entity wishes to support development in a community. The question is how one can ensure that the people are put first. How can you ensure that other forces or drivers, such as expenditure targets and personal dreams, are not put first? This study aims to identify a systematic approach to putting people at the centre of development.

People-centred development in post-Apartheid South Africa has become essential to the policy-making environment through the main building blocks such as public participation, social learning, social consultation, empowerment, and sustainability. Most importantly, for this study, participation must include the following:

- Participation in decision-making.
- Participation in implementation.
- Participation in monitoring and evaluation.
- Participation in sharing of benefits.

Participation is a cornerstone of the Reconstruction and Development Programme (RDP) in South Africa (Government of South Africa, 1994). Participation by the public should be active and voluntary to ensure the desired results. On the negative side, participation may have the following costs and constraints (Davids & Theron, 2014):

- It may be time-consuming.
- It can delay project start-up.
- It can increase demand for managers.
- It can bring historical issues to the surface.
- It can increase the risk of the project being co-opted by others.
- It can be perceived that only a few do participate.

Whilst this study does support participation, or participatory approaches, it will have to be aware of these costs or constraints when tools and methodologies for the improved revitalization of smallholder irrigation are being proposed and developed.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

The research methodology is a mixed-methods design. The primary research methodology applied is evaluation research. Three different types of evaluation research are described by Mouton (2014), which are implementation (process) evaluation, experimental and quasi-experimental and qualitative (naturalistic) research methods. Qualitative methods include empowerment evaluation methods.

This study opted for the last of the three. Qualitative evaluation research methods are used to describe and evaluate the performance of programmes in their natural setting and focus on the process rather than the outcome. This study intends to assess the current process of revitalising smallholder irrigation schemes. A commercial farmer can develop an average economic unit in a few months (with adequate resources). The revitalization of smallholder schemes (of the same extent) can take two to five years to get off the ground. The outcome is important, but experience has shown that much effort should be afforded to the process.

Empowerment Evaluation (EE) uses evaluation concepts and techniques to foster improvement and self-determination (Fetterman, 2001). Stuart Theobald wrote that decolonising science is not that far reached. He believes shifting to decolonising science is a paradigm (Theobald, 2016). This aligns with this study's paradigm; indigenous knowledge needs to be valued (Tempelhoff, 2006). This study listens to the African farmer himself. Both the qualitative and empowerment evaluation approaches are used.

The best attributes of these two approaches were explored to compile a system whereby best practice in the revitalization of smallholder irrigation is enhanced. Government and NGOs are believed to overshadow the smallholder farmer as an individual but more so as an organised commodity group. It can be explained in terms of a parallel. The parallel is that of the relation between a Passport and a Visa. To start with, you need both to visit certain foreign countries. We say the passport is the plan to visit a foreign country and revitalize an irrigation scheme. The Visa is the guarantee that the farmers have adopted the plan. It is proved that the farmers are the citizens of the foreign country, the owners of their destination. They have made decisions at each step, even though options and alternatives have been explained and provided. Empowerment evaluation seeks to involve beneficiaries of programmes through all decision checkpoints. Empowerment Evaluation represents the “VISA” in this case, as demonstrated in Figure 3.1.

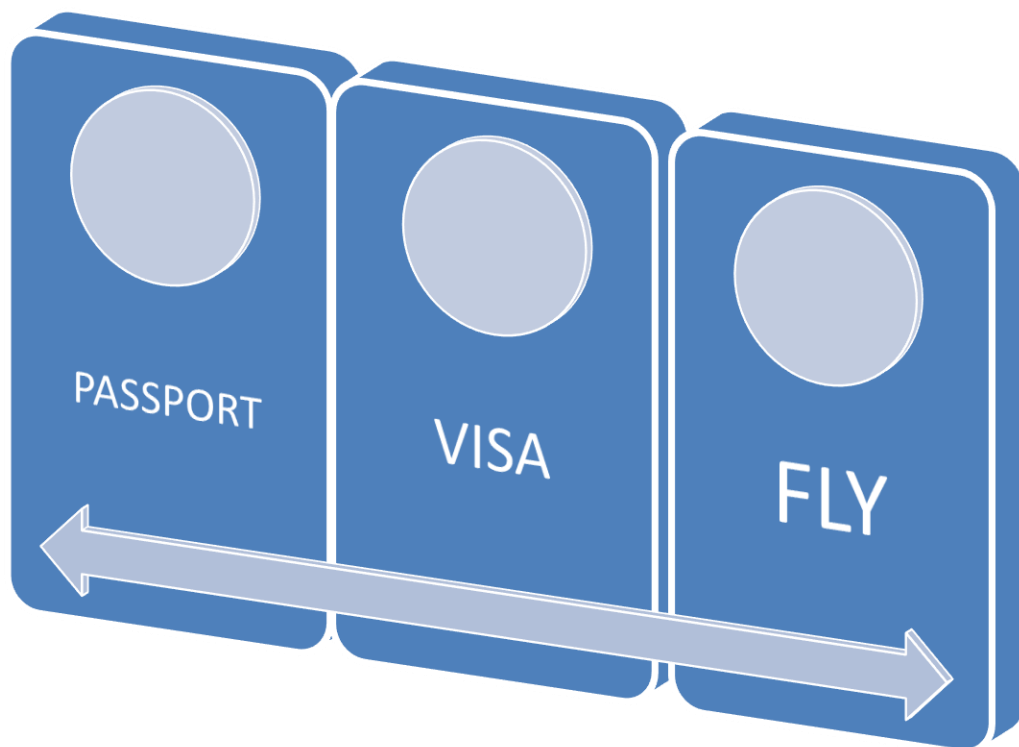


Figure 3.1: The Journey is Possible with Both a Passport and a VISA.

Developmental principles (Davids & Theron, 2014) suggest a participatory approach but do not prescribe controls. This study aims to ensure that best practice is applied in irrigation development through a method that involves the complete body of knowledge written into a system that will allow forward progression only when a minimum predetermined effort is completed. The study's starting point is to identify controls to be included and how such a system should function through interaction with the farmers.

Figure 3.1 indicates a possible solution to empower irrigation farmers. The “VISA” part includes a toolkit to lift smallholder irrigation farmers to the same level of the Government/NGO block (Passport). The result is that the productivity of smallholder irrigation schemes will “FLY”. This is a possible solution proposed which needs to be developed in detail. “VISA” should be developed to equal “PASSPORT”. The smallholder irrigation farmer should be an equal partner around the planning table and on the ground during implementation and operations. The VISA should be as crucial as the PASSPORT. The PASSPORT has been around for many decades (Government programs etc.). We now must put the VISA in place. The VISA represents the aspirations and decisions of the farmers. Without a VISA, the developmental project or programme will not FLY. As in the government's case, farmers

should also have their programs, policies, systems, and quality assurance. They must commit their assets to the partnership (Kretzmann & McKnight, 1993). This study explored empowerment evaluation (Fetterman, 1994) as a perfect fit to establish the so-called VISA.

The VISA may incorporate elements of the following tools:

- Algorithm
- Annual Performance Plan
- Analysis
- Application
- Assessment
- Authorisation
- Best Management Practice
- Board Resolution
- Body of Knowledge
- Certificate
- Checklist
- Continuous Improvement
- Condition
- Control
- Due diligence
- Examination
- Guideline
- Interface
- Investigation
- Manual
- Map
- Monitoring and Evaluation
- Operational Plan
- Pass rate
- Permit
- Power of attorney
- Program
- Procedure
- Process

- Project Charter
- Project Implementation Plan
- Project Management Plan
- Recipe
- Schedule
- Scorecard
- Standard Operating Procedure
- Strategy
- Study
- System
- Vetting
- Veto
- Visa application

The revitalization of the Free State's smallholder schemes will unfold over time. This happened in parallel with this study. Time will tell if this study's findings positively impact the revitalization of the three schemes and if the hypothesis can be proved correct or incorrect. Notwithstanding, it is believed that combining various knowledge areas into a toolkit for the revitalization of irrigation schemes can only make a positive contribution and cannot do any harm. However, a positive outcome of this study can provide more impetus for a new toolkit. It will add value if many practitioners and farmers use such a toolkit. For example, a toolkit for irrigation designers in South Africa is widely recognised and used. It even serves as the basis for the training syllabus for designers who wish to be accredited with the South African Irrigation Institute (SAII) in the designer category of membership. This toolkit addresses design aspects of irrigation systems but does not cover project management or socio-economic principles. This toolkit is called the "Irrigation Design Manual for South Africa" and is compiled and updated by experts in the irrigation sector in South Africa (SAII, 2021). A new toolkit could use the Irrigation Design Manual for South Africa as a first module and then expand on that to include various other modules to cover project phases such as project identification, feasibility, project authorisation, funding, social consultation, training, capacity building, production, and marketing.

Up to four (4) data collection instruments were used in this study:

- ✓ TOOL 1: Open-ended questionnaires (Industry leaders: e.g., Tribal authorities, academics, government officials, policymakers, sponsors, non-government organisations)
- ✓ TOOL 2: Open-ended questionnaire (Farmers)
- ✓ TOOL 3: Observations documented (Walk crop fields, satellite images)
- ✓ TOOL 4: Review of the knowledge base (Programmes, policies, guidelines)

In Tool 1, the intention is to obtain valuable inputs from industry leaders, carefully selected, who are/were intimately involved in the revitalization of small-scale irrigation schemes in the Free State Province and other irrigation regions in South Africa. Such industry leaders represent well-established organisations such as the Water Research Commission (WRC), Agricultural Research Council (ARC), Department of Agriculture, Forestry and Fisheries (DAFF), the International Water Management Institute (IWMI), universities and non-government organisations.

The principal investigator was fortunate enough that the focus area of this study was well-studied. In addition to the authors of studies and textbooks, various “industry leaders” were identified to be interviewed. Thus, the logic behind Tool 1. One such example of an Industry Leader is Mr Felix Reinders, former supervisor of the principal investigator and outgoing president of the International Committee for Irrigation and Drainage (ICID). This international committee represents an industry that uses the largest portion of almost 70% of global freshwater withdrawals (FAO, 2017). This is only one example of an industry leader with expertise and knowledge who contributed to this study. The basic framework of Tool 1 and Tool 2 is very similar, except it is meant for two different audiences. Results from Tools 1 and 2 complemented each other in many ways.

3.1. SITE SELECTION

The study intended to influence both government policy and best practice through the research design, to positively impact crop production on three irrigation schemes in the Free State province. The study adds to the knowledge base of the theme under discussion and presents it differently to provide practitioners with workable tools. Therefore, the study views the research question through an epistemological lens. The study investigates all applicable policies, legislation, literature, guidelines, evaluation reports, case studies and best practices to arrive at

something which can have a noticeable impact on the quality of life of smallholder irrigators in the Free State Province.

The target area is the Free State Province, central South Africa (Figure 3.2). The Thaba Nchu rural area is within the Mangaung Metro Municipality area of jurisdiction. Still, the Maroka Tribal Authority also have certain constitutional rights, only within communal areas within the metro boundaries. For instance, the Tribal Authority owns all agricultural land in the tribal areas. In the context of the previous political dispensation, the Maroka tribal area was part of an independent state known as Baphutatswana. The three sites for the study are situated at three of 40 villages in the Thaba Nchu tribal area. The three villages are Sediba, Woodbridge and Feloana. The three existing but collapsed smallholder irrigation schemes are named after the three villages. A summary of the population demographics is extracted from Monokoane (2015) and indicated in Table 3.1. The three villages are very rural and untouched by modern life. People are also amongst the poorest in the Metro Municipality. The most important natural resource is the availability of surface water and one earthen reservoir for each village. The runoff water, stored in the three reservoirs, is exclusively available for each village for irrigation and stock watering purposes. The three villages are very fortunate that the water was not taken up by industry and mining, in the light that water was not used optimally during the past two decades.

Table 3.1: Summary of Population Demographics of Three Villages Selected for this Study (Monokoane, 2015)

Irrigation Scheme	No. of Households	Male	Female	Total	Youth	Disabled
Sediba Scheme	82	116	103	219	131	5
Woodbridge Scheme	158	214	228	442	316	16
Feloana Scheme	146	236	199	435	267	2
TOTAL	386	566	530	1096	714	23

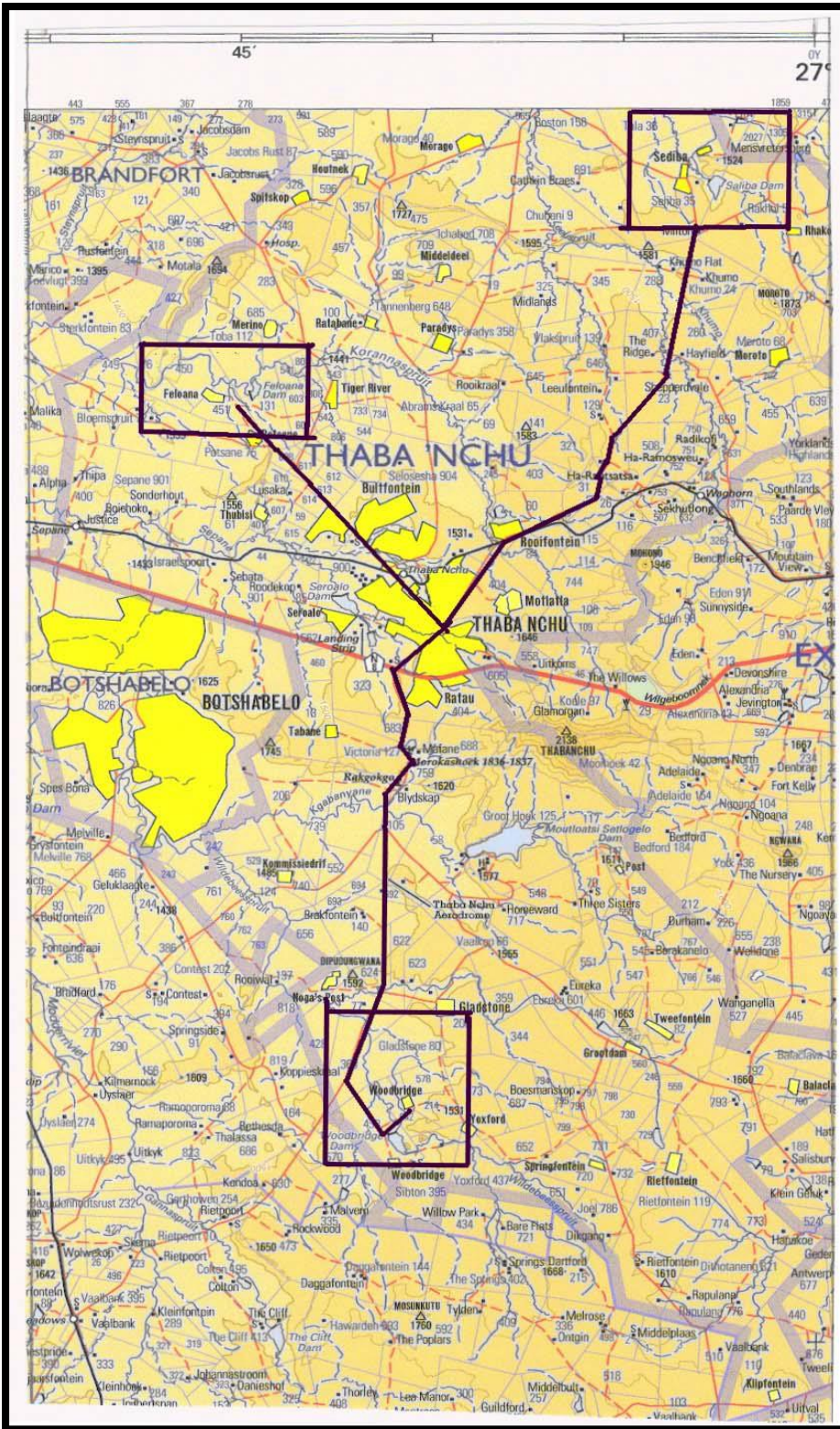


Figure 3.2: A Map of Thaba Nchu Tribal Area Indicating the Locality of the Three Irrigation Schemes Selected (Monokoane, 2015).

Whilst the case under study is in a rural setup under tribal rule, this study is grounded in an Afrocentric philosophical lens or paradigm (Okeke & Van Wyk, 2015). Moreover, this

paradigm is most applicable because many farmers produce crops on small pieces of land. Unlike other research paradigms, the Afrocentric belief system emphasises moral beliefs rather than theory. The Afrocentric paradigm focuses on inclusivity, equality, values, social justice, fairness, and transformation (Okeke & Van Wyk, 2015), which is applicable in the case under study. In the Limpopo Province, irrigation infrastructure was vandalised (Stevens & Van Koppen, 2015) because farmers were excluded from certain processes and decisions. One needs a solid air of togetherness where people depend on the same resources in a small space. Society is also experiencing a communication revolution where people know everything of everything and have strong political awareness as a result. People in most distant corners are no longer excluded from the rest of society. In addition, a rich cultural history of irrigation farming over many centuries does exist in Southern Africa (Tempelhoff, 2006). Tempelhoff describes the existence of complicated irrigation and canal systems discovered in Zimbabwe.

3.2. SAMPLING

In contrast to other provinces, the Free State has few collapsed smallholder irrigation schemes (Denison & Manona, 2007). There are less than five collapsed schemes in the Thaba Nchu tribal area, and three have been selected to be included in the sample location. They are in a radius of about 30 km around the Thaba Nchu node. All three villages are very rural; they relate to the outside world with gravel roads and do not have a supermarket or a police station. The production system and land tenure are communal. All three villages are under the same tribal authority (Maroka) and within the same local government (Mangaung Metro Municipality). Accidentally, Thaba Nchu is the only tribal authority in South Africa located within a Metro Municipality. The three villages are also within the same tertiary rainfall catchment area. The climate, average rainfall and average temperatures are also very similar.

The number of farming units in the three villages is as follows (Monokonae, 2015):

• Feloana	51
• Woodbridge	70
• Sediba	38
TOTAL	159

It should be noted that the number of farming units differs from the number of households in the villages or communities listed in Table 3.1. The sample size will be related more to the number of farming units.

There are indications that the number, location and size of irrigation plots will change, mainly because of less runoff from the catchment than previously assumed (SMEC, 2016). The number of pre-intervention farming units was used to determine the sample size. Interviews and questionnaires focused more on the farmer and competencies than the irrigation plot per se. The success rate and any projection of the intervention measures at the three villages (schemes) can only be measured over the medium term.

According to Johnson and Christensen (2004), the sample size of a population of 159 is 113. This is approximately 71% of the population. In a personal interview with Dr Lynette Jacobs (6 May 2019), she advised that one can even consider using the whole population as the sample in this case. It proved to be a wise approach to follow because it was found that many plot holders have jobs elsewhere, and others have even passed on. Preliminary observations indicated a very homogeneous farming community regarding living conditions and educational levels. The sample size of 113 farmers is therefore regarded to be acceptable.

3.2.1. Sampling Criteria

The population was divided into three distinct sub-populations since a government state department identified the three villages for support. All three villages were included in the study to increase the population and to allow for any other value-adding to the study. Sample criteria are not applied intentionally, but it is anticipated that different results will be obtained from the three villages because of the differences indicated in Table 3.2.

Table 3.2: Sample Criteria to Indicate Differences Amongst the Three Villages Selected

Sample Criteria	Sediba	Woodbridge	Feloana
Different Locations	Approximate distance between the three Villages is 30 kilometres	Approximate distance between the three Villages is 30 kilometres	Approximate distance between the three Villages is 30 kilometres
Different Population Sizes (Households)	82	158	146

Difference in Integrity of the Community	More stable	Less stable	Stable
Difference in progress regarding project phases	Infrastructure completed; some capacity building done	Infrastructure incomplete due to contractual problems, little capacity building	Infrastructure planning at the preliminary design stage, little capacity building
Different sponsorships	Department of Rural Development and Land Reform (DRDLR)	Free State Department of Agriculture and Rural Development (FS-DARD)	Free State Department of Agriculture and Rural Development (FS-DARD)

Because the whole population is targeted as the sample, no specific sample criteria were applied.

3.3. QUESTIONNAIRES

3.3.1. Purpose of Farmer Questionnaires

The farmer questionnaires aim to determine the community's "assets". Only when you can find and mobilise community assets will you be able to build communities from the inside out (Kretzmann & McKnight, 1993)? Communities' assets are described as contributions of individuals, associations, and institutions. The overall purpose of this study is to compare the community's assets with the government's assets in the case where the government intends to invest in the revitalization of smallholder irrigation schemes. If it is proved that there is a vast difference in the assets of these two partners to the development initiative, measures will be required to establish an equal partnership. This study will assess the assets of the individual and the collective of the community.

3.3.2. Purpose of Industry Leader Questionnaires

The purpose of questionnaires aimed at industry leaders is to have an external view of the assets possessed by the farmer or farmer group. These questionnaires were not analysed statistically. However, it does complement the outcomes of the farmer questionnaires. The study includes a mixed research design with the farmer questionnaires and documented observations (Mouton,

2014). Extension services are available in the Thaba Nchu area, and extension staff is also explicitly allocated to the three villages targeted in this study. In addition, there are also other support services in the district and at the head office, such as engineering, agricultural economics, and research. Five questionnaires were completed for this purpose.

3.3.3. The Purpose for Documenting Observations

Site observations further strengthen and explain results from farmer questionnaires and include the following:

- Satellite images (cultivation areas)
- Assessments (infrastructure, knowledge base and farming systems)
- Soil reports (over time)
- Meeting documentation

3.4. ETHICAL CLEARANCE

The application for Ethics Clearance was submitted to the General Human Research Ethics Committee (GHREC) via the Research Information Management System (RIMS) portal. Ethical Clearance was confirmed on 12 November 2021 with Reference Number HSD2020/0262/21. Ethical Clearance is valid for twelve (12) months. Submitting the final research report to the ethics office is required.

3.5. FIELDWORK AND DATA COLLECTION

Research fieldwork was conducted in a very conducive environment. The three research sites are situated in a classic rural environment. Cattle and sheep sleep right next to the owner's dwelling each night. In some villages, no schools, shops or community halls can be found. Despite the lack of these facilities, residents are well-informed about global activities. No criminal activities were observed, and the researcher could conduct personal interviews in a relaxed setup. Although interviews were conducted without prior appointments, no interviewee objected to being interviewed. Special care was taken to observe general cultural protocol. All ethics prescripts were implemented and documented. The researcher is grateful for the support of the communities and community leaders.

Consent to conduct research was obtained from the relevant head man/head lady before any field work or filling of interview questionnaires. The village leadership informed the

community of the intended research study differently. In some instances, an information session was called for the whole community. In other cases, the head man/head lady informed the community about the study during a regular village meeting or a scheduled irrigation committee meeting. It was observed that communities have very effective communication methods.

No expectations of any changes, improvements, or investments in the irrigation schemes were created. During the fieldwork, household and irrigation plot numbers were recorded on the individual consent forms to improve the accuracy of the information. Data were processed in a way that the identities of respondents could not be traced. The principal investigator (PI) was assisted by selected community members to conduct interviews and to translate questions either to Sesotho or, in a few cases, to Afrikaans. The PI provided training to the assistants on the background of the irrigation schemes and the purpose of the research study.

The PI monitored the quality of interviews and the completion of interview questionnaires continuously. The PI has a fundamental knowledge of Sesotho and Setswana. No difficult situation of any kind was encountered during interviews or field observations. The community was found to be very open to outsiders. It was also advantageous that the PI provided technical support in a personal capacity, representing the Provincial Department of Agriculture, to the irrigation schemes for fifteen years.

3.6. DATA PROCESSING AND STATISTICAL ANALYSIS

Qualitative and quantitative results are included in this analysis as follows:

- ✓ SPSS version 28 was used for the analysis of quantitative data. Qualitative data was analysed by creating themes and coding responses accordingly.
- ✓ Statistics for numerical data included measures of central tendency. Results for central tendency were written mean \pm standard deviation unless stated otherwise.
- ✓ Frequency tables were produced for all categorical data (multiple choice-like questions). Percentages include all participants; valid percent include only participants who answered the question. Tables can be integrated at the researcher's discretion.
- ✓ A short interpretation is provided underneath each table. Percentages were rounded off to 2 digits (no decimal places).
- ✓ Statistical significance was accepted at $p \leq 0.05$.

- ✓ In collaboration with the principal investigator, a statistician prepared the statistical analysis.

3.6.1. Research variables

The research variables are explained in Figure 3.3. Three “independent variables” were studied, while the fourth was excluded because it cannot easily be modified. Climate, soils, land size and the regulatory and policy environment are given. This study aims to identify and propose certain independent variables which can be altered and improved to increase the possibility for the revitalization of smallholder schemes in the Free State Province and hopefully in all nine provinces in South Africa. This study intends to clearly show that specific recommendations, already documented in the “revitalization” body of knowledge, can be implemented more successfully by putting the community behind the steering wheel of the revitalization process.

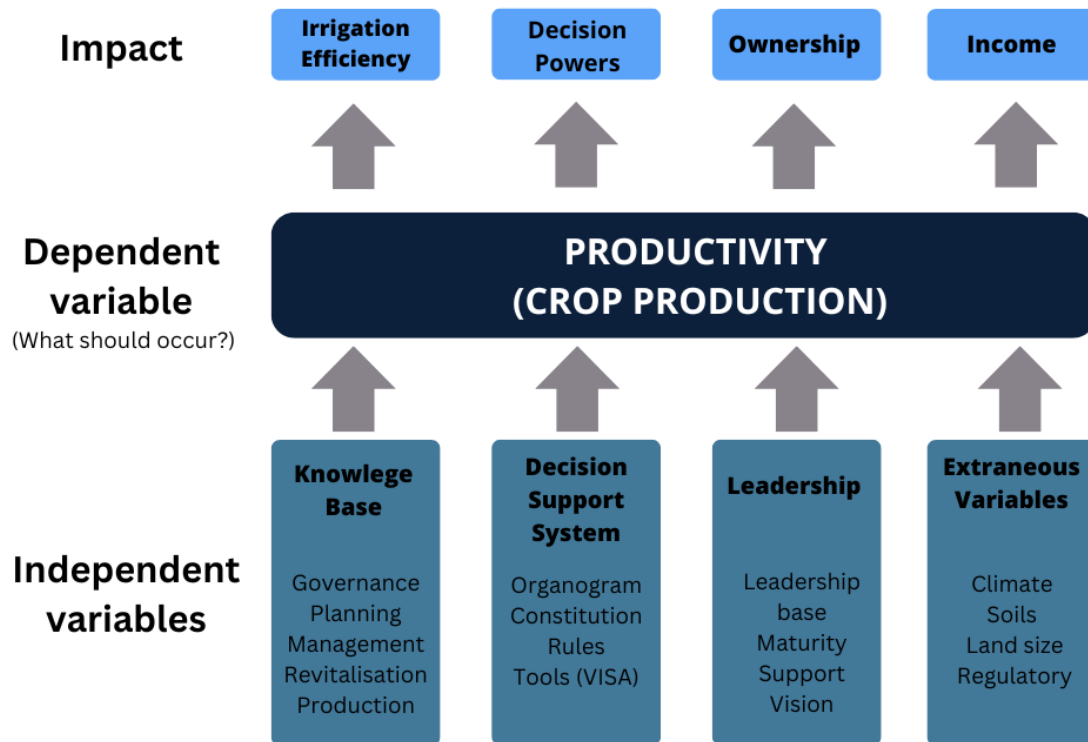


Figure 3.3: Research Construct Indicating Key Research Variables.

3.7. CONCLUSION

This chapter discussed how the research was conducted. It included using research instruments, ethical issues, and field work. It also discussed data processing and analysis. The next chapter discusses the study's results and explains pertinent trends and relations among variables.

CHAPTER 4: RESULTS AND DISCUSSION

Farmers completed the questionnaires enthusiastically, openly, and positively. Fieldwork was completed over three months. Additional information was acquired whilst conducting interviews with farmers. In all three villages, farmers and residents have a rich culture of cultivating vegetables and pastures. Cultivation, harvesting, and in some cases, the processing of produce is done whilst socialising with each other. They are also very proud of their products, such as their huge pumpkins and healthy “morogo” (Spinage).

Only a selected number of industry leaders were interviewed mainly to confirm current gaps in the revitalization of smallholder irrigation schemes which are not documented yet. It also includes extension support staff intimately involved in revitalising the Free State Province's three smallholder irrigation schemes. Industry leaders from other provinces also provided valuable insight into the realities of this developmental exercise. Inputs from industry leaders are summarised as follows:

- Successful farmers should be able to work in larger areas.
- RESIS requires competent and specialist extension staff.
- Each farmer must have their own basic mechanisation equipment.
- Allow farmers to make mistakes.
- The Communal Property Association Act (Act 28 of 1996) should be considered a vehicle to manage land included in the irrigation scheme.
- The CPA is to appoint the implementing agent for revitalization.
- Public Private Partnership (PPP) should be considered.
- Revitalization should be viewed in the context of rural development.

Observations during site visits were conducted in different ways. It was also possible to observe other necessary activities for profitable crop production. A farmer was busy dismantling a chisel plough on the bare ground to replace worn parts. A family was noticed hitting maize from the kernel with their bare hands and basic tools. On a sunny winter morning, a few strong men processed sweet-smelling lucerne chopped with a dilapidated hammer mill and a borrowed tractor. Farmers responded positively to difficult questions even though you could see the frustration on their faces. Still, no farmer had a negative view of crop farming.

In a nutshell, smallholders, and homestead gardeners in the three villages are the same people. Today you tend to your garden at your back door, and tomorrow you get on to a tractor in the open fields. “Farming Systems” applied by farmers and described by Bembridge (2000) makes huge sense when one becomes one with these communities for a few days. Each small-scale farmer, smallholder, and homestead gardener calculates what farming system will work for him. Farmers also use indigenous farming practices (Crosby *et al.*, 2000) by applying animal manure to crop fields to improve fertility and soil structure.

Overall, observations made on the research sites were motivational to conclude the study. Farmers practice crop production as a daily routine, like cleaning the house. This is a positive to work from. Different studies have indicated that farmers, especially homestead gardeners, are hesitant to move from the backyard system to the open fields. This tendency is also shown by In-field Rainwater Harvesting (IRWH) research results (Blignaut & Sibande, 2008).

Due to limited information available in the Free State Province, an effort was made to obtain as much information from the knowledge base in South Africa and abroad. Certain institutions such as the Water Research Commission (WRC) have produced vast research-based knowledge over three decades related to the research title. At the same time, it raises the question of why little progress was made on smallholder irrigation schemes in the Free State Province and other provinces in South Africa, whilst there is evidence of a smallholder irrigation boom in Asia (World Bank Group, 2020).

The review of the knowledge base also targeted other literature sources such as academic textbooks. One such textbook is “Development, the State and Civil Society” by Davids and Theron (2014). Another textbook is “Introduction to Participatory Community Practice” by Schenck, Nel and Louw (2017). These literature sources are critical in understanding basic human needs and behaviour.

Adequate data were collected to be able to make a positive contribution to the knowledge base. A good balance was struck between farmer questionnaires, industry leader questionnaires, site observations and a literature review.

4.1. DEMOGRAPHICS

Although demographics are not the focus of this study, it sheds light on the farming communities' character. Only basic demographics were explored.

4.1.1. Gender

Most participants were male (57%) (Appendix B). In general, it was not expected to have many male participants available because of migrant labour effects. On the other hand, various female participants travel to Bloemfontein daily, resulting in the unavailability of female participants for interviews.

4.1.2. Age

Most participants were 61 or older (32%). Although it may seem that all participants are close to retirement age, it is calculated that 50% of all participants are younger than 50 (Appendix B). It is still worrying that young people are not involved in smallholder irrigation in large numbers.

4.1.3. Level of education

Most participants attended secondary school but did not matriculate (40%). Only 23% of participants have matriculated, matriculation and tertiary qualification combined.

4.1.4. Summary

As expected, demographics indicate an average rural environment. As shown in other studies, it is a worrying fact that youth is not interested in crop farming, homestead gardening or smallholder irrigation.

4.2. CURRENT SITUATION

The current position of smallholder farmers on the three irrigation schemes selected for this study should be viewed from the farmers perspective, captured in the farmer questionnaires, and through site observations made by the investigator. Figure 1.1 compares the status of the smallholder irrigators with a ship on the ocean. The immediate observation from visiting the three sites is that the smallholder irrigators are lost on a big sea. There are vast areas which are not irrigated currently. Even on the irrigation plots provided with irrigation systems recently, few crop production activities are visible.

Analysis of the “Position” section (Appendix A) of the farmer questionnaires indicates a slightly different picture. Although some pertinent problems and challenges are restrictive to crop production, many inherent enabling factors exist. Figure 4.1 portrays a much more positive view of the current situation on the irrigation schemes. Problems experienced on plots almost equal enabling factors. Issues and challenges indicated by interviewees are very similar to those displayed by smallholder farmers on other schemes in other provinces in South Africa (Van Averbeke, 2008). Enabling factors shown by smallholder irrigators on the three selected irrigation schemes in the Free State Province is as follows:

- Irrigable lands are readily available.
- Soils are irrigable.
- Water is available in volume and when required.
- Farmers have basic knowledge of crop production.
- Farming is profitable.

The research question touches on why little crop production is visible in the Free State Province's three smallholder irrigation schemes whilst various enabling factors are present. This study aims to assist irrigation farmers to “re-position” and “Navigate” to a better destination. Statistical analysis of the position part of the farmer questionnaire indicates serious challenges and restrictive factors but also shows inherent enabling factors to build on (Figure 4.1).

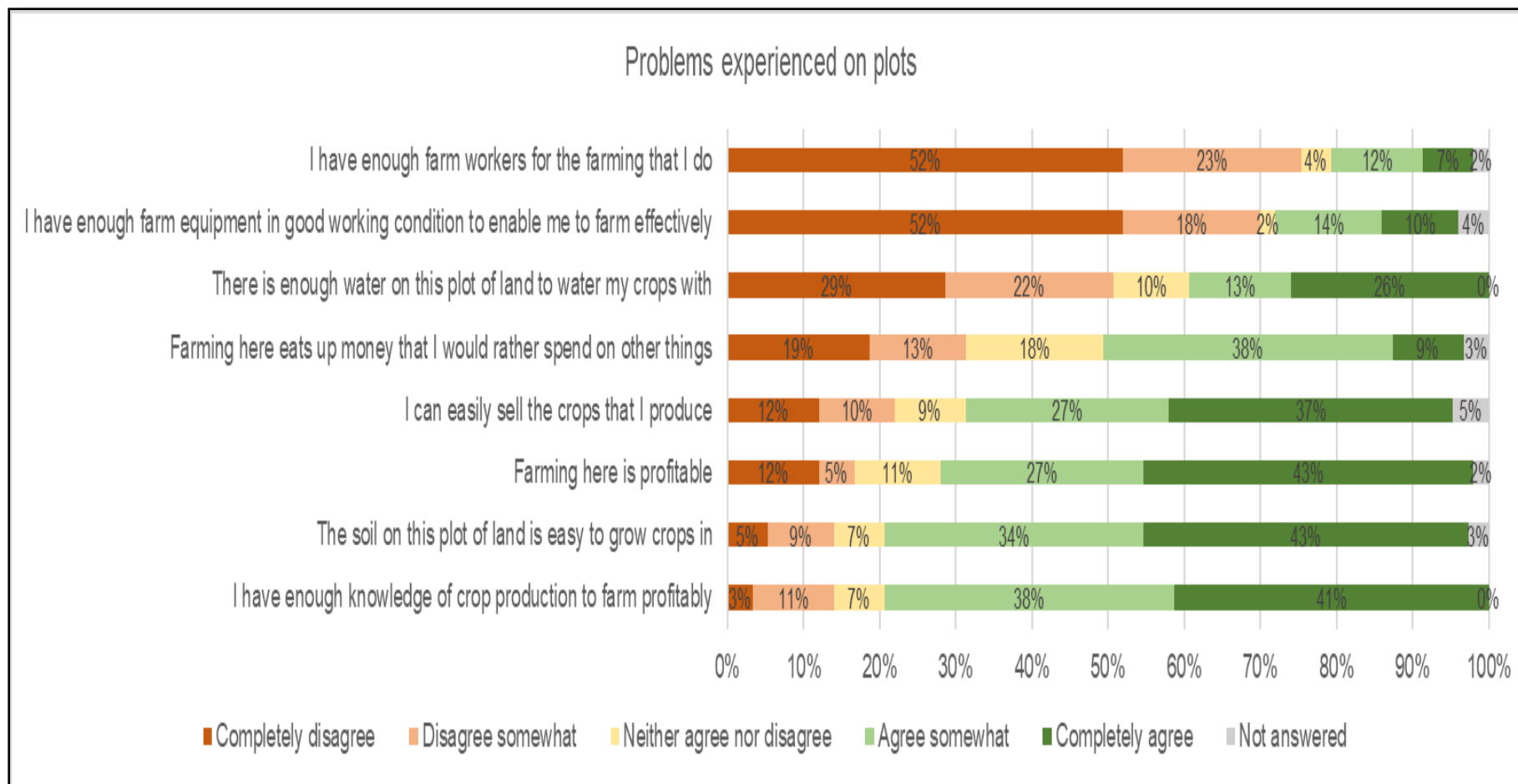


Figure 4.1: Problems Experienced on Irrigation Plots and Enabling Factors.

4.3. TARGET

For this study to have meaning, it is imperative to understand the dreams and aspirations of the smallholder irrigators on the three schemes in the Free State Province. The overall question is, “where do you want to go”? (Appendix A). Questions were asked from different angles to get a glimpse of their thinking.

4.3.1. Angle 1: Love of the Land

Analysis of the farmers' responses indicated that they are emotionally attached to the land. Most participants agreed on the statement, based on the mean, “I want to continue with crop production until I am too old to farm any longer” (4.66 ± 0.67), with 75% of participants completely agreeing.

4.3.2. Angle 2: Objective Setting

Most agreed on the statement, based on the mean, “I am satisfied that the goals I set are good enough for me to achieve results” (3.82 ± 0.76), with 60% of participants agreeing and 17% completely agreeing. Farmers are comfortable with goal setting by and for themselves, meaning there are other reasons for them not achieving goals.

4.3.3. Angle 3: Sources of Information

It was very informative to learn that farmers are using a wide range of sources of information related to crop production and crop farming, as indicated in Figure 4.2. Sources of information used to make better farming decisions include YouTube and internet searches.

Information, especially relevant and quality information, can assist farmers in setting objectives and goals. It can also help them in making informed decisions. Through the farmer questionnaires and observations by the investigator, it can be stated that farmers are well-informed about most aspects of life. In addition, youth study at formal institutions and through online platforms. Farmers are informed about politics and the economy. They have access to formal media as well as social media.

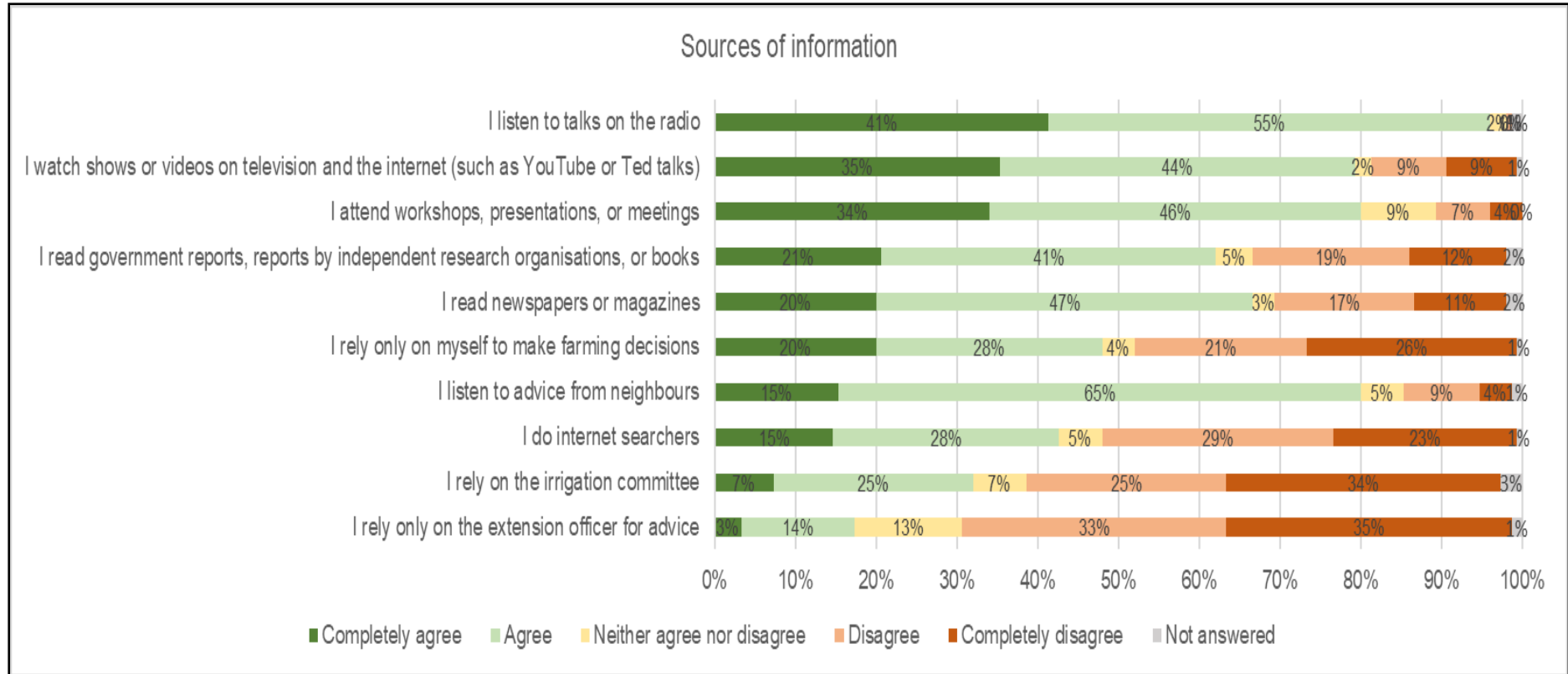


Figure 4.2: Sources of Information Utilized by Smallholder Irrigation Farmers on Three Irrigation Schemes in the Free State Province.

4.3.4. Angle 4: Farming Decisions

Most participants completely disagreed with the statement, “Decisions about my farm are made for me by someone else (71%). Most participants agreed with the follow-up question, “I rely only on myself to make farming decisions” (28%). A deduction can therefore be made that farmers believe they have the ability and the right to make their own decisions.

4.3.5. Angle 5: Wealth

Any person in society needs to pay bills and needs to save money for the future. Therefore the “cash” question was included in this section. Most participants want to earn more than R10 000 (41%) monthly. They believe that crop farming is expensive but also that crop farming is profitable.

4.3.6. Summary

Farmers generally had a good idea of “where they want to go”. They love their land; they have objectives, use different sources of information, can make decisions, and have a good idea of how much to earn to run a farming enterprise. They have achievable targets in mind and wish to have proper yields on a meaningful scale. The question remains why substantial crop production was not visible during site observations.

4.4. NAVIGATE

4.4.1. Strategies to Achieve Goals

In question 5.1 of the questionnaire (Appendix A), farmers were asked to choose one of three answers. There was little room to answer in the negative. This question was included intentionally. Thirty-four percent (34%) of participants indicated that production on the scheme could improve by doing current practices better (Appendix C). Fifteen percent (15%) of participants agreed that production on the scheme could improve by adopting new practices. The difference in the above outcomes can be attributed to human nature, that is, to be uncertain of something new.

But when asked if a participant equally agreed with the first two questions, exactly fifty percent (50%) of the participants agreed. There was no room for the participants to answer that “production can improve by doing the same practices as in the past.” Only one person did not answer the question. It can therefore be deduced that most participants agreed equally with both statements. Farmers are, therefore, optimistic that a mix of “doing things better” and

adopting new practices could improve production on the schemes. Fifty percent of the farmers still have different views on improving production on the three schemes. Again, there is a lot of positive thinking to work from.

4.4.2. Interventions to Achieve Goals

When asked to list any suggestions (Appendix A) on improving current production practices on the scheme, they came forward very clearly. The top-scoring suggestions are mechanisation (11%) and training (6%). Other suggestions by farmers did not come close to these two (Appendix C). It can therefore be deduced that those farmers have their views on specific interventions that can improve production on the irrigation schemes.



Picture 4.1: A tractor and mould board plough are well looked after at Woodbridge Irrigation Scheme.

4.4.3. “Secret” Plan to Revitalize Smallholder Irrigation Schemes

Results indicate a plan to revitalize the three smallholder irrigation schemes between the government and the community in the Free State Province. Seventy-seven percent (77%) of participants indicated that the community planned to improve production on the scheme in the past (Appendix C). In addition, eighty-one percent (81%) of participants indicated that the government currently plans to revitalize the irrigation scheme. Most participants (52%) know the government’s plan, but only thirty-seven percent (37%) know where to obtain a copy.

4.4.4. “Magic” Step-By-Step Handbook

Most participants indicated (41%) that no complete handbook on the revitalization of smallholder irrigation is available to the community members. Participants are, however, highly positive (81%) that such a “Magic” and complete step-by-step plan for smallholder

irrigators can assist the community in managing the irrigation scheme on their own (Appendix C). This result is very much in support of the title of this thesis. At this point, it is not yet clear on the detail and approach of such a step-by-step plan. Most participants (74%) are also positive about adopting and using such a “step-by-step” plan to revitalize the scheme.

4.4.5. The Final Match: Government Versus Community

Results indicated that the tug of war between the government and the community is indecisive (Appendix C). They are a perfect match for each other. On the question of whether the government’s plan or the communities plan will succeed, participants responded “extremely” likely to these two questions (62% and 56%). It is a draw, even after extra time. They demonstrated a positive view of the current situation, even though site observations by the investigator indicated the opposite. Once again, this positive attitude is a very good base to work from.

4.4.6. Summary

Although the community has a plan to revitalize the three smallholder irrigation schemes, and it is positive that any plan can work, they do not have a detailed and workable plan on the table (Appendix C). They are, however, in favour (80%) of a detailed step-by-step plan or handbook to assist the community in managing the irrigation scheme on their own.

4.5. DECISION-MAKING POWER

4.5.1. Community

Although most participants (52%) agree that the community was given the opportunity to make their own decisions on the revitalization of the irrigation scheme (Appendix D), they still need a guarantee or agreement of some nature (63%) that they will be allowed to make their own decisions about the irrigation scheme in the future.

4.5.2. Individuals

Twice the participants declared that they oversaw the revitalization process. First, the participant was asked if the community was responsible for revitalization. Immediately after that, the participant was asked to indicate which entity oversaw the revitalization process (Questions 6.3 and 6.11). On the first question (Appendix D), most participants agreed (55%). On the second question, the entity with the highest rating, based on the mean, was the community, with 47% saying they are in charge to a large extent.

4.5.3. Irrigation Committee

Although most participants do agree that 1) an elected irrigation committee do exist (34%), 2) the community does respect the irrigation committee (37%), and 3) the irrigation committee is capacitated to lead the community in the revitalization process (35%), it is not a very strong case. Finding proof of either irrigation committee membership or irrigation committee meeting documents during site observations was not always easy.

Most participants agreed (45%), and an additional 29% completely agreed, that a complete handbook (step-by-step plan) on smallholder irrigation can assist the irrigation committee in making better decisions in the revitalization process (Appendix D). Therefore, this research study intends to provide a step-by-step plan or toolkit to capacitate and strengthen the irrigation committee or whoever is leading the community.

4.5.4. Government

Participants were asked if the government will allocate funding towards revitalising the smallholder irrigation scheme, even if they are not making all the decisions (Appendix A). Most participants either agreed or completely disagreed (29% respectively). It can therefore be assumed that participants are not very sure about this question (Appendix D). People-orientated approaches (Davids & Theron, 2014) should be applied in the complete sense of the word. It should also apply to decisions on sponsorship and funding. The proposed complete step-by-step plan or toolkit should also address funding issues and the decision-making powers that go along with that.

4.5.5. Summary

The current view of the community is that they oversee the revitalization plan. Time will tell if they take charge or be allowed to control the revitalization process. The proposed toolkit can only assist in making clear the roles and responsibilities of role-players and strengthening the community and the irrigation committee to play their part.

4.6. KNOWLEDGE AND PRODUCTIVITY

Inferential statistics were used to investigate the relationship between knowledge base on crop production and productivity. A knowledge base variable was created using questions 3.14 and 4.10 (Appendix A). The mean of the two variables was calculated; a higher mean indicates a higher knowledge base.

A productivity variable was created using questions 3.48 - 3.53 (Appendix A). The mean of these variables was calculated; a higher mean indicates better production. Statistical significance was accepted at $p \leq 0.05$ (Appendix E).

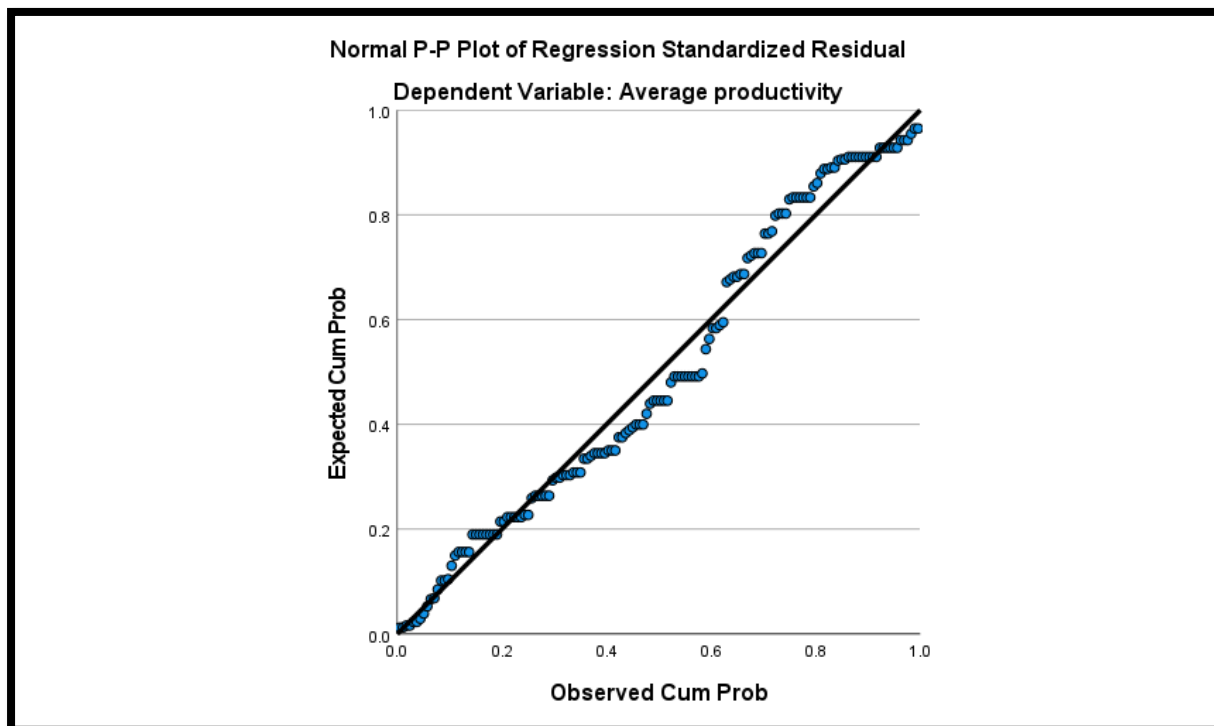


Figure 4.3: Normal P-P Plot of Regression Standard Residual with Average Productivity as Dependent Variable.

A linear regression was run to understand the effect of the knowledge base on productivity (Appendix E). Assumption testing included testing for linearity, independence of residuals, outliers, homoscedasticity, and normality. None of these assumptions was violated. Linear regression results showed that knowledge base accounted for 4% of the variation in productivity, although a small effect size (adjusted $R^2 = 4\%$), knowledge base significantly predicted productivity, $F(1,148) = 6.53, p = 0.01$. For every 0.16 increase in the knowledge base, there was a one (1.0) unit increase in productivity, with a prediction equation of:

$$\text{Productivity} = 2.39 + 0.16 * \text{knowledge base}.$$

The above inferential statistic indicates a strong correlation between the existence of a knowledge base and productivity. This correlation is based on the expectations and perceptions of the interviewees (farmers) on the future, not on the measured improvement of any crop production cycle.

This correlation supports the sub-research question (Table 1.3): "What is the relationship between the knowledge base and productivity, as demonstrated on crop fields on these schemes?". It was not expected to find the opposite, but it is profound that such a strong correlation does exist.

The question is what informed the farmers to have responded in this way. What experience do they have? What previous exposure do they have? Where did they previously gain knowledge which has improved their crop production and productivity?

One experience which may have influenced the above response is several "In-field Water Harvesting and Water Conservation Techniques" research programmes which have run in forty-two (42) villages in the Thaba Nchu Area for over fifteen years. Sediba, Woodbridge and Feloana Villages (Irrigation Schemes) were also included in this "water conservation" research studies and training programmes. This water harvesting research study included in-field water conservation techniques but excluded irrigation practices from a bulk water supply. Sometimes, smallholder irrigation schemes depend on bulk storage and water supply. An impact assessment study IRWH by Blignaut and Sibande (2008) showed that In-field Rainwater Harvesting (IRWH) had improved the social well-being of participants in the Thaba Nchu Area. It was further found that there is indeed a "large degree of participation and knowledge about IRWH".

Other evidence of knowledge gained on crop production and productivity was confirmed during the research study and fieldwork; as part of fundraising for the revitalization of the three smallholder irrigation schemes (Sediba, Woodbridge and Feloana), a master plan was conducted. Compiling this master plan included interaction, social consultation, training, and information sharing. After seven years, the community could still produce such documents on request (Rekgonne Community Projects, 2015).

In addition, the provincial department for agriculture (FS-DARD) has a substantial extension services section based in the Thaba Nchu Tribal Area. Apart from the management structure, each village (irrigation scheme) is allocated a dedicated extension officer. This extension officer has access to professional support from the Head Office based at the Glen Institute for Agriculture, also the headquarters of the provincial government department (FS-DARD). Professional Services include agricultural economics, agricultural engineering services, veterinary services, research, and informal training (FS-DARD, 2017). Over time, this free and

continuous service may also have positively impacted the views and perceptions of farmers on the value of knowledge to their crops and productivity.

Kretzmann and McKnight (1993) focussed on rebuilding troubled communities. They sought to learn from neighbourhood leaders in troubled communities in the United States (US). According to these two researchers, there are only two alternatives, namely (1) the traditional needs-driven dead-end path and (2) the capacity-focused development path. They promote the latter in arguing, with historical evidence, that “significant community development takes place only when local community people are committed to investing themselves and their resources in the effort”.

4.6.1. Summary

Therefore, the positive correlation between the knowledge base and productivity (Appendix E) is unsurprising. It is most probably based on the experience of a community, which influences the perceptions and expectations of participants in this study. It supports any initiative to improve further the knowledge base of revitalising smallholder irrigation schemes in the Free State Province. Past experiences on IRWH can be used as a solid foundation which also has the following similarities with smallholder irrigation schemes:

- ✓ It supports crop production.
- ✓ It supports food security.
- ✓ It is practised in a communal setup.
- ✓ It was demonstrated in the same community.
- ✓ Leadership in the community is the same.
- ✓ The climate is similar.
- ✓ Soils are similar.
- ✓ In most instances, selected crops are the same.

4.7. RELATIONSHIP BETWEEN LEVEL/QUALITY OF LEADERSHIP AND DECISION MAKING

Inferential statistics were used to investigate the relationship between the quality of leadership and decision-making by leaders.

A level/quality of leadership variable was created using questions 3.30 - 3.38 and 3.42 - 4.45 (Appendix A). The mean of these variables was calculated; a higher mean indicates a higher level/quality of leadership.

Question 4.11 was -coded and used with question 4.12 to create a decision-making variable (Appendix A). The mean of the two variables was calculated; a higher mean indicates a higher level of decision-making. Statistical significance was accepted at $p \leq 0.05$ (Appendix F).

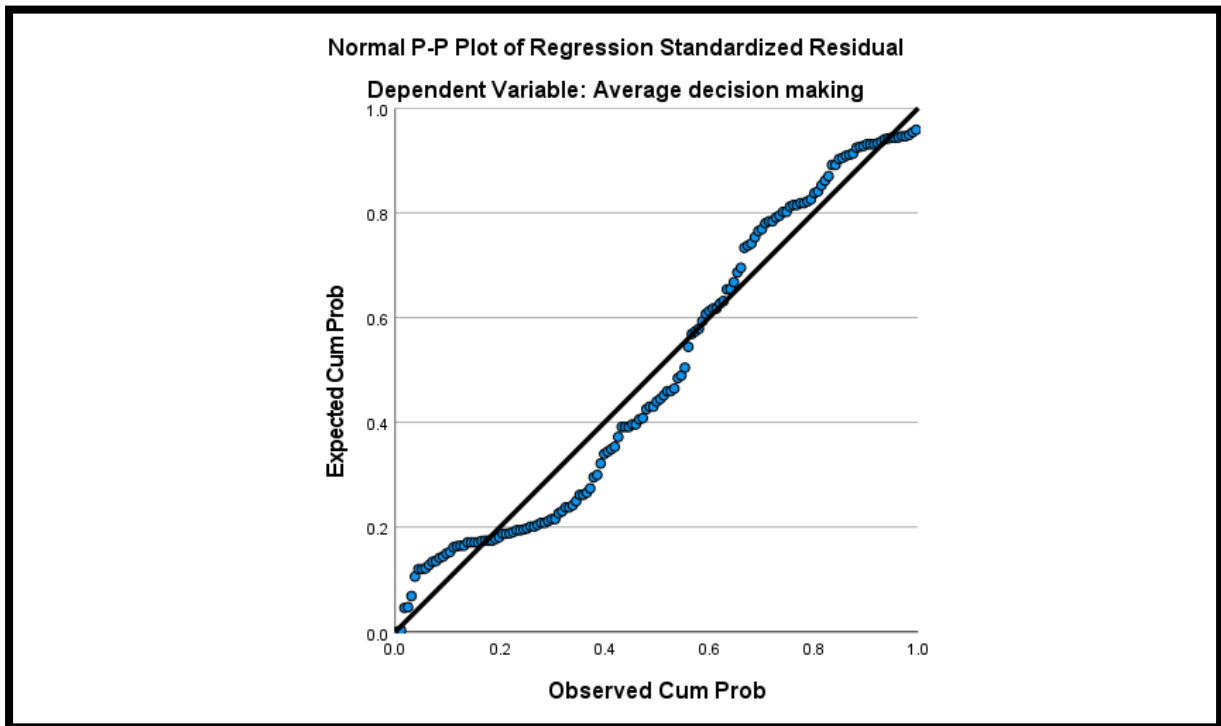


Figure 4.4: Normal P-P Plot of Quality of Leadership and Decision Making.

Residuals were normally distributed as assessed by visual inspection of a normal probability plot (Figure 4.4). A linear regression was run to understand the effect of leadership on decision-making. Assumption testing included testing for linearity, independence of residuals, outliers, homoscedasticity, and normality. One outlier was detected but included in the analysis as it was an actual data point. Linear regression results showed that leadership accounted for 2% of the variation in decision-making. In line with the small effect size (adjusted $R^2 = 2\%$), leadership did not significantly predict decision-making, $F(1,147) = 3.19, p > 0.05$.

It was impossible to indicate a strong correlation between leadership and decision-making at the irrigation scheme management level (Appendix F). Once again, the statistical results are based on the perceptions and views of the respondents. However, these results may point to the existence of an inherent leadership problem in some of the schemes. Blignaut and Sibande

(2008) also concluded that in the case of IRWH programmes conducted in 42 Thaba Nchu villages, “social and leadership issues are the determining factors regarding the future success and expansion of IRWH to the croplands”.

Leadership in villages is governed by traditional structures instituted through applicable legislation, the Traditional Leadership and Governance Framework Act 23 of 2003 (Government of South Africa, 2003a). Each village has a block man or block lady. Within the boundaries of the above legislation, other community committees are established. Similarly, in each community/village, an irrigation committee is elected. Different villages have indicated who oversees the irrigation scheme as follows:

Sediba: The entity with the highest rating, based on the mean, was the consultant engineer (4.36 ± 1.07), with 62% saying they are in charge to a large extent. Infrastructure has been successfully completed at Sediba. The consulting engineer played a very pertinent role in planning and supervising construction. Sediba was also selected by DALRRD (Urban Eco, 2017) to be a Farmer Production Support Unit (FPSU) linked to the AgriPark programme of this sister department to FS-DARD. The Scope of Work of the consulting engineer included infrastructure planning and construction supervision of the FPSU. The good work and time spent with committee members by the consulting engineer may explain the high percentage scored.

Woodbridge: The entity with the highest rating, based on the mean, was the irrigation committee (3.98 ± 1.22), with 44% saying they are in charge to a large extent. In this case, the irrigation committee took bold decisions to install different irrigation systems than was planned by the consulting engineer. A recent shift in the project implementation approach by FS-DARD gave the community more authority in planning and implementation activities. This irrigation committee indicated it could lead the revitalization process with improved decision-making powers.

Feloana: The entity with the highest rating, based on the mean, was the community (4.09 ± 1.34), with 53% saying they are in charge to a large extent. In this case, planning is at the concept level, and no revitalization implementation has occurred yet. Irrigation is still practised on a low level with very old and dilapidated infrastructure. It is possible that because other

institutions have failed the Feloana community, they perceive themselves as overseeing the revitalization process. This is the hypothesis to be tested in this study (Table 1.3).

Despite the above responses, drawing a strong correlation between leadership and decision-making was impossible. Too many external factors may impact leadership and decision-making powers on the scheme level. One example is that the post of head man/lady for Woodbridge is presently vacant. Sadly, the head lady passed away soon after the filling of questionnaires was agreed upon with the principal investigator. The head man for Feloana is currently acting as the head man for Woodbridge. However, in his home village, it was clear that he was a strong leader. He effectively called the community together during fieldwork visits, even at short notice. He also had the approved project planning documents (Rekgonne Community Projects, 2015) in his possession when called upon.

However, it was discovered that certain external factors played a huge considerable role in leadership at the scheme level. Certain communities are divided along visible and invisible lines as follows:

- ✓ Separate clusters of settlements (Sediba Village, Sediba Trust, Sediba “Skema”)
- ✓ Separate allocations of irrigation water and land
- ✓ Different historical events (Forced relocations of previous governments)
- ✓ Different interventions and support (different government departments funding different clusters on one scheme)

It was most difficult, for instance, for the Sediba head lady to coordinate support from two government departments (FS-DARD, DALRRD) as one intervention event. Although the above are external factors, they may have negatively impacted the decision-making powers of the leadership of communities.

4.7.1. Summary

Despite the above explanations on leadership problems and challenges at the three irrigation schemes and communities, it was impossible to test the hypothesis linked to the quality of leadership and decision-making powers of farmers. Further research is required to obtain a better understanding of the matter.

4.8. PERCEIVED LIKELIHOOD OF GOVERNMENT AND COMMUNITIES' PLAN SUCCEEDING

Inferential statistics were used to investigate the perceived likelihood of the government's plan versus the community's plan to succeed.

Question 5.11 and question 5.12 were used respectively to determine any statistically significant difference between the perceived likelihood of the government's plan succeeding and the community's (Appendix A).

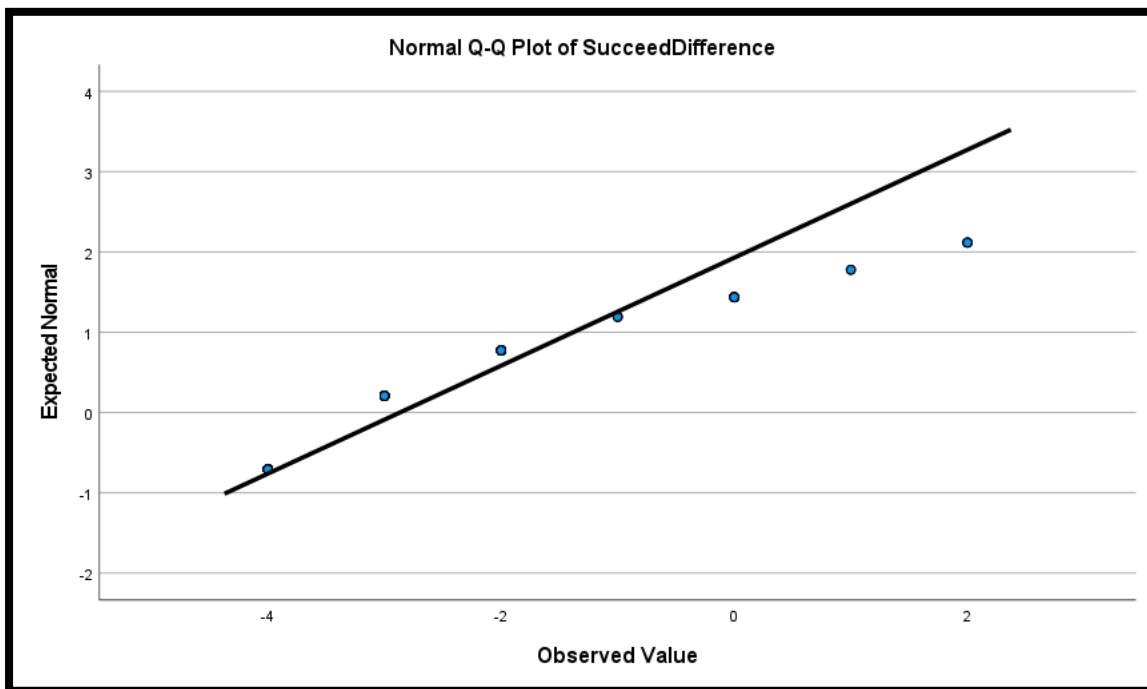


Figure 4.5: Testing for Normality of Government Plan and Community Plan to Succeed.

Data were normally distributed as assessed by a normal q-q plot (Figure 4.5). A paired-sample t-test was used to determine whether there was a statistically significant mean difference between the likelihood of the government's plan succeeding and the community's plan succeeding. Four outliers were detected. Inspection of their values did not reveal them as extreme, and they were kept in the analysis. The normality assumption was not violated, as assessed by visual inspection of a q-q plot. Participants thought the government's plan was more likely to succeed (4.26 ± 1.23) than the community's plan (3.99 ± 1.48). This was a statistically significant mean difference of 0.28, $t(144) = 2.12$, $p = 0.04$ (Appendix G).

Statistical significance is based on previous experiences and perceptions of the interviewees (farmers). Farmers still have confidence in the government. In any case, having only one plan

on the table would be ideal. Still, the results are significant. The results are encouraging. Results from normal statistics indicate that the farmers have their own plans. On question 5.3 (Appendix A): “The community had a plan to improve production on the scheme in the past”, a total of 77% of the respondents answered yes (Appendix C). Secondly, in answering question 5.11, farmers believe their plan can work to an extent (Extremely likely, 56%). It can be deduced that those farmers know how to revitalize smallholder irrigation schemes. Also, they have the confidence to add value with their knowledge.

Additional analysis through inferential statistics (Appendix G) indicates a strong correlation between the perceived likelihood of the communities’ plan and governments’ plan to succeed. The government’s plan came out to be the winner. Participants thought that the government’s plan was more likely to succeed.

4.8.1. Summary

Although the community have a perception (Appendix G) that the government’s plan has a slightly better chance of succeeding, they had their plan (77%), of which they had much confidence (56%) that their plan could work (Appendix C). This can be regarded to be something to work from. If one can add to the strong correlation between knowledge and productivity (Appendix E), it would be worthwhile to investigate the desirability of the community to be the author of the plan for the revitalization of the smallholder irrigation schemes.

The bottom line is that communities do conceptualise their situation. They do discuss and think about real issues. The above inferential statistic (Appendix G) indicates that participants have evaluated themselves and the government. They have also considered many factors to compare their abilities with the abilities and resources of the government. They are also honest with themselves. They have credited the government despite many negative feelings towards the government. Intuitively they know “Passport” is still a factor and “VISA” still needs to be developed (Table 1.2).

4.9. CORRELATION BETWEEN THE CURRENT AVAILABILITY OF A TOOLKIT, PROPOSED TOOLKIT AND SUSTAINABLE REVITALIZATION OF SMALLHOLDER IRRIGATION SCHEMES IN THE FREE STATE PROVINCE

Inferential statistics were used to investigate the association between a village and the following two situations:

- current availability of a complete handbook, and
- confident level to adopt and use a step-by-step plan to revitalize smallholder irrigation schemes.

Most participants (41%) said there was no handbook on the revitalization of smallholder irrigation. However, 78% said the community is confident in adopting and using a step-by-step plan to revitalize the scheme (Appendix H).

Table 4.1: Correlation between Availability and Confident Level to Adopt a Step-By-Step Handbook/Plan for Revitalization of Smallholder Schemes

	Sediba	Woodbridge	Feloana	p-value
A complete handbook on the revitalization of smallholder irrigation is available to the community members	43%	19%	58%	< 0.001
The community is confident to adopt and use such a step-by-step plan to revitalize the scheme.	55%	83%	92%	< 0.001

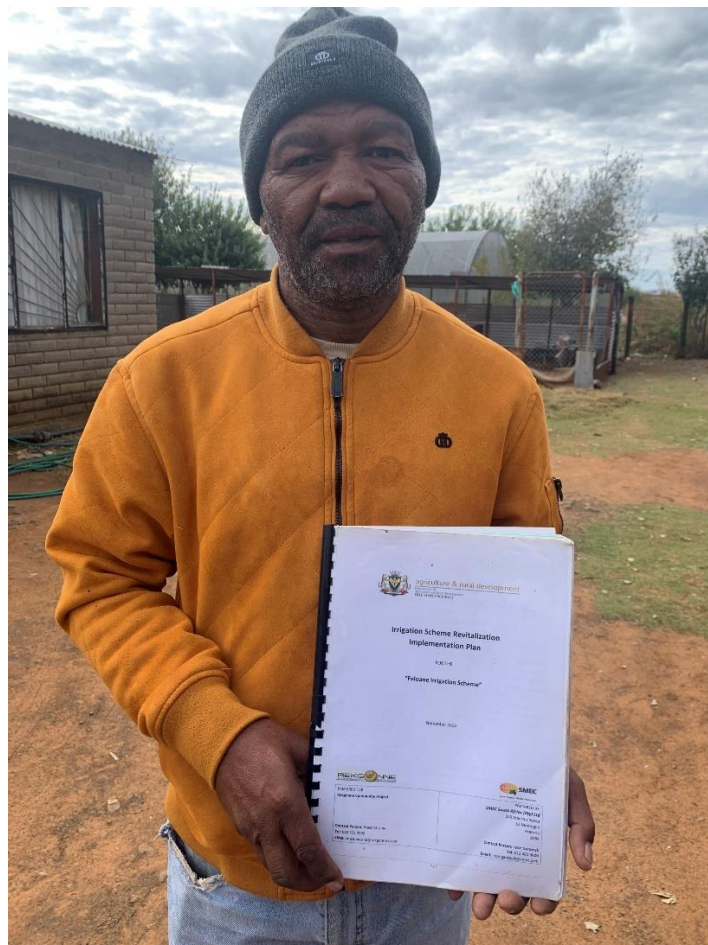
Note: These percentages are found in the descriptive statistics.

Most Feloana participants (58%) said that a complete handbook on the revitalization of smallholder irrigation is available for the community members, compared to 43% of Sediba participants and 19% of Woodbridge participants. A chi-square test of independence showed a statistical association between the participant's village and the availability of a handbook on the revitalization of smallholder irrigation, $\chi^2(4) = 40.62$, $p < 0.001$.

Similarly, most Feloana participants (92%) said the community was confident to adopt and use a step-by-step plan to revitalize the scheme, compared to 83% of Woodbridge participants and 55% of Sediba participants. Again, a chi-square test of independence showed a statistical

association between the participant's village and the community's confidence to adopt and use a step-by-step plan to revitalize the scheme, $\chi^2(4) = 28.38, p < 0.001$.

Confirmation of statistical association in the above cases is significant. In all three irrigation schemes, farmers had some agreement that a complete handbook is available for the community (Appendix H). Even during visits to the villages, community members could produce previous planning documents related to the revitalization of their irrigation scheme. On visiting the Feloana village, the principal investigator asked the head man of Feloana, Mr Jacob Mathews, if he knew the government's revitalization plan. To the surprise of the principal investigator, Mr Mathews collected a document from his house. He proudly produced an original copy of the “Irrigation Scheme Revitalization Plan for the Feloana Irrigation Scheme”. This document was facilitated by and adopted by FS-DARD as an official planning document for the revitalization of the Feloana Irrigation Scheme (Rekgonne Community Projects, 2015).



Picture 4.2: Feloana Head Man in Possession of a Revitalization Plan for Feloana Irrigation Scheme.

4.9.1. Summary

An inferential statistic (Appendix H) indicates a statistical association between a village and the availability and confidence level of adopting a complete step-by-step plan to revitalize a particular smallholder irrigation scheme. In both cases, Feloana came out very strongly. Feloana participants are well-informed about planning processes. Still, they are also optimistic that detailed plans can assist implementation even though Feloana Village has not seen any progress, as was the case with Sediba and Woodbridge.

It can only point to a very strong and resilient community. This characteristic of Feloana is positive when the revitalization of the irrigation scheme can kick off. In this case, inferential statistics indicate an upward trend. Participants have a positive outlook on the future. Researchers, practitioners, and policymakers have a moral duty to contribute more positively to revitalising smallholder irrigation schemes in the Free State Province.

4.10. COMPARISON BETWEEN VILLAGES AND LEVEL OF AGREEMENT TOWARDS A COMPLETE HANDBOOK ON SMALLHOLDER IRRIGATION ASSISTING THE IRRIGATION COMMITTEE IN MAKING BETTER DECISIONS IN THE REVITALIZATION PROCESS

Inferential statistics were used to investigate any statistical difference between a village and the level of an agreement if a complete handbook on the revitalization of smallholder schemes can assist irrigation committees in making better decisions in the revitalization process (Appendix H).

From Q6.14 and Q6.15 (Appendix A), descriptive statistics indicated that most participants (58%) agreed to some extent (agreed or strongly agreed) that the irrigation committee is capacitated to lead the community in the revitalization process (Appendix H). In addition, 75% of the participants agreed to some extent that a complete handbook on smallholder irrigation could assist the irrigation committee in making better decisions in the revitalization process.

A one-way ANOVA was conducted to determine if there was a statistical difference between the participant's village and the level of agreement towards a complete handbook (Toolkit) on the revitalization of smallholder irrigation schemes assisting the irrigation committee in making better decisions in the revitalization process (Appendix H). The assumptions of no outliers, normal distribution and homogeneity of variance were met. The level of agreement

towards a complete handbook (Step-by-step plan) on smallholder irrigation assisting the irrigation committee in making better decisions in the revitalization process was statistically different for the villages, $F(2,144) = 12.34$, $p < 0.001$. Woodbridge had the highest level of agreement (4.32 ± 0.96), followed by Feloana (4.08 ± 0.98) and Sediba (3.44 ± 0.95). Turkey posthoc analysis showed that there was a statistical difference between Sediba and Woodbridge ($p < 0.001$) and Sediba and Feloana ($p = 0.005$), but not between Woodbridge and Feloana ($p > 0.05$).

It was previously mentioned that the revitalization of the Woodbridge smallholder irrigation scheme is incomplete. The reasons will not be discussed in detail. This has led the community to be dissatisfied with the processes followed. This may be why Woodbridge respondents have indicated the highest level of agreement towards a better situation: to have a complete handbook (step-by-step plan) assisting the irrigation committee in making better decisions in the revitalization process.

Feloana Scheme indicated the second highest level of agreement. This scheme could also be frustrating and dissatisfying due to little progress on revitalization. This scheme fell behind the other two schemes. At least at Sediba and Woodbridge, physical and visible infrastructures can already be utilised, although not perfect in all regards. The author, therefore, assigns this second position to the following:

- The irrigation scheme and leadership did gain knowledge through past experiences with positive results (Blignaut & Sibande, 2008).
- The current frustration levels make them more dedicated to improving the situation through any attempt to add to the existing knowledge base.
- Strong leadership in the community, as indicated in Paragraph 4.9

4.10.1. Summary

Most participants (58%) agreed to some extent (agreed or strongly agreed) that the irrigation committee is capacitated to lead the community in the revitalization process. In addition, 75% of the participants agreed to some extent that a complete handbook on smallholder irrigation could assist the irrigation committee in making better decisions in the revitalization process.

It was indicated that there is a statistical difference between the participant's village and the level of agreement towards a complete handbook (Toolkit) on the revitalization of smallholder irrigation schemes assisting the irrigation committee in making better decisions in the revitalization process. As a starting point, it is assigned to the fact that revitalization progress on the three schemes is at three different stages. In terms of the IDMS (National Treasury, 2013) system for infrastructure development in government projects, the stages for progress at the three irrigation schemes are as follows:

- ✓ Feloana (Concept and Viability)
- ✓ Woodbridge (Works)
- ✓ Sediba (Close-out)

Between the above stages, there are still other stages that each project life cycle must follow. The IDMS system focuses on infrastructure development, but it still indicates the different levels of progress at the three schemes.

However, it was impossible to confirm a statistical difference between Woodbridge and Feloana. This fact can either be helpful information or not. It is assigned to the fact that in the case of the Sediba Scheme, the infrastructure component of revitalization was implemented perfectly (Eloff, 2019). It could be regarded as a good example of revitalization. Independently, the two other schemes (farmers and/or leadership) have compared their schemes with Sediba. Communities are very much aware of activities in other villages.

Differences in leadership quality may be why Feloana and Woodbridge's differences could not be confirmed statistically. As indicated previously, leadership at Feloana was viewed as strong, as observed through personal interviews by the researcher. Sadly, the head lady of Woodbridge passed away in 2021. Conflict amongst members of the community of Woodbridge was also observed during the refurbishment of the irrigation infrastructure. The above explanation is based on speculation and is not confirmed through any statistical method.

4.11. EXPRESSED NEED FOR THE DEVELOPMENT OF A TOOLKIT FOR THE SUSTAINABLE REVITALIZATION OF SMALLHOLDER IRRIGATION SCHEMES IN THE FREE STATE PROVINCE

It would be worthwhile to develop a toolkit for the sustainable revitalization of smallholder irrigation schemes in the Free State Province only if an expressed need could be established.

The logic for the development of such a toolkit can be explained as follows:

- The three smallholder irrigation schemes investigated have collapsed previously.
- In recent revitalization attempts, guidelines of existing best management practices were not followed in all aspects.
- Statistical results indicated a strong correlation between knowledge and productivity in the three schemes.
- Previous experiences in similar knowledge-based programmes added value to the livelihoods in the three villages (irrigation schemes).
- It was indicated that available best management practices are not standardised in the province and elsewhere.
- Good examples of standardised best management practices are available in related disciplines.
- Standardised best management practices can be achieved through voluntary consensus efforts.
- A common theoretical base amongst researchers, practitioners, policymakers, farmers and communities can be achieved through voluntary consensus.
- A toolkit, or best management practice, should be developed equally well on different levels (framework, management, and operational).

4.11.1. Recent Developments in the Free State Province

The Free State Department of Agriculture and Rural Development (FS-DARD) has revitalized three smallholder irrigation schemes during the past decade. To date, this process was not completely successful for several reasons. In one of the schemes, the infrastructure development was completed according to specifications. In the second scheme, the infrastructure was only partially completed. In the last scheme, planning has not been completed yet. The above situation has led to the current study. The objective of this study, as far as the title of the study suggests, is twofold: 1) to confirm the expressed need for such a toolkit and 2) to propose a methodology and framework for developing such a toolkit.

Other recent developments in the province include the establishment of crops at Sediba and the installation of three centre pivots at Woodbridge.

4.11.2. Availability of a Complete Revitalization Toolkit

Only limited research on the revitalization of smallholder irrigation schemes has been conducted in the Free State Province. A potential irrigation study (Du Randt & De Lange, 2008) is one of few investigations or studies that were done on the three irrigation schemes in the Thaba Nchu Tribal Area. Other studies include only soil and irrigation suitability reports. In contrast, much research has been conducted on revitalising smallholder irrigation schemes in other parts of South Africa and abroad.

A comprehensive review of knowledge generated through twenty years of research by the Water Research Commission (Van Averbeke *et al.*, 2011) confirmed the availability of multiple guidelines for revitalising smallholder irrigation schemes in South Africa. The same review document also identified gaps in knowledge of “social, human and economic aspects” of smallholder irrigation schemes. Other guidelines were published between 2011 and the present, which must be looked at. The Irrigation Design Manual published by the South African Irrigation Institute (SAII, 2021) was also updated recently. This design manual is a good example of a guideline which does not cover none-technical items such as social matters. However, this manual did not intend to be a developmental guideline. Guidelines that do not directly address smallholder irrigation as a discipline but can add value to the body of knowledge will also be consulted. The proposed Toolkit of this study intends to include and cover a wide range of disciplines, even conflict management. This will add to the gaps Averbecke *et al.* (2011) identified.

The National Water Act 36 of 1998 (Department of Water Affairs [DWA], 1998) authorise water use for different water use categories. Clause 27(1) indicates eleven clauses the responsible authority must consider when issuing a General Authorisation or a Water Use License. These clauses, on its own, represent some type of guideline. These clauses are briefly indicated below:

- ✓ Existing lawful water uses (*Community Profile, Entity, Permission to Occupy*)
- ✓ The need to redress the results of past racial and gender discrimination (*BBBEE*)
- ✓ Efficient and beneficial use of water in the public interest (*Viability and Feasibility*)
- ✓ The socio-economic impact (*Socio-economic factors*)

- ✓ Any catchment management strategy applicable to the relevant water resource (*Area Wide Planning*)
- ✓ The likely effect of the water used to be authorised on the water resource and other water users (*Environmental Impact*)
- ✓ The class and the resource quality objectives of the water resource (*Environmental Impact*)
- ✓ Investments already made and to be made by the water user in respect of the water use in question (*Viability and Feasibility*)
- ✓ The strategic importance of the water used to be authorised (*Policies, Strategies*)
- ✓ The quality of water in the water resource which may be required for the Reserve and for meeting international obligations (*Environmental Impact*)
- ✓ The probable duration of any undertaking or which water use is to be authorised (*Life-cycle Approach, Project Management*)

From the above, with additional notes in brackets, it is clear that the National Water Act's conditions need to be considered for inclusion in any guideline or toolkit. The National Water Act addresses more issues in revitalising smallholder irrigation schemes than other relevant guidelines. This, for instance, includes socio-economic factors and strategic objectives of the day's ruling party. The National Development Plan (NPC, 2011) is a strategic governmental policy document. Other policies and strategies emanating from the National Water Act, and of which any principle or condition must be included in a guideline or toolkit, are as follows:

- ✓ Draft position paper for water allocation reform (2005)
- ✓ National Water Resource Strategy (2013)
- ✓ Draft National Pricing Strategy for Raw Water Use Charges (DWA, 2022), where comments closed by 5 November 2022.

In the same manner, the following documents (Table 4.2) do confirm current guidelines which can be part of the proposed toolkit:

Table 4.2: Existing Guidelines with Identified Gaps: Free State Province and Global

Year	Document Name (Shortened)	Author (Shortened)	Guideline Category	Existing Principles and Guidelines	Gaps Identified
1993	Building Communities	Kretzmann and McKnight	Theory	Capacity-Focused Developmental Path.	Community to invest own resources.
1993	Sustainable Land Management	Smyth and Dumanski	Pillars	Five pillars of sustainable agriculture.	Increased yields Land degradation National accounting of resources
1994	Empowerment Evaluation	Fetterman	Theory	Self-determination	
1996	Constitution of South Africa	South Africa	Legislation	Fair access to natural resources (Article 24). Sufficient food and water (Article 27(1) (b)) to its citizens.	
1996	Policy proposal for irrigated agriculture	Backeberg <i>et al.</i>	Policy	Resource limitations Policy problem statement Transparency Accountability Three types of feasibilities Devolution of responsibility Appropriate technology Multi-disciplinary Approach Flexible farm sizes	Socio-economic parameters
1996	Communal Property Association Act	South Africa	Legislation	Dispute resolution Owers of the association Purpose of the land Holding property in common	Spacial development
1996	National Water Act.	DWS	Policy	Socio-economic factors Investment considerations Strategic importance	
2000	Guidelines for rehabilitation of small-scale irrigation schemes in South Africa	Bembridge	Guideline	Diagnostic analysis Socio-psychological factors Technology suitability Impact on non-participants Acceptability of irrigation systems Alternative farming systems	Guaranteed financial support over the project life cycle.
2000	Guidelines and checklists	De Lange <i>et al.</i>	Guideline Checklist	Bottom-up approach. Simple technology. Exit plan strategy. Community priorities. Farmer is central in planning vs community. Incremental development.	Procurement strategies Building social capital

Year	Document Name (Shortened)	Author (Shortened)	Guideline Category	Existing Principles and Guidelines	Gaps Identified
				Define the target group	
2000	Planning and design procedures	Crosby <i>et al.</i>	Procedures	Participatory planning Water delivery control Water measurement Water payment Technology uptake	Indigenous irrigation systems Irrigation units are based on social groups
2004	BBBEE Act.	Government Printer	Policy	Ownership Management control Employment equity Skills development Enterprise development Socio-economic development	Economic empowerment of the very poor
2004	National guidelines for integrated water use	NDA	Guideline	Transfer of smallholder irrigation schemes to farmers. Multiple uses of agricultural water	Catchment Management
2005	A guide for farmer trainers and facilitators	Botha and De Lange	Guide	Eight (8) learning areas Ninety three (93) learning modules	Extension linkage with farmers Knowledge base of extensionists Multidisciplinary irrigation training at Higher Education Institutions.
2005	Draft Position Paper: Water Allocation Reform.	DWS	Policy	Active and equitable participation Improved livelihoods Productive use of water	
2005	Smallholder farming styles and development policy in South Africa: The case of Dzindi Irrigation Scheme	Van Averbeke	Case study	Farming style theory Farming strategy Farming objectives Smallholder development policy Exposure to risk	Uniform response by farmers to agricultural and related policy Diversity in livelihood and farming
2007	Participatory revitalization of smallholder irrigation schemes	Denison <i>et al.</i>	Principles Guideline	Profitability Economic Viability Financial Feasibility Conceptual Determinism	Revitalization Policy Land Registers Scheme Classification System Interactive Media
2008	Best management practices for small-scale subsistence farming	Van Averbeke	Best Management Practice	Livelihood types Farming styles Land exchange system	Value of the irrigation plot Livelihood linkages and other social and economic benefits Diversity of farmers Methodological innovation Pertinent theoretical paradigm.

Year	Document Name (Shortened)	Author (Shortened)	Guideline Category	Existing Principles and Guidelines	Gaps Identified
					Support to institutions and organisations
2008	Developing a land register and a set of rules in three villages (IRWH)	Manona <i>et al.</i>	Rules	Land register Land exchange policy Land Exchange Agreements	Land Use Planning
2008	Assesing fifteen years of IRWH Research in Thaba Nchu	Blignaut & Sibande	Assessment	Knowledge base	Leadership support Coordination and Governance Kowledge transfer applied to extended crop fields
2008	Thaba Nchu Dams Project: Report on Field visit findings	De Lange	Case study	Multi-generational time-span for institutional building Push and pull factors Equal partners principle Homestead yard production first Short furrow flood irrigation technology Low-energy irrigation systems	Cross-visits to successful schemes in other provinces Integration of RESIS and IRWH Empower extension advisory services
2009	Agricultural Water Use in Homestead Gardening Systems	Stimie <i>et al.</i>	Evaluation Report	Certificate in Education: Participatory Development (CEPD) Essential knowledge Facilitation tools Field testing Refinement of technologies Indigenous crop production practices Developmental constraints Economic incentives.	Low-external-Input Sustainable Agriculture (LEISA) farming system Entrepreneurial opportunities Monitoring and Evaluation
2009	Report on an Irrigation Audit in the Free State Province	De Necker (KV3 Engineers)	Audit	Fourteen (14) Criteria for irrigation potential: a comparison tool: water, soil and other features	Water Use License Group Dynamics Technical skills Development options
2010	Best management practice for smallholder farming: Eastern Cape and Kwazulu-Natal.	Mnkeni <i>et al.</i>	Best Management Practice.	Identification of constraints Land use intensity Crop planning Marketing strategies Problem-solving Record keeping Farmer institutional arrangements	Coordination of Well-meaning organisations Leadership support Ownership Access to support services Conservation agriculture Productivity Knowledge generation Focussed research chair on smallholder irrigation

Year	Document Name (Shortened)	Author (Shortened)	Guideline Category	Existing Principles and Guidelines	Gaps Identified
2011	A review of knowledge generated by the Water Research Commission (Paper at 40 year celebrations of the WRC).	Van Averbek <i>et al.</i>	Review	Planning Design and technology Livelihoods Institutions and organisations Support services Agronomic practices Revitalization	Research on black irrigators outside schemes Social aspects Human aspects Economic aspects
2012	Training material for extension advisors in irrigation water management.	Stevens <i>et al.</i>	Training Material	Eight (8) Learning Area. Ninety-three (93) Learning Modules.	Knowledge transfer to extension officers Multi-disciplinary training on irrigation management at Tertiary Institutions Assessment of curricula at Tertiary Institutions
2012	Development of a sustainable irrigation scheme in South Africa. Paper at ICID 2012, Adelaide	Van Rensburg <i>et al.</i>	Paper	Project success factors Wholistic feasibility assessment	Acceptability of project proposal to role players Regional planning Alternative energy Crop matching Surface and sub-surface drainage design Business Model Farmer identification Social conventions Incentives for investment Crop water requirements
2012	New institutional economic analysis of emerging irrigation farmer's food value chains (Thesis)	Jordaan	Thesis	Cognitive social capital Structural social capital Social capital index Determinants of social capital	Financial performance Socio and institutional dynamics Incentive structure Social capital analysis Social embeddedness
2013	NWRS2	Department of Water and Sanitation	Policy	Racial and gender equality	Poverty eradication
2013	Improving plot holder livelihood and scheme productivity Vhembe District, Limpopo	Van Averbek <i>et al.</i>	Case study	Farming system innovations Social resource constraints	Free hold property ownership
2013	Infrastructure Delivery Management System (IDMS)	National Treasury, South Africa	Policy	Client Management Process Implementer Management Processes	Socio-economic factors
2013	Evaluation of the Comprehensive Rural Development Programme (CRDP)	The Presidency	Evaluation Report	Inter-governmental Coordination Value for money Integrated planning	Supporting Land Reform Alignment of Policy Goals Comprehensive Extension Support Tenure reform in communal areas

Year	Document Name (Shortened)	Author (Shortened)	Guideline Category	Existing Principles and Guidelines	Gaps Identified
					Conflict resolution
2014	The impact of smallholder irrigation on household welfare: Tugela Ferry Irrigation Scheme, KZN, South Africa	Sinyolo <i>et al.</i>	Case study	Government investment justified	Rural micro-industries to supplement smallholder irrigation
2014	Investigation on water conservation in food value chains	De Lange <i>et al.</i>	Typology	Typology of farmers according to abilities. Guidelines are categorised according to different role players	Linkages between land reform and water reform
2014	Agricultural Policy Action Plan (APAP)	Agricultural Industry	Policy	Poverty line criteria	Extension services
2014	Development, the State and Civil Society in South Africa	Davids <i>et al.</i>	Text book	People orientated theory	Application of best practice by government agencies and NGO's
2014	Standard Operating Procedure Framework (SOP) for Comprehensive Agricultural Support Programme (CASP)	DALRRD	Framework	Needs driven support Business approach Launching pad approach Skills development Capacity building Business development Knowledge management Regulatory services Viable units Proof of tenure Access to services Governance systems Managerial skills Own contribution	Compliance with the Division of Revenue Act Consequences of non-compliance Suitable commodities Records of decisions Value for money
2015	Irrigation Strategy for South Africa.	DALRRD	Policy	Food security Poverty alleviation Increased employment Agrarian reform Development paradigm shift Stakeholder identification Roles and responsibilities of stakeholders Beneficiary participation Farmer settlement Acceptable technology	Social Facilitation Holistic development philosophy Contractual decision-making powers of farmers Conflict resolution structures
2015	Agenda 2063	Africa Union	Strategy	Self-reliance Solidarity Hard work Collective prosperity	Changing attitudes and mind-sets
2015	Trends and Outlook: Agricultural water Management: Southern Africa	IWMI	Case study		Monitoring and control over partnerships

Year	Document Name (Shortened)	Author (Shortened)	Guideline Category	Existing Principles and Guidelines	Gaps Identified
2015	Evaluation of socio-economic factors for sustainable re-use of irrigation schemes in Thaba Nchu.	Monokoane	Dissertation	Re-use irrigation schemes	Socio-economic factors
2016	Lessons from our smallholder neighbours (Farmers Weekly)	Armour	Article	Apprenticeship of farmers Farmer labour Profit sharing	Business mind-set
2016	Fiscal Commission: 2016/2017 Submission to National Treasury.	Fiscal Commission	Submission	Competition for government funding. Play-off of different sectors for the same pool of resources.	Return on Investment (ROI)
2016	Preliminary Interviews by the researcher.	Grobler	Interview		Social facilitation New approach
2016	Appropriate entrepreneurial development paths from homestead gardening to smallholder irrigation.	Ajuruchukwu	Case study	Entrepreneurial pathways	Strategies to move farmers from homestead gardening to open crop fields
2017	Project Management Body of Knowledge (PMBOK)	PMI	Guide	Project Management - best management practice	Revitalization is a once-off planned event
2017	Business Case: Sediba Farmer Production Support Unit (FPSU).	Urban Econ	Business Case	Labour Management Funding Source Site assessment Needs assessment Land Acquisition Human Resource Plan Waste Management Staffing	Asset Management Immovable Asset Register Operational Plan
2017	Introduction to participatory community practice.	Schenck <i>et al.</i>	Textbook	People centredness Participation Empowerment Ownership Self-reliance Sustainability Learning process	Fund raising Communication as a management function Vision for action Disconnecting and departing Delivery of a project
2018	An earth observation approach: Mapping of irrigated areas.	Van Niekerk <i>et al.</i>	Map	Use of modern technologies to plan and manage irrigation activities	Capacitate smallholder irrigation farmers with modern technologies
2018	Joint Ventures in the Flag Boshielo Irrigation Schemes, South Africa.	Van Koppen <i>et al</i> (IWMI Report 171)	Case Study	Contractual decision-making powers of farmers Skills transfers in Joint Ventures Policy Dialogues Out-grower arrangements	Long and short routes of accountability Policy Framework Different goals and constituencies Smallholder irrigators' preferences

Year	Document Name (Shortened)	Author (Shortened)	Guideline Category	Existing Principles and Guidelines	Gaps Identified
2018	Improving Public Policy for good Governance.	Cloete <i>et al.</i>	Textbook	Theoretical Policy Models to include: (1) Policy content (2) Stakeholders (3) Processes (4) Systems	New shift in benefits of project management: (1) better organisational behaviour (2) work closer with customers (3) better problem solving (4) reduce power struggling (5) good company decisions (6) deliver solutions
2019	National policy on comprehensive producer development support.	DAFF & DRDLR	Policy	Mandatory producer registration Own contribution Sustainable natural resources Value chain approach Equitable access to support Coordination Needs assessment and skills audit Needs driven support Participatory planning Market-led approach Community, Public-Private Partnerships. Capped financial support Accountability Ring-fenced allocations Sustainable products Exit Strategy	Incentives for producers practising best practices
2019	Framework for Infrastructure Delivery and Procurement Management (FIDPM).	National Treasury, South Africa	Policy	Once off development event. Stage approach	Total Life-cycle Costs
2020	Accelerated irrigation expansion in Sub-Saharan Africa: Lessons learned.	World Bank Group.	Case study	Farmer-led smallholder irrigation (FLSI). Irrigation adapted to farming rather than farming adapted to irrigation	Geo-hydrological study Groundwater supplement surface water Water shed/catchment approach
2020	Irrigation Design Manual (Third Edition).	Water Research Commission (WRC)	Manual	Includes an Irrigation User's Manual to cater for smallholder irrigators	Socio-economic factors
2020	Close-out Report: Upgrading Sediba Irrigation Scheme	Eloff	Close-out Report	Scope of Work Contract Management Health and Safety Quality Control Construction Finance Operating and Maintenance Manuals Benefit Management	Management of Joint Ventures Energy Plan Variation Orders Employer Management Beneficiary Management Maintenance Plan

Year	Document Name (Shortened)	Author (Shortened)	Guideline Category	Existing Principles and Guidelines	Gaps Identified
2021	Agricultural norms for the design of irrigation systems.	South African Irrigation Institute (SAII)	Norms	Technical design parameters	Socio-economic factors
2022	National Pricing Policy (Draft).	DWS	Policy	The user pays to recover costs Accountability and governance	

The need for a complete toolkit for the revitalization of smallholder irrigation schemes in the Free State Province, therefore, derives from the following sources:

- ✓ Existing guidelines are not standardised and are in different formats (Standards, guidelines, checklists, training material, manuals, policies, and procedures).
- ✓ New legislation was passed since most guidelines were published.
- ✓ Government administrations adopt new priorities every five years.
- ✓ Gaps identified in current guidelines.
- ✓ Audiences of existing guidelines differ.
- ✓ Smallholder irrigation schemes still experience challenges despite the availability of various guidelines.
- ✓ Challenges and slow progress in the Thaba Nchu Irrigation Schemes indicated other possible disciplines to be involved.
- ✓ An increased knowledge base will drastically improve productivity (Appendix E).
- ✓ An inclusive project management approach for the revitalization of smallholder irrigation schemes is proposed.
- ✓ Integration of different scientific disciplines requires careful consideration.
- ✓ A common theoretical base may enhance best management practices.
- ✓ When the industry is well organised, farmers can only benefit.

Many policies, guidelines, and procedures exist for the revitalization of smallholder irrigation schemes. They emanate from different regions and different sources. Very few guidelines, specifically for the Free State Province, exist. A lack of standardisation amongst available best management practices, nationally and internationally, was identified (Table 4.2) through the literature study. This lack of standardisation refers to several elements which may be included in any best management practice in any scientific discipline.

One best practice management document available in the Free State Province is the Scope of Work (Grobler & Mokone, 2015), used to procure professional services for the planning of the revitalization of the three irrigation schemes in the Free State Province. This Scope of Work document had current best management practices as a project deliverable in sourcing professional services. A field visit report to the three Thaba Nchu irrigation schemes by De Lange (2008) provided good guidance on providing water to homestead gardens as a first intervention in the community. An Irrigation Audit (De Necker, 2009) conducted by FS-DARD on sixty irrigation farms in the Free State Province proposed fourteen criteria as a comparison

tool for planning purposes. In this audit, the three irrigation schemes were found to have moderate irrigation potential.

4.11.3. Types of Best Management Practices, Check Lists and Guidelines to Choose From

Various best practice systems exist in the domain of modern science and industry. Practitioners need to adopt any best practice system to obtain maximum value. In addition, best practice systems may be voluntary or compulsory. Either industry or legislation may prescribe compulsory participation and compliance.

Well-known international best practice systems include the International Standard Organisation (ISO) standards and systems. It applies to a wide range of industries and professions. The South African National Standards (SANS) adopted certain international standards as part of its compendium.

The International Project Management Institute (PMI, 2013) regularly updates the Project Management Body of Knowledge (PMBOK). This international standard was accredited with the American National Standard (ANSI/PMI 08-001-2012) in October 1998. It is a widely acknowledged standard in the project management profession and others in the built environment. It is super structured, and output driven. It is an option for a framework for the proposed toolkit for the sustainable revitalization of smallholder irrigation schemes because of a strong element of standardisation and global acceptance. It provides the human element to include knowledge areas such as project human resources management, project communications management and project stakeholder management.

Various organisations have instituted best practice guidelines for the crop production industry. The overarching global organisation representing the irrigation industry is the International Committee on Irrigation and Drainage (ICID). In the African Region, the agricultural engineering profession took the lead in representing the irrigation sector through the Pan African Society for Agricultural Engineering (PASAE). The South African Irrigation Institute (SAII) represents farmers, manufacturers, installers, scientists, and certified design agents in the irrigation industry of the country. Competent individuals and companies can affiliate with SAI. Design agents can write the design exam to be registered as professional design agents with SAI. There is no requirement for any private entity in South Africa to install an irrigation system approved by an SAI-affiliated design agent. It is, therefore, not a compulsory standard.

Through the National Treasury Regulations, the South African Government impose on any infrastructure development project funded through public finance to involve built environment professionals to oversee planning and construction. In this case, the Engineering Council of South Africa (ECSA) will provide best management practice guidelines and best conduct prescripts in line with the Engineering Professions Act (Act 46 of 2000). When contracted to a built environment project, the registered professional needs to apply all relevant regulations, legislation, bi-laws, and compulsory standards as part of his responsibilities.

Similarly, other professions are also organised in the same way. This may include, amongst others, soil scientists, agronomists, climatologists, hydrologists, geologists, regional planners, geographic information system practitioners, and economists. These professions are well known and contracted in RESIS in most cases. As indicated in Table 4.2, certain professions and knowledge bases are omitted or excluded in many smallholder irrigation development projects. It is, therefore, critical that these other professions and knowledge bases be included in the process in an orderly and standardised approach. These professions and knowledge bases may include sociology, law, public administration, labour, education, facilitation, entrepreneurship, rural and urban planning, town planning, spatial planning, food sciences, accounting, commerce, logistics, and information technology.

A very relevant profession or discipline to be included in the proposed toolkit is “Community Practice”. The reason is that almost all smallholder irrigation schemes in the Free State Province and South Africa are in rural areas, mainly in the former “Homeland” or Tribal Areas. The textbook “Introduction to participatory community practice” by Schenk, Nel and Louw (2017) discusses the principles of the above discipline. These principles must be understood and included in the proposed toolkit for the sustainable revitalization of smallholder irrigation schemes. These principles have a solid theoretical base and include the following:

- ✓ People centeredness
- ✓ Participation
- ✓ Empowerment
- ✓ Ownership
- ✓ Self-reliance
- ✓ Sustainability
- ✓ Learning process

The Literature review of this study indicates that the best management practice for the RESIS is not standardised (Table 4.2). That is regarding structure and theory. In addition, specific gaps have been identified by practitioners and researchers. Little inputs on gaps in the knowledge base have been identified or documented by farmers as individuals or as an organised commodity group. As is the case for practitioners and researchers, smallholder irrigators are not as organised as a concerned group. Experiences from three Free State Province schemes also add several gaps in the knowledge base. A proposed Toolkit, therefore, needs to address the following five criteria and should:

- ✓ Be standardised.
- ✓ Be complete.
- ✓ Address different audiences.
- ✓ Be well represented.
- ✓ Have a common theoretical base.

A toolkit can be compiled on a strategic, management, or operational level. This study aims to propose a toolkit at a strategic level. More resources and engagement would also be required to compile a toolkit at the management and operational level.

4.11.4. Revitalization Versus Multi-Generational Time Span Development

RESIS as an approach or programme originates in the Limpopo Province, South Africa. An early definition of RESIS is “A strategy to empower farmers to be able to take ownership of their schemes, to rehabilitate infrastructure, to construct conservation works, and to manage the infrastructure and conservation works properly” An assessment study on progress with RESIS in the Limpopo Province was conducted in 2012. The report “Assessment of RESIS program in Limpopo Province: A study commissioned by Limpopo Department of Agriculture” was an introspective look into more than ten years of hard work. (Mudau *et al.*, 2012).

RESIS refers to an intervention of three to eight years (Denison & Manona, 2007a). This timeframe can be regarded as a relatively short-term intervention in the context of community development processes. It is in contrast with a “multi-generational period” in which institutional building is achieved over generations (Eicher, 2003), as cited by De Lange (2008).

This now necessitates further clarification of a definition of the Revitalization of Smallholder Irrigation Schemes. But first, a definition of “smallholder” needs to be sought. The Draft National Policy on Producer Development Support (DAFF, 2019) defines a smallholder producer as a “venture undertaken by an individual or business entity for the purpose of household consumption and deriving a source of income from agriculture activities along the value chain “. It is indicated that smallholders are usually new entrants with an annual turnover between R50 001 to R1 000 000.

Van Averbeke and Mohamed (2005) describe smallholder irrigation farmers as those who practise farming on very small plots mainly to provide food for home consumption and are independent irrigation farmers, farmers on irrigation schemes, community gardeners, or home gardeners.

The term RESIS has developed over time and is commonly accepted by researchers and policy makers as a general term. Strictly speaking, some farmers may be in a lower or higher producer category. Therefore, it is convenient that different categories of producers are combined in RESIS.

RESIS originates in Irrigation Management Transfer (IMT) which refers to the strategy to transfer the responsibility of managing, operating, and maintaining irrigation schemes from the state to farmers (Van Averbeke & Mohamed, 2005). RESIS is, therefore, an intervention to prepare for IMT. A different definition to describe a smallholder irrigation scheme was proposed by Van Averbeke, together with Denison and Mnkeni, in a paper presented at the Water Research Commission 40-Year Celebration Conference (Van Averbeke *et al.*, 2011). The definition used for smallholder irrigation scheme and the purpose of the paper is “An irrigation scheme that was constructed specifically for occupation and use by Black farmers”.

This research study, therefore, proposes that RESIS be defined as indicated in the text box below:

RESIS is a once-of intervention of between three to eight years, which will affect Irrigation Management Transfer (IMT), and of which “Institutional building” is achieved over a “Multi-generational Time Span”.

4.11.5. Proposed Format of the Toolkit

A similar approach to the PMBOK is proposed. Projects are activities with a defined start (Project Initiation) and end (Close-out). Revitalization can similarly be considered a once-of event, although it can be completed over an extended period (Denison & Manona, 2007). The authors reason that revitalization should not be less than three years but preferably between five and eight years. Revitalization cannot be indefinite; otherwise, it would become normal operations. Revitalization is not a normal activity. It is a very pertinent intervention.

After successfully completing the revitalization process, some type of close-out or hand over needs to occur, or merely a withdrawal by the sponsor, agent, or facilitator. Denison and Manona (2007) explain that “*as time progresses, the role of the implementing agents will shift....*” meaning that the revitalization process gradually needs to end. A critical stage or milestone in project management is project close-out, which is a process which requires time, resources, procedures, documentation, and certification (PMI, 2013).

The Draft National Policy on Comprehensive Producer Development Support (2019) includes an “Exit Strategy” as part of the sixteen guiding principles of the policy. Support to a producer in a specific category should not last five years.

The literature study could not identify any study indicating that revitalization is a permanent arrangement or solution. On the other hand, it could also not find any best management practice promoting project management as a vehicle for revitalising smallholder irrigation schemes (RESIS). Synonyms for revitalize are renovated, rejuvenate, repair, replenish, reinvigorate, and modernize. All of which indicates a once-off event. The Britannica Dictionary describes revitalize as “to make (someone or something) active, healthy, or energetic again”. It does not read again and again.

Project management does, however (PMBOK), intersect with operations at various points during the product life cycle, such as:

- ✓ At the closeout phase (stage).
- ✓ New product development, upgrading, expanding outputs.
- ✓ When improving the product process.

This study hypothesises that farmers need to be capacitated to be equal to the outside world or “outside domain”, as described by Van Averbeke (2008). A passport represents the outside world, and VISA represents the irrigation community or scheme (Figure 1.1). This means that the irrigators need to take charge very early in the revitalization process, meaning that after successful revitalization, which is not indefinite, the irrigators should fly on their own. That was also the idea of Irrigation Management Transfer (IMT) as a policy proposal in the National Guidelines for Integrated Water Use (NDA, 2004). All this supports the idea that a revitalization is a once-off event. Then, project management as a concept does fit in with revitalization. As a management discipline, project management is not meant to be an operational tool.

Therefore, a project management approach is proposed as a framework for developing a toolkit for the sustainable revitalization of smallholder irrigation schemes in the Free State Province. This approach would give revitalization a flavour and a sense that there is life after revitalization, which is normal operations, and a better life for all. If this toolkit can add value to the knowledge base in South Africa and abroad, it would be gladly welcomed. As with other best management practice systems, it must evolve over time and in the industry's quality and quantity of contributions. It does not always mean that an engineer or a project management professional should oversee revitalization. A movie or a concert can also be organised and be completed through the project management principle or be regarded as a project, a once-off event.

The PMBOK Guide (PMI, 2013) suggests the following definition: “The application of knowledge, skills, tools, and techniques to project activities to meet the project requirements”. Some definitions are more specific to indicate time as one constraint or limited resource.

The word “project” has powerful meanings, such as “extending outwards beyond something else” and protruding. It is also very much related to the word projectile. Once an object, such as a satellite or warhead, is launched, there is very little intervention, or at least very little external energy applied. Two words now become related: revitalize and project, to be almost synonyms in the current context. It has the meaning of taking something from a shallow level to a much higher level in a short space of time. The three primary objectives of project management are to complete a project within budget, on quality and on time (PMI, 2013).

Different project management tools exist in the knowledge base of project management as a discipline. A related field is “systems engineering”, which will not be considered because of the limited scope of the discipline. Systems engineering does not focus much on the human element in the planning and execution of projects. That is regarding the external human element of the project. Although the Project Management Body of Knowledge (PMI, 2013) is considered a framework, the content of the proposed toolkit will differ mostly due to the social element already identified in the literature research and the gaps identified.

The PMBOK Guide (PMI, 2013) follows a very structured methodology where in each small step, “inputs” and “outputs” are identified. In addition, relationships between steps (work packages) are defined throughout the body of knowledge. Although the engineering and construction industry is a main user of the PMBOK, this best management practice guide refers to social issues from the start. It further ensures that essential activities are not left out. For example, project stakeholder management is one of ten knowledge areas applied throughout the whole project life cycle. It is already covered in the project initiation. Each work package requires outputs from a preceding work package to be processed and signed off. In turn, the output of one work package may be used as the input of one or more work packages in the complete process (Figure 4.6).

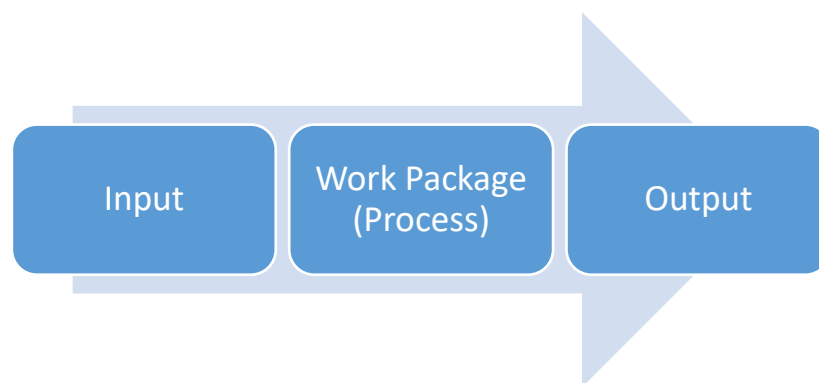


Figure 4.6: Basic Component of the PMBOK Guide.

This approach is also the fundamental principle of the National Treasury Standard for an Infrastructure Delivery Management System (National Treasury, 2013), prescribed as a compulsory best management practice by the government in South Africa. This principle is also cascaded down to the Framework for Infrastructure Delivery and Procurement Management (National Treasury, 2019). When infrastructure improvements (including expenditure) include a major element of the revitalization of smallholder irrigation schemes, then project management principles contained in treasury regulations must be incorporated in

some way or another. It is not to say that these management systems need to overrule the revitalization approach. The proposed revitalization toolkit suggests an inclusive approach in all regards.

4.11.6. Principles and Structure of the PMBOK Guide

Project management is widely acknowledged as a professional occupation or service. A practitioner can register and be accredited by different professional bodies. This research study will only seek to explore project management as a framework to standardise RESIS. It will pertinently exclude any requirement to restrict RESIS from being implemented by project management professionals. This study has already indicated that various gaps in sociopsychology (Table 4.2) exist in the RESIS body of knowledge or best management practice.

The PMBOK Guideline is a well-structured guideline or best management practice. Furthermore, it is developed through a “voluntary consensus standards development process”. The PMI only administers the consensus process and does not police or enforce compliance with the PMBOK Guide. Project management is achieved by applying and integrating forty-seven (47) project management processes. These processes are further grouped into five process groups. RESIS could very easily follow the same five process groups. It was already indicated that RESIS could not be an on-going activity. It should be planned to have an end.

As indicated, the PMBOK Guide acknowledges the human element from the start. The only two processes in the initiation process group are the development of a project charter and identifying stakeholders. The main principle of the PMBOK Guide is to integrate all activities throughout the project. This is achieved by including project integration management as a dedicated knowledge area.

4.11.7. Limitations of the PMBOK Guide as a Possible Framework for a Toolkit

At first glance at the PMBOK Guide, it is unclear who the client or project owner is. But once the well-defined steps are unravelled, it becomes clear that the PMBOK Guide's objective is to include all relevant parties such as the project owner, project initiator, project sponsor, project manager, project management team, internal stakeholders, external stakeholders, and customers. The main objective of the initiation process group is to indicate how the stakeholders' participation in the project will ensure their expectations are achieved.

In the case of RESIS, it would be very important to indicate the role of the farmers as an important stakeholder. In the extreme case, they may take up the following roles:

- ✓ Project owner
- ✓ Project initiator
- ✓ Project manager
- ✓ Internal stakeholder
- ✓ Customer

The theoretical base of RESIS will support the above scenario. All the slogans such as “People-Centred Development”, “Self-determination”, “Devolution of power”, and “Farmer-led Smallholder Irrigation” (World Bank Group, 2020) now come to mind. Therefore, it would be required to include the theoretical base of RESIS into a framework such as the PMBOK Guide. In the end, it may look different to the PMBOK Guide, but it can include all elements that have made this example guideline successful and acknowledged best management practice worldwide. Table 4.2 includes many elements identified through the existing knowledge base and identified gaps, which can be translated to the theoretical base or theoretical paradigm.

The PMBOK Guide, and the principles advocated by the PMI, have been applied to various project management scenarios. It aims to be an inclusive system or best management practice guideline. The knowledge base is incorporated into the ten knowledge areas. The proposed RESIS toolkit may have more knowledge areas if required.

The statistical results of the research study now support this strong emphasis on “knowledge” in the PMBOK Guide. Inferential Statistics indicates a strong correlation between knowledge and productivity. This correlation is confirmed for all three selected irrigation schemes. Therefore, there are no limitations on the PMBOK Guide to be used as an example of a theoretical framework for RESIS. The PMBOK Guide is, however, a high-level guideline. It does not address or includes detailed work packages. The proposed RESIS toolkit may ultimately differ from the PMBOK Guide in having lower-level guidelines and standard operating procedures. It would be necessary first to get the theoretical base and framework right.

4.11.8. Proposed Methodology to Use the PMBOK Guide Approach

The comprehensive and concise paper by Van Averbek *et al.* (2011) on the status, characteristics and knowledge generated through 20 years of research has listed various types and categories of best management practice. This includes the following:

- ✓ Reports
- ✓ Assessments
- ✓ Guidelines
- ✓ Studies

With all gaps identified and the many categories of guidelines and best management practices (Table 4.2), it was indicated that standardisation for best practices is urgently required.

A similar process to develop a body of knowledge to that of the PMBOK Guide is proposed for RESIS. It should also be developed through a voluntary consensus process (PMI, 2013). Best management practice for RESIS already exists in pockets and different wrappings. Researchers, practitioners, policymakers, and farmers should only seek to standardise processes and find a common development theory. They should also agree, in principle, if RESIS is a once-off event or the opposite.

The Irrigation Strategy of South Africa (DAFF, 2015) includes lessons learned from the recent past. It states that project sponsors should involve farmers as decision-makers, specifically where strategic partners are stakeholders. It is recommended that smallholder irrigators be organised in a commodity group, on a provincial or national basis, to participate in the development of a standardised framework for RESIS.

4.11.9. Proposed RESIS Process Group and Knowledge Areas Mapping

The following framework example is proposed to enable standardisation of the “RESIS Body of Knowledge”. In the case of the PMBOK Guide, 47 project management processes are mapped to fill the below cells. The PMBOK Guide is, however, the result of many years of refinement and voluntary consensus by practitioners, almost like processes involved in compiling “open source” computer software.

Table 4.3: Project Management Process Mapping (With acknowledgement of the trademark PMBOK® Guide)

		“Revitalization Management Process Groups”				
		Initiating	Planning	Execution	Monitoring and Control	Close-out
“ Revitalization Knowledge Areas”	Integration Management	●				
	Scope Management					
	Time Management					
	Cost Management					
	Quality Management					
	Human Resource Management					
	Communications Management					
	Risk Management					
	Procurement Management					
	Stakeholder Management	●				

For example, in Table 4.3, included in the initiating process group, only two processes are involved, as indicated by the dots. This is the case with the PMBOK Guide. “RESIS-BOK” can have more processes included in the initiating process group. As indicated in Table 4.2, the above table or system is still at a “framework” level. Lower levels of the above framework would be required to complete the exercise and a detailed toolkit for the sustainable revitalization of smallholder irrigation schemes in the Free State Province and beyond.

It is once again emphasised that the PMBOK Guide is only used here as an illustration to indicate what has transpired in a different management discipline. It is also significant that other findings of this study concluded that the revitalization of smallholder irrigation schemes must follow distinct phases, of which “close-out” is also one of the distinct phases. This is also one of the main characteristics of project management as a system or profession.

4.12. TESTING THE HYPOTHESIS AND DISCUSSION ON THE RESEARCH QUESTIONS

By utilising the selected research tools, the research study was able to test the hypothesis to a large extent. It was, however, not possible to confirm the main hypothesis. Strong correlations

were found in the subsidiary hypothesis. The most significant finding of the research study is the strong correlation between the knowledge base and productivity. Farmers believe that knowledge of smallholder irrigation schemes, or a good knowledge base, will positively impact productivity. It was indicated that farmers had good previous experiences of improved knowledge of crop production activities in these communities (Blignaut & Sibande 2008). This was mainly due to two decades of applied research on these communities' In-field Rainwater Harvesting (IRWH).

Main Research Question (1.0):

“How can farmers improve production levels through improved decision-making powers in revitalising smallholder irrigation schemes in the Free State Province”?

It was not possible to confirm the above hypothesis.

Subsidiary Research Question (1.1)

“What is the relationship between the knowledge base and productivity, as demonstrated on crop fields on these schemes”?

A very strong correlation was found between the knowledge base and productivity. There was a unit productivity increase for every 0.16 increase in the knowledge base. This positive outcome was further explored in this research study. Outcomes of the literature study, farmer interviews and lessons learned from other irrigation schemes and lessons learned from the three Thaba Nchu Irrigation Schemes themselves assisted in formulating a proposed solution to improve productivity on these schemes. This finding directly supports the title selected for the study. Much knowledge can be included in a toolkit. It is proposed that a standardised toolkit (Framework) be compiled through a “voluntary consensus” process, as was followed in other widely accepted industry standards (PMI, 2013).

Subsidiary Research Question (1.2)

“Which possible decision support system toolkit can be introduced to empower smallholder irrigation farmers to improve decision-making and productivity”?

Through a thorough research study, it was possible to demonstrate that examples of standardised best management practices do exist in related disciplines. This type of best

management practice system or guidelines can be established through voluntary consensus processes. This proposed toolkit needs to be developed on three levels: strategic, management and operational.

Subsidiary Research Question (1.3)

“What is the relationship between the level and quality of leadership and productivity, as demonstrated on crop fields on these schemes”?

It was not possible to confirm the above hypothesis.

4.13. OVERALL FINDINGS

Expected and unexpected results were achieved. The main findings can be summarised as follows:

4.13.1. Expected Findings

- ✓ A limited number of youths are involved in smallholder irrigation farming.
- ✓ Farmers believe that they have a vast knowledge of crop production methods.

4.13.2. Unexpected Findings

- ✓ The current standardisation of best management practices is limited (Table 4.2).
- ✓ An improved knowledge base of crop production greatly impacts productivity (Appendix E).
- ✓ Smallholder irrigators in the Thaba Nchu traditional area have good past experiences in improving their knowledge base in crop production methods (Blignaut & Sibande, 2008).
- ✓ Existing RESIS guidelines are unclear about being a once-off intervention or an operational activity.

4.14. MEANING AND RELEVANCE OF THE STUDY

The research study has penetrated a complicated socio-economic study field. Due to the frustrations experienced by researchers, NGOs, practitioners, and sponsors, the theme has changed from rehabilitation to revitalization to programme names such as RESIS-Recharge. This research study has aimed to review the current body of knowledge, particularly the best

management practice. It also has posed a question on the most relevant developmental theory to be applied.

In many ways, the study has confirmed current best management practices. Practices such as a participatory approach, people-centred research and community-based development are non-negotiable. It was also indicated that in real life, resources are limited, most of all financial resources. A toolkit for revitalising smallholder irrigation schemes can assist in creating more order and transparency to the research problem and question. It can also serve as a tool for other purposes. This may include strategic planning (Backeberg & Sanewe, 2013) by organisations, a tool to evaluate an application for financial instruments and a tool for farmers to check where they are at any given moment in this tedious and complicated process of revitalization. It can provide them with hope or lead them to do serious introspection.

A very interesting part of project management is “programme management”. In any industry, financial resources are limited. Sometimes a project has obtained adequate finances or sponsorships, but the project is not ready to be implemented. This may be due to outstanding authorisations or political decisions. Programme management (PMI, 2013) makes provision for a situation where several proposed projects are diverted into a pool of projects. A project will be put on hold until all requirements are met before proceeding. The proposed best management practice or toolkit can also be used to evaluate the readiness of projects to be approved and funded. It means that outsiders, such as financial institutions and NGOs, can use an industry tool to evaluate and support projects. It was indicated that government, and certain other organisations, have a huge responsibility in the allocation of limited financial resources. Backeberg and Sanewe (2013) conclude that this research-based knowledge, and perhaps best management practice, should be incorporated into “public policies, strategies and programmes”. This way, policies and strategies will have a scientific foundation that can have a longer lifespan than one government administration.

Therefore, the study has relevance for a wider audience or role players. One of the main findings, which makes it very much relevant, is that best management practice is not standardised (Table 4.2). If it is assumed that adequate knowledge is available in the most favourable scenario, then much work is needed to standardise best management practices. It is the view of the author that the nature of current best management practice is closer to that of

principles and theory. The author proposes a more structured and generic standard to be adopted, as is the case in other developmental disciplines.

In addition, this research study and recommendations can add value to other related study fields, such as In-field Water Harvesting (IRWH), as proposed by De Lange (2008).

CHAPTER 5: DISCUSSION, IMPLICATIONS AND RECOMMENDATIONS

5.1. OBJECTIVES OF THE RESEARCH STUDY

The overarching rationale of the study is to identify an intervention strategy to majorly improve crop production for smallholder irrigators in the Free State Province. It is a sad situation whereby after many interventions on irrigation schemes, research studies, trials, case studies, policy changes and many more, that little progress was made on the revitalization of smallholder irrigation schemes. It seems that the situation has not improved in most cases.

Therefore, this study aims to make sense of such a demotivating status quo. As indicated in the research study title, the objective is to provide researchers, practitioners, farmers, community leaders, policymakers, and donors with a complete toolkit for the revitalization exercise. The goal would also be to have a standardised toolkit widely accepted as a best management practice.

5.2. RESIS AS A ONCE-OFF EVENT

Due to “a complex of activities” involved in smallholder irrigation schemes (Denison & Manona, 2007), RESIS became an ongoing activity on many smallholders’ irrigation schemes in the Free State Province and other areas in South Africa. This situation now needs to caution other role players to be clear on planning objectives. It was concluded that revitalization could not be an ongoing process. Revitalization is a drastic intervention which can be completed between three and eight years.

A simple case can be used as an example for discussion. The canal system on a smallholder irrigation scheme has reached the end of its life cycle, and of which, it is the only limiting factor for effective and efficient crop production. Canals can be repaired or replaced with a pipe system, all in two years. This scenario can also be regarded as the revitalization of a smallholder irrigation scheme, a once-off event. One can still follow all steps in the proposed toolkit. You can conduct social consultation, even have the irrigation committee lead the process (Denison & Manona, 2007), identify the needs of smallholder farmers, raise funding, conclude procurement, and complete the infrastructure part. All in a short period of time. In between, the project close-out has been certified, and irrigation has been commissioned. Other normal activities such as extension services, institutional building (World Bank Group, 2020) and market penetration can continue. Most importantly, the toolkit must lead the owner of the

process to plan the revitalization process to be a once-off event. It would help if you planned to walk away. If you do not intend to walk away, you will stay.

Schenk *et al.* (2017) explain that “delivery of a project facilitates the empowerment of the people”. The authors assume that, even in the case of community practice, the practitioner’s involvement should end, though through a specific planned method. A Sepedi idiom reads that separation means that relationships change but do not end:

“Go ya ka magoro ga se go tswana”.

This textbook (Schenk *et al.*, 2017) demonstrates the following process (Figure 5.1) of disconnecting and departing. This is proposed in the context of socio-economic and community practice disciplines. It is profound how much this process is related to pure project management best practices (PMI, 2013) and the National Treasury Framework for Infrastructure Delivery and Procurement Management (National Treasury, 2019).

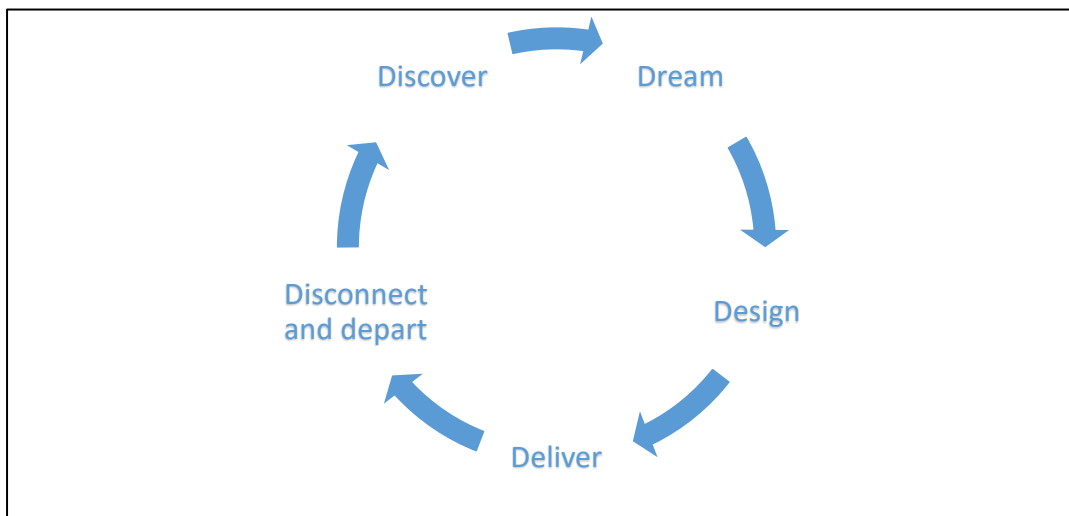


Figure 5.1: Disconnect and Depart as a Normal Activity of Community Practice.

5.3. IMPLICATIONS OF THE STUDY

The research study was able to make a valuable contribution to the current knowledge base and best management practices of revitalization of smallholder irrigation schemes. A new approach to the revitalization of smallholder irrigation schemes is proposed. Adequate evidence was documented to motivate a new approach (Table 4.2). Farmers and communities are ready to learn more about smallholder irrigation practices (Appendix E). Knowledge gained can add

value in the Free State Province as well as outside the borders of this unique geographic area. It is proposed that best management practices be standardised through a “voluntary consensus” process amongst industry role players, including farmers and irrigation committees.

However, the main implication of this study is that RESIS should be viewed as a once-off intervention or event, and by default be guided by project management principles. This is having very pertinent implications for RESIS as a programme or vehicle for development. Soft issues such as community practice and people-centeredness are part of the effort. This study however did not investigate the current project management competencies of role players in the RESIS study field.

5.4. INVOLVEMENT OF FARMERS, COMMUNITIES, AND IRRIGATION COMMITTEES

Farmers, communities, and irrigation committees will play a pivotal role in establishing standardised best management practices for the sustainable revitalization of smallholder irrigation schemes. Ideally, they should oversee the process. All role players should assist in establishing the “VISA” for them (Figure 1.3). Smallholder irrigation farmers should take charge of their “own destiny” through the following:

- Organise themselves in a commodity group provincially and nationally.
- Motivate a standardised best management practice guideline or toolkit.
- Participate in a voluntary consensus process to compile a standardised best management practice guideline or toolkit.
- Adopt a new standardised best management practice or toolkit covering all three management levels.
- Only implement revitalization of smallholder irrigation schemes through a standardised best management practice guideline or toolkit.

5.5. RECOMMENDATIONS

The following recommendations are proposed through this research study:

- ✓ The knowledge base of smallholder irrigation farmers needs to be strengthened. This can be achieved through a combination of the provision of a complete toolkit and training on the value and use of such a toolkit. It will result in a marked improvement in productivity on the smallholder irrigation schemes.

- ✓ Smallholder irrigation farmers in the Free State Province must organise themselves into a commodity group. This initiative must be spontaneous but can be supported by the government. It will result in farmers owning the process of revitalization.
- ✓ RESIS should be considered a once-off event. It will align all available resources towards a focused intervention within an agreed time frame. It will increase urgency amongst all role players in the revitalization process.
- ✓ The revitalization of smallholder irrigation schemes needs to be removed from infrastructure-based professionals to developmental-orientated professions and agencies. Identified gaps in the body of knowledge (BOK) focused much on soft issues. In most cases, infrastructure was delivered within industry norms, meaning that infrastructure-based professionals will augment the developmental effort lead by professionals in the developmental-orientated professions.
- ✓ The industry needs to develop a complete Best Management Practice Guideline in the form of a Toolkit. The industry includes government, NGOs, sponsors, researchers, practitioners, farmers, and a proposed commodity group representing RESIS farmers in the Free State Province and farmers in all nine provinces in South Africa. The approach used by the international project management profession is proposed as a framework for a complete toolkit for revitalization.
- ✓ Compiling such a Best Management Practice guideline, or toolkit, requires a purposefully planned and “voluntary consensus” process. Existing organisations such as ICID, SAI, WRC, ARC or a relevant government department can facilitate and administer such an industry-based process.
- ✓ An existing body of knowledge (BOK) is proposed as an example for compiling a framework for best management practices or toolkits.
- ✓ The knowledge base and crop production methods of IRWH and RESIS be shared and integrated.
- ✓ Further research be conducted to investigate the impact of leadership quality on the decision-making powers of smallholder irrigation schemes.

5.6. FINAL CONCLUSION

This thesis reflected on the many aspects influencing the sustainable revitalization of smallholder irrigation schemes in the Free State Province. Hopefully, this simple effort can significantly improve the livelihoods of many smallholders’ irrigation schemes in the Free State Province and elsewhere.

The study aimed to find out how farmers can improve production levels through improved decision-making powers in revitalising smallholder irrigation schemes in the Free State Province. However, it was impossible to confirm a strong correlation between production levels and improved decision-making powers of farmers or irrigation schemes. Fortunately, a strong statistical inferential was confirmed on one of the subsidiary research questions and hypotheses. This subsidiary hypothesis, which was confirmed, reads as follows:

“There is a direct relationship between the knowledge base and productivity of smallholder irrigation schemes in the Free State Province.”

This strong relationship directly supports the title of this thesis, which reads as follows:

“Development of a toolkit for sustainable revitalization of smallholder irrigation schemes: Free State Province.”

A thorough literature review, and a consequent search for a relevant framework for the compilation of such a toolkit, have resulted in identifying a proven tool or method for this purpose. It was indicated that the methodology of developing such a toolkit is more important than the tool itself. It is strongly recommended that role-players involved in RESIS follow a “voluntary consensus” process and, using a proven framework, develop a toolkit for the sustainable revitalization of smallholder irrigation schemes in the Free State Province. The idea is that this toolkit will drastically improve the knowledge base of all role-players in RESIS, including irrigation farmers and decision-makers on irrigation schemes.

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APPENDICES

Appendix A: Interview Questionnaire

evasys	Development of a toolkit for sustainable revitalization of smallholder irrigation schemes: Free	
University of the Free State	HF. Grobler	
Department for Sustainable Food Systems and Development	PhD Questionnaire	

Mark as shown: Please use a ball-point pen or a thin felt tip. This form will be processed automatically.

Correction: Please follow the examples shown on the left hand side to help optimize the reading results.

1. INFORMATION LEAFLET

There are only three collapsed smallholder irrigation schemes in the Free State Province which need urgent interventions to be sustainable again. These three schemes are in the Thaba Nchu tribal area situated in the jurisdiction of the Mangaung Metro Municipality. The three schemes are in the villages of Feloane, Woodbridge and Sediba. For the time being, the three schemes are named after the villages.

The Free State Department of Agriculture and Rural Development has embarked on a revitalization process to have these schemes both productive and profitable once again. The department acknowledged that a holistic and inclusive process be followed to revitalize these schemes. This is in line with experience, information, policy and best practice gained from similar revitalization efforts in South Africa and elsewhere.

This questionnaire is an academic exercise and cannot influence the outcome of the government led revitalization process. The study results can, however, help the government to make decisions informed by the insights, views and experiences of the people directly affected by these decisions. It is further believed that any lessons learned from this study could improve best practices of the revitalization of smallholder irrigation schemes in other areas of South Africa.

Since farmers in South Africa have practiced "irrigation" and "rainwater harvesting" for centuries, the aim of this study is to gather information from the community and learn from the farmers themselves. The study aims to dig deep into the foundations of irrigation practices in a rural and communal setup and learn as much from the farmers as possible.

2. DEMOGRAPHIC INFORMATION

2.1 What is your gender?

Male Female Other

Prefer not to answer

2.2 Respondent age:

18 - 20 21 - 25 26 - 30
 31 - 35 36 - 40 41 - 50
 51 - 60 61 or older

2.3 What is your highest level of education?

Never been to school Primary school (Grade R to Grade 7) Secondary school (Grade 8 to Grade 12), but did not matriculate
 Matriculated Tertiary qualification (i.e., degree, diploma, certificate) Other

2.4 If other to question 1.3, please specify:

3. POSITION (WHERE ARE WE NOW)

3.1 Which of the following statements best describes your access to a plot of land on the scheme?

Choose only one option.

I have a "permission to occupy" permit from the tribal authority I do not have a "permission to occupy" permit from the tribal authority, but I have a written agreement with another farmer to use a portion of their land. I do not have a "permission to occupy" permit from the tribal authority but have a verbal agreement with another farmer to use a portion of their land.
 I had a "permission to occupy" permit from the tribal authority, but it was cancelled. Other

3.2 If other to question 3.1, please specify:



3. POSITION (WHERE ARE WE NOW) [Continue]

- 3.3 How long have you been farming on this plot of land?
 Less than 1 year 1-5 years 6-10 years
 11-20 years More than 20 years

To what extent do the following statements accurately describe the cultivation of your plot over the past five years?

	Not accurate at all	Somewhat accurate	Accurate	Mostly accurate	Completely accurate
3.4 I plant crops only once a year	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.5 I plant crops on my plot year-round	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.6 I only plant crops when I get input materials from the government	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.7 I only plant crops when the irrigation committee permits me to do so	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3.8 If none of the above statements accurately describe the cultivation of your plot over the past five years, please provide an accurate description:

- 3.9 How satisfied are you with your current crop production on your plot?
 Not satisfied at all Somewhat satisfied Satisfied
 Very Satisfied Extremely satisfied

To what extent do you agree/ disagree with the following statements concerning problems you may be experiencing on your plot?

	Completely disagree	Disagree somewhat	Neither agree nor disagree	Agree somewhat	Completely agree
3.10 Farming here is profitable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.11 Farming here eats up money that I would rather spend on other things	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.12 There is enough water on this plot of land to water my crops with	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.13 The soil on this plot of land is easy to grow crops in	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.14 I have enough knowledge of crop production to farm profitably	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.15 I have enough farm equipment in good working condition to enable me to farm effectively	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.16 I have enough farm workers for the farming that I do	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.17 I can easily sell the crops that I produce	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



3. POSITION (WHERE ARE WE NOW) [Continue]

3.18 Do you have other concerning problems that you experience on your plot that were not mentioned above?

How often do you ask for help from the following sources to improve your crop production?

	Never	Occasionally	Regularly
3.19 An extension officer of DARD	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.20 A commercial farmer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.21 Another farmer on the scheme	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.22 Neighboring farmers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.23 A friend	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.24 A family member	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.25 Farmers' Association	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.26 Tribal Authority	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.27 Irrigation committee	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.28 Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.29 If other, please specify:			

How satisfied are you with the assistance you received, if any, from the following sources?

	No assistance required	No assistance received	Not satisfied at all	Somewhat satisfied	Extremely satisfied
3.30 An extension officer of DARD	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.31 A commercial farmer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.32 Another farmer on the scheme	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.33 Neighboring farmers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.34 A friend	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.35 A family member	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.36 Farmers' Association	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.37 Tribal Authority	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.38 Irrigation committee	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.39 Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.40 If other, please specify:					



3. POSITION (WHERE ARE WE NOW) [Continue]

3.41 How regularly do the community members discuss problems on the scheme in a formal setting like a community meeting or a co-operative meeting?

- Never Only when a specific problem needs to be addressed Once or twice a year
 Every two to three months Monthly or more regularly

Rate the extent to which you are satisfied with how the irrigation committee fulfils the following managerial and leadership functions, with "1" indicating that you are not satisfied at all and "5" indicating that you are extremely satisfied?

	1 - Not at all	2	3	4	5 - Extremely satisfied
3.42 Raising concerns from the community with the Department of Agriculture	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.43 Managing conflict between farmers on the scheme	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.44 Informing farmers about laws and regulations that affect their farming activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.45 Including farmers in decision-making about the scheme	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.46 Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3.47 If other, please specify:

To what extent do you succeed in producing food for the following reasons?

	Not one of my objectives	Not achieved at all	Partially achieved	Achieved completely
3.48 I succeeded in producing food for my family	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.49 I succeeded in producing food for my animals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.50 I succeeded in producing food to sell in the village	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.51 I succeeded in producing food to sell at another village	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.52 I succeeded in producing food to sell at a market	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.53 I succeeded in producing food for celebrations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.54 I succeeded in producing food for other reasons	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3.55 If for other reasons, please specify:



3. POSITION (WHERE ARE WE NOW) [Continue]

Rate the degree to which you agree/ disagree with the following statements about the success of your crop production for the past year/ season:

	Completely disagree	Disagree	Neither agree nor disagree	Agree	Completely agree
3.56 My crop production for this past year/ season was a success	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.57 I am worried about the current crop production on my plot	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.58 A neighbour told me that my current crop is a failure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.59 A government official told me that my current crop production is a failure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.60 Someone from the irrigation committee told me that my current crop production is a failure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

4. TARGET (WHERE DO YOU WANT TO GO)

To what extent do you agree/ disagree with the following statements regarding the utilisation of your plot?

	Completely disagree	Disagree	Neither agree nor disagree	Agree	Completely agree
4.1 I want to continue with crop production until I am too old to farm any longer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.2 I want to continue with production here until I can buy a large farm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.3 I want to continue with farming the way I am now without changing anything	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.4 If I can, I will give my plot to somebody else immediately	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



4. TARGET (WHERE DO YOU WANT TO GO) [Continue]

The following questions are about planning and setting objectives for your plot and farming activities. Please indicate the extent to which you agree/ disagree with the following statements:

	Completely disagree	Disagree	Neither agree nor disagree	Agree	Completely agree
4.5 I write out yearly goals for what I want to achieve with my farm.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.6 I have yearly goals for what I want to achieve with my farm, but I do not write them down.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.7 I am satisfied that the goals I set are good enough for me to achieve results	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.8 I have adequate skills to set general goals for my farm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.9 I need special tools (such as computer software) to help me set goals for my farm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.10 I have adequate knowledge to set goals for crop production on this plot	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.11 Decisions about my farm are made for me by someone else	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

To what extent do you agree with the following statements on different sources of information in helping you make farming decisions?

	Completely disagree	Disagree	Neither agree nor disagree	Agree	Completely agree
4.12 I rely only on myself to make farming decisions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.13 I listen to advice from neighbours	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.14 I rely only on the extension officer for advice	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.15 I read government reports, reports by independent research organisations, or books	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.16 I do internet searches	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.17 I read newspapers or magazines	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.18 I listen to talks on the radio	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.19 I watch shows or videos on television and the internet (such as YouTube or Ted talks)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.20 I attend workshops, presentations, or meetings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.21 I rely on the irrigation committee	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.22 Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.23 If other, please specify:					



4. TARGET (WHERE DO YOU WANT TO GO) [Continue]

- 4.24 How much money would you like to earn from farming your plot per month?
 R0 –R999 R1 000 – R1 999 R2 000 –R2 999
 R3 000 – R4 999 R5 000 – R9 999 More than R10 000

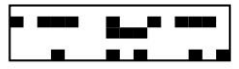
To what extent would you like to achieve the following goals by farming on this plot, with “1” indicating “not at all” and “5” indicating “to a large extent”?

	1 - Not at all	2	3	4	5 - To a large extent
4.25 I would like to earn extra income	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.26 I would like to live solely from the income received from farming	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.27 I would like to employ workers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.28 I would like to send my children to university or college	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.29 I would like to build me a nice house	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.30 I would like to buy myself farming equipment such as a tractor of LDV	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5. NAVIGATE (HOW WILL YOU ACHIEVE YOUR GOALS, WHAT IS YOUR PLAN?)

- 5.1 Which one of the following statements do you agree with the most?
 Choose only one statement.
 Production on the scheme can improve by doing current practices better. Production on the scheme can improve by adopting totally new practices. I agree equally with the two statements

5.2 Do you have any suggestions on improving current production practices on the scheme?
 (List the kind of current production practices which one can do better or new production practices one include to improve production on the scheme):



5. NAVIGATE (HOW WILL YOU ACHIEVE YOUR GOALS, WHAT IS YOUR PLAN?) [Continue]

According to your knowledge, answer either “yes”, “no”, or “do not know” for each of the following statements about revitalisation schemes in your area.

	Yes	No	Don't know
5.3 The community had a plan to improve production on the scheme in the past.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.4 The government currently has a plan to revitalise the irrigation scheme.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.5 I know what the government's plan to revitalise the scheme is about.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.6 I can obtain a copy of the government's plan to revitalise the scheme.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.7 The community members were given the opportunity to participate in the drafting of a revitalisation plan for this scheme	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.8 A complete handbook on the revitalisation of smallholder irrigation is available to the community members	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.9 A complete step-by-step plans for smallholder irrigators can assist the community in managing the irrigation scheme on their own.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.10 The community is confident to adopt and use such a step-by-step plan to revitalise the scheme.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please consider the following statements and indicate the likelihood for each of these statements regarding the implementation of a revitalisation plan for this irrigation scheme:

	1 - Extremely unlikely	2	3	4	5 - Extremely likely
5.11 The government's plan for the revitalisation of the scheme will succeed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.12 The community's plan for the revitalisation of the scheme will succeed.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



6. STEER (WHO IS GOING TO BE IN CHARGE OF THIS PLAN?)

To what extent do you agree/ disagree with the following statements about decision-making by the community with regards to the irrigation scheme?

	<input type="checkbox"/> Completely disagree	<input type="checkbox"/> Disagree	<input type="checkbox"/> Neither agree nor disagree	<input type="checkbox"/> Agree	<input type="checkbox"/> Completely agree
6.1 The community was given the opportunity to make their own decisions on the revitalisation of the irrigation scheme	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.2 The community needs a guarantee or agreement of some nature that they will be allowed to make their own decisions about the irrigation scheme in the future.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.3 The community is in charge of the revitalisation of the irrigation scheme	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

To what extent are the following entities in charge of the revitalisation process, with "1" indicating "not at all" and "5" indicating "to a large extent"?

	<input type="checkbox"/> 1 - Not at all	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5 - To a large extent
6.4 The government	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.5 The tribal authority	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.6 The Head Man/Lady	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.7 The Mangaung Metro Municipality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.8 The consultant engineer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.9 A few members of the community	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.10 The Irrigation committee	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.11 The community	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

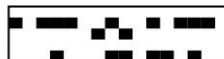


6. STEER (WHO IS GOING TO BE IN CHARGE OF THIS PLAN?) [Continue]

To what extent do you agree/ disagree with the following statements:

	Completely disagree	Disagree	Neither agree nor disagree	Agree	Completely agree
6.12 There is currently an elected irrigation committee.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.13 The community respects the irrigation committee.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.14 The irrigation committee is capacitated to lead the community in the revitalisation process.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.15 A complete handbook (Step by step plan) on smallholder irrigation can assist the irrigation committee in making better decisions in the revitalisation process.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.16 Production on my plot will improve after the current revitalisation process has been completed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.17 Production on the scheme will improve when the current revitalisation process has been completed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.18 The government will allocate funding towards revitalising the smallholder irrigation scheme, even if they are not making all the decisions.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Thank you for your time and participation



Appendix B: Statistical Analysis for Demographics

❖ Gender

		Frequency	Percent	Valid Percent
Valid	Male	86	57.3	59.3
	Female	58	38.7	40.0
	Prefer not to answer	1	0.7	0.7
	Total	145	96.7	100.0
Missing	System	5	3.3	
Total		150	100.0	

Note: Five participants did not answer this question
Most participants were male (57%).

❖ Age

		Frequency	Percent	Valid Percent
Valid	21 - 25	6	4.0	4.1
	26 - 30	4	2.7	2.7
	31 - 35	10	6.7	6.8
	36 - 40	15	10.0	10.2
	41 - 50	39	26.0	26.5
	51 - 60	25	16.7	17.0
	61 or older	48	32.0	32.7
	Total	147	98.0	100.0
Missing	System	3	2.0	
Total		150	100.0	

Note: Three participants did not answer this question
Most participants were 61 or older (32%).

❖ Level of education

		Frequency	Percent	Valid Percent
Valid	Never been to school	11	7.3	7.6
	Primary school (Grade R to Grade 7)	50	33.3	34.7
	Secondary school (Grade 8 to Grade 12), but did not matriculate	60	40.0	41.7
	Matriculated	15	10.0	10.4
	Tertiary qualification (i.e., degree, diploma, certificate)	8	5.3	5.6
	Total	144	96.0	100.0
	Missing	System	6	4.0
Total		150	100.0	

Note: Six participants did not answer this question
Most participants completed secondary school but did not matriculate (40%).

Appendix C: Combined Statistics on How to Achieve Their Goals (Navigate)

5.1 Which one of the following statements do you agree with the most? Choose only one statement.

		Frequency	Percent	Valid Percent
Valid	Production on the scheme can improve by doing current practices better	51	34.0	34.2
	Production on the scheme can improve by adopting totally new practices	23	15.3	15.4
	I agree equally with the two statements	75	50.0	50.3
	Total	149	99.3	100.0
Missing	System	1	0.7	
Total		150	100.0	

Note: One participant did not answer this question

Most participants agreed equally with both statements (50%).

5.2 Do you have any suggestions on improving current production practices on the scheme?

	Frequency	Percent (n=150)
Equipment and mechanisation	16	10.7
Training (improve skills and knowledge)	9	6.0
Any support from anybody	2	1.3
Increase number of employees	2	1.3
Communication	1	0.7
New advanced farming production techniques	1	0.7
ARC (W.H.T) for households	1	0.7
Forestry. Planting fruit trees on the scheme	1	0.7
Rent additional hectares out	1	0.7
Ownership of land	1	0.7
Ploughing in time, normally we delay ploughing and that affect production	1	0.7

Most participants suggested equipment and mechanisation, followed by training (improve skills and knowledge).

According to your knowledge, answer each of the following statements about revitalization schemes in your area

5.3 The community had a plan to improve production on the scheme in the past.

		Frequency	Percent	Valid Percent
Valid	Yes	116	77.3	78.9
	No	12	8.0	8.2
	Don't know	19	12.7	12.9
	Total	147	98.0	100.0
Missing	System	3	2.0	
Total		150	100.0	

Note: Three participants did not answer this question
 Most participants answered yes (77%).

5.4 The government currently has a plan to revitalize the irrigation scheme.

		Frequency	Percent	Valid Percent
Valid	Yes	122	81.3	82.4
	No	8	5.3	5.4
	Don't know	18	12.0	12.2
	Total	148	98.7	100.0
Missing	System	2	1.3	
Total		150	100.0	

Note: Two participants did not answer this question
 Most participants answered yes (81%).

5.5 I know what the government's plan to revitalize the scheme is about.

		Frequency	Percent	Valid Percent
Valid	Yes	79	52.7	53.0
	No	40	26.7	26.8
	Don't know	30	20.0	20.1
	Total	149	99.3	100.0
Missing	System	1	0.7	
Total		150	100.0	

Note: One participant did not answer this question
 Most participants answered yes (53%).

5.6 I can obtain a copy of the government's plan to revitalize the scheme.

		Frequency	Percent	Valid Percent
Valid	Yes	56	37.3	37.6
	No	70	46.7	47.0
	Don't know	23	15.3	15.4
	Total	149	99.3	100.0
Missing	System	1	0.7	
Total		150	100.0	

Note: One participant did not answer this question
 Most participants answered no (47%).

5.7 The community members were given the opportunity to participate in the drafting of a revitalization plan for this scheme

		Frequency	Percent	Valid Percent
Valid	Yes	106	70.7	72.1
	No	23	15.3	15.6
	Don't know	18	12.0	12.2
	Total	147	98.0	100.0
Missing	System	3	2.0	
Total		150	100.0	

Note: Three participants did not answer this question

Most participants answered yes (71%).

5.8 A complete handbook on the revitalization of smallholder irrigation is available to the community members

		Frequency	Percent	Valid Percent
Valid	Yes	57	38.0	38.3
	No	61	40.7	40.9
	Don't know	31	20.7	20.8
	Total	149	99.3	100.0
Missing	System	1	0.7	
Total		150	100.0	

Note: One participant did not answer this question

Most participants answered no (41%).

5.9 A complete step-by-step plans for smallholder irrigators can assist the community in managing the irrigation scheme on their own.

		Frequency	Percent	Valid Percent
Valid	Yes	120	80.0	81.6
	No	8	5.3	5.4
	Don't know	19	12.7	12.9
	Total	147	98.0	100.0
Missing	System	3	2.0	
Total		150	100.0	

Note: Three participants did not answer this question

Most participants answered yes (80%).

5.10 The community is confident to adopt and use such a step-by-step plan to revitalize the scheme.

		Frequency	Percent	Valid Percent
Valid	Yes	112	74.7	76.2
	No	12	8.0	8.2
	Don't know	23	15.3	15.6
	Total	147	98.0	100.0
Missing	System	3	2.0	
Total		150	100.0	

Note: Three participants did not answer this question

Most participants answered yes (78%).

Please consider the following statements and indicate the likelihood for each of these statements regarding the implementation of a revitalization plan for this irrigation scheme

5.11 The government's plan for the revitalization of the scheme will succeed.

		Frequency	Percent	Valid Percent
Valid	1 - Extremely unlikely	11	7.3	7.5
	2	7	4.7	4.8
	3	10	6.7	6.8

	4	25	16.7	17.0
	5 - Extremely likely	94	62.7	63.9
	Total	147	98.0	100.0
Missing	System	3	2.0	
Total		150	100.0	

Note: Three participants did not answer this question

Most participants answered extremely likely (63%).

5.12 The community's plan for the revitalization of the scheme will succeed.

		Frequency	Percent	Valid Percent
Valid	1 - Extremely unlikely	24	16.0	16.3
	2	3	2.0	2.0
	3	6	4.0	4.1
	4	30	20.0	20.4
	5 - Extremely likely	84	56.0	57.1
	Total	147	98.0	100.0
Missing	System	3	2.0	
Total		150	100.0	

Note: Three participants did not answer this question

Most participants answered extremely likely (56%).

Appendix D: Combined Statistics on Who is Going to be in Charge (Steer)

To what extent do you agree/ disagree with the following statements about decision-making by the community with regards to the irrigation scheme?

6.1 The community was given the opportunity to make their own decisions on the revitalization of the irrigation scheme

		Frequency	Percent	Valid Percent
Valid	Completely disagree	6	4.0	4.1
	Disagree	10	6.7	6.8
	Neither agree nor disagree	22	14.7	14.9
	Agree	78	52.0	52.7
	Completely agree	32	21.3	21.6
	Total	148	98.7	100.0
Missing	System	2	1.3	
Total		150	100.0	

Note: Two participants did not answer this question
Most participants agreed (52%).

6.2 The community needs a guarantee or agreement of some nature that they will be allowed to make their own decisions about the irrigation scheme in the future.

		Frequency	Percent	Valid Percent
Valid	Completely disagree	4	2.7	2.7
	Disagree	2	1.3	1.4
	Neither agree nor disagree	8	5.3	5.5
	Agree	94	62.7	64.4
	Completely agree	38	25.3	26.0
	Total	146	97.3	100.0
Missing	System	4	2.7	
Total		150	100.0	

Note: Four participants did not answer this question
Most participants agreed (63%).

6.3 The community is in charge of the revitalization of the irrigation scheme

		Frequency	Percent	Valid Percent
Valid	Completely disagree	7	4.7	4.7
	Disagree	15	10.0	10.1
	Neither agree nor disagree	29	19.3	19.6
	Agree	83	55.3	56.1
	Completely agree	14	9.3	9.5
	Total	148	98.7	100.0
Missing	System	2	1.3	
Total		150	100.0	

Note: Two participants did not answer this question
 Most participants agreed (55%).

To what extent are the following entities in charge of the revitalization process?

6.4 The government

		Frequency	Percent	Valid Percent
Valid	1 - Not at all	20	13.3	14.1
	2	12	8.0	8.5
	3	14	9.3	9.9
	4	21	14.0	14.8
	5 - To a large extent	75	50.0	52.8
	Total	142	94.7	100.0
Missing	System	8	5.3	
Total		150	100.0	

Note: Eight participants did not answer this question
 Most participants rated this to a large extent (50%).

6.5 The tribal authority

		Frequency	Percent	Valid Percent
Valid	1 - Not at all	40	26.7	27.6
	2	19	12.7	13.1
	3	24	16.0	16.6
	4	26	17.3	17.9
	5 - To a large extent	36	24.0	24.8
	Total	145	96.7	100.0
Missing	System	5	3.3	
Total		150	100.0	

Note: Five participants did not answer this question
 Most participants rated this to no extent at all (27%).

6.6 The Head Man/Lady

		Frequency	Percent	Valid Percent
Valid	1 - Not at all	31	20.7	21.2
	2	27	18.0	18.5
	3	31	20.7	21.2
	4	18	12.0	12.3
	5 - To a large extent	39	26.0	26.7
	Total	146	97.3	100.0
Missing	System	4	2.7	
Total		150	100.0	

Note: Four participants did not answer this question
 Most participants rated this to a large extent (26%).

6.7 The Mangaung Metro Municipality

		Frequency	Percent	Valid Percent
Valid	1 - Not at all	58	38.7	40.0
	2	24	16.0	16.6
	3	18	12.0	12.4
	4	8	5.3	5.5
	5 - To a large extent	37	24.7	25.5
	Total	145	96.7	100.0
Missing	System	5	3.3	
Total		150	100.0	

Note: Five participants did not answer this question
Most participants rated this to no extent at all (39%).

6.8 The consultant engineer

		Frequency	Percent	Valid Percent
Valid	1 - Not at all	11	7.3	7.6
	2	15	10.0	10.3
	3	23	15.3	15.9
	4	41	27.3	28.3
	5 - To a large extent	55	36.7	37.9
	Total	145	96.7	100.0
Missing	System	5	3.3	
Total		150	100.0	

Note: Five participants did not answer this question
Most participants rated this to a large extent (37%).

6.9 A few members of the community

		Frequency	Percent	Valid Percent
Valid	1 - Not at all	19	12.7	13.1
	2	9	6.0	6.2
	3	30	20.0	20.7
	4	42	28.0	29.0
	5 - To a large extent	45	30.0	31.0
	Total	145	96.7	100.0
Missing	System	5	3.3	
Total		150	100.0	

Note: Five participants did not answer this question
Most participants rated this to a large extent (30%).

6.10 The Irrigation committee

		Frequency	Percent	Valid Percent
Valid	1 - Not at all	13	8.7	8.9
	2	9	6.0	6.2
	3	19	12.7	13.0
	4	41	27.3	28.1
	5 - To a large extent	64	42.7	43.8
	Total	146	97.3	100.0

Missing	System	4	2.7
Total		150	100.0

Note: Four participants did not answer this question
Most participants rated this to a large extent (43%).

6.11 The community

		Frequency	Percent	Valid Percent
Valid	1 - Not at all	12	8.0	8.5
	2	11	7.3	7.7
	3	21	14.0	14.8
	4	28	18.7	19.7
	5 - To a large extent	70	46.7	49.3
	Total	142	94.7	100.0
Missing	System	8	5.3	
Total		150	100.0	

Note: Eight participants did not answer this question
Most participants rated this to a large extent (47%).

To what extent do you agree/ disagree with the following statements?

6.12 There is currently an elected irrigation committee.

		Frequency	Percent	Valid Percent
Valid	Completely disagree	15	10.0	10.3
	Disagree	24	16.0	16.4
	Neither agree nor disagree	7	4.7	4.8
	Agree	52	34.7	35.6
	Completely agree	48	32.0	32.9
	Total	146	97.3	100.0
Missing	System	4	2.7	
Total		150	100.0	

Note: Four participants did not answer this question
Most participants agreed (35%).

6.13 The community respects the irrigation committee.

		Frequency	Percent	Valid Percent
Valid	Completely disagree	12	8.0	8.2
	Disagree	22	14.7	15.0
	Neither agree nor disagree	35	23.3	23.8
	Agree	56	37.3	38.1
	Completely agree	22	14.7	15.0
	Total	147	98.0	100.0
Missing	System	3	2.0	
Total		150	100.0	

Note: Three participants did not answer this question
Most participants agreed (37%).

6.14 The irrigation committee is capacitated to lead the community in the revitalization process.

		Frequency	Percent	Valid Percent
Valid	Completely disagree	14	9.3	9.5
	Disagree	20	13.3	13.6
	Neither agree nor disagree	26	17.3	17.7
	Agree	53	35.3	36.1
	Completely agree	34	22.7	23.1
	Total	147	98.0	100.0
Missing	System	3	2.0	
Total		150	100.0	

Note: Three participants did not answer this question
Most participants agreed (35%).

6.15 A complete handbook (Step by step plan) on smallholder irrigation can assist the irrigation committee in making better decisions in the revitalization process.

		Frequency	Percent	Valid Percent
Valid	Completely disagree	7	4.7	4.8
	Disagree	7	4.7	4.8
	Neither agree nor disagree	21	14.0	14.3
	Agree	68	45.3	46.3
	Completely agree	44	29.3	29.9
	Total	147	98.0	100.0
Missing	System	3	2.0	
Total		150	100.0	

Note: Three participants did not answer this question
Most participants agreed (45%).

6.16 Production on my plot will improve after the current revitalization process has been completed

		Frequency	Percent	Valid Percent
Valid	Disagree	5	3.3	3.4
	Neither agree nor disagree	17	11.3	11.6
	Agree	69	46.0	47.3
	Completely agree	55	36.7	37.7
	Total	146	97.3	100.0
Missing	System	4	2.7	
Total		150	100.0	

Note: Four participants did not answer this question
Most participants agreed (46%).

6.17 Production on the scheme will improve when the current revitalization process has been completed

		Frequency	Percent	Valid Percent
Valid	Completely disagree	1	0.7	0.7

	Disagree	4	2.7	2.7
	Neither agree nor disagree	17	11.3	11.5
	Agree	64	42.7	43.2
	Completely agree	62	41.3	41.9
	Total	148	98.7	100.0
Missing	System	2	1.3	
Total		150	100.0	

Note: Two participants did not answer this question
Most participants agreed (43%).

6.18 The government will allocate funding towards revitalising the smallholder irrigation scheme, even if they are not making all the decisions.

		Frequency	Percent	Valid Percent
Valid	Completely disagree	44	29.3	29.9
	Disagree	8	5.3	5.4
	Neither agree nor disagree	33	22.0	22.4
	Agree	44	29.3	29.9
	Completely agree	18	12.0	12.2
	Total	147	98.0	100.0
Missing	System	3	2.0	
Total		150	100.0	

Note: Three participants did not answer this question
Most participants either agreed or completely disagreed (29% respectively).

Appendix E: Inferential Statistics on the Relationship Between Knowledge Base and Productivity

Notes:

Knowledge base: A knowledge base variable was created using question 3.14 and 4.10. The mean of the two variables were calculated, a higher mean indicates a higher knowledge base

Productivity: A productivity variable was created using questions 3.48-3.53. The mean of these variables was calculated, a higher mean indicates better production

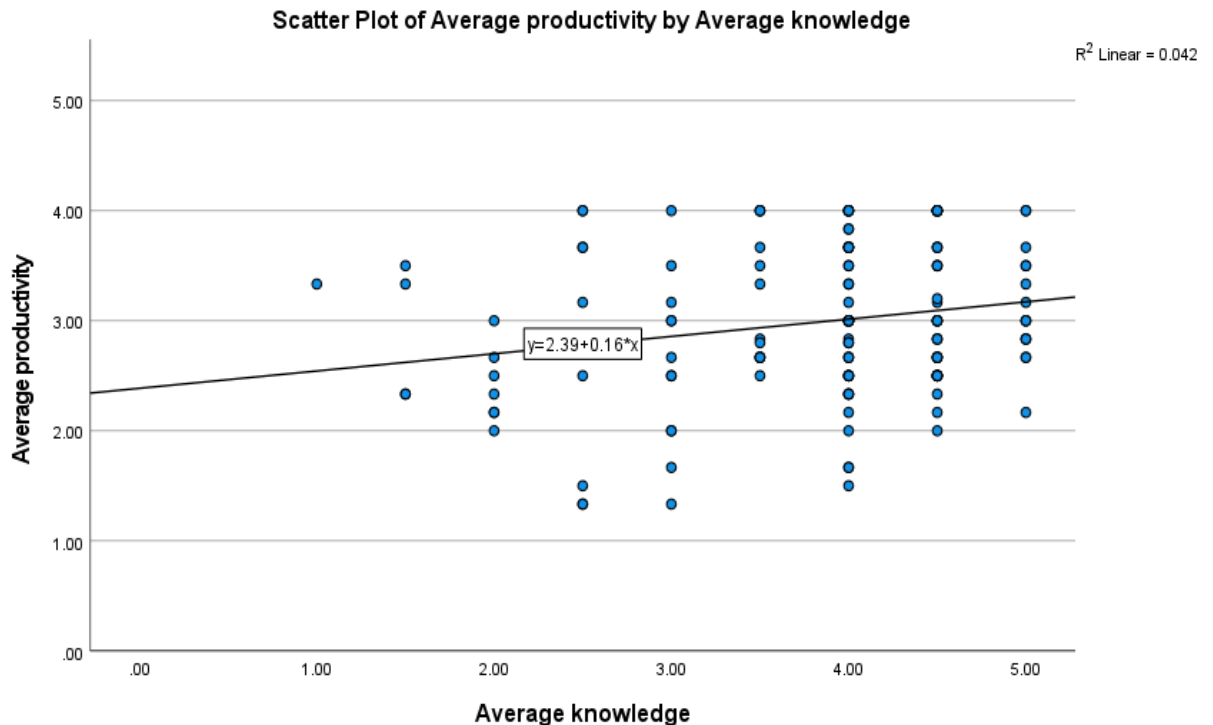
Statistical significance was accepted at $p \leq 0,05$

Simple linear regression

Assumption testing

Assumption testing is done before the results of the regression can be interpreted. This makes sure there are no violations in your data that could influence the test results.

Testing for linearity:



A scatterplot of knowledge base against productivity was plotted. Visual inspection of the scatterplot indicated a linear relationship between the variables.

Testing for independence of residuals:

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.206 ^a	0.042	0.036	0.67456	1.149

a. Predictors: (Constant), Average knowledge

b. Dependent Variable: Average productivity

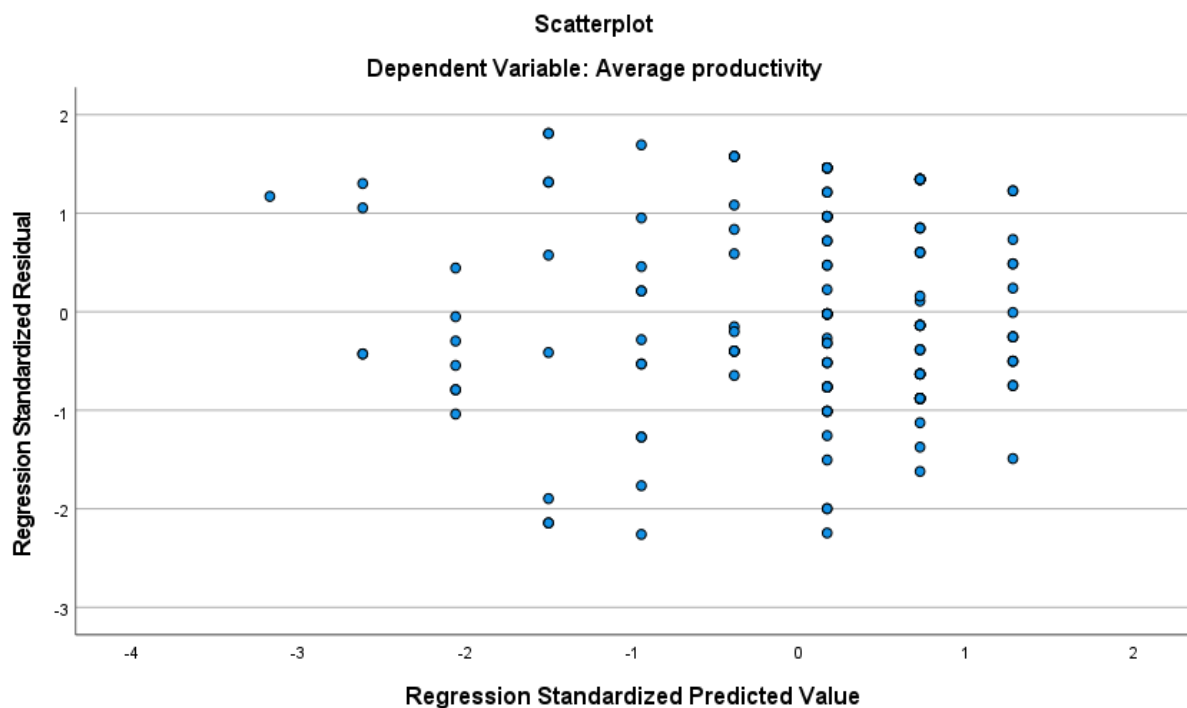
There was independence of residuals, as assessed by Durbin-Watson statistic of 1,15.

Note: A value close to 2 indicates that there is no correlation between residuals.

Testing for outliers:

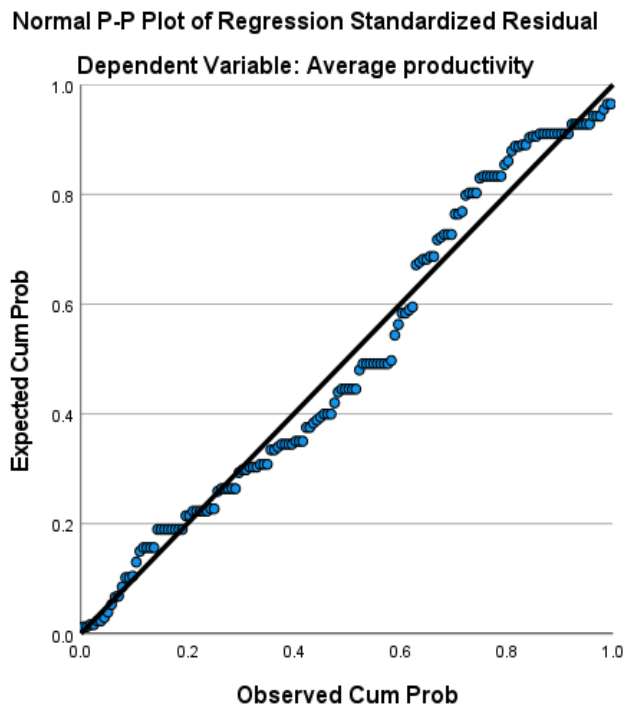
Casewise diagnostics revealed no outliers.

Testing for homoscedasticity:



There was homoscedasticity, as assessed by visual inspection of a plot of standardized residuals versus standardized predicted variables.

Testing for normality:



Residuals were normally distributed as assessed by visual inspection of a normal probability plot.

Linear regression results

All assumptions were met (no violations), therefore the results of the linear regression can be interpreted.

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.206 ^a	0.042	0.036	0.67456	1.149

a. Predictors: (Constant), Average knowledge

b. Dependent Variable: Average productivity

The model summary table shows that knowledge base accounted for 4% (R^2) of the variation in productivity, with a small effect size (adjusted $R^2 = 4\%$).

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.970	1	2.970	6.526	.012 ^b
	Residual	67.344	148	0.455		

Total	70.314	149		
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- a. Dependent Variable: Average productivity
- b. Predictors: (Constant), Average knowledge

The ANOVA table above shows that knowledge base significantly predicted productivity $F(1,148) = 6,53, p = 0,01$. The coefficients table below shows that for every 0,16 increase in knowledge base, there is a one unit increase in productivity.

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	2.386	0.243		9.818	0.000	1.906	2.866
	Average knowledge	0.157	0.061	0.206	2.555	0.012	0.036	0.279

- a. Dependent Variable: Average productivity

Summary

A linear regression was run to understand the effect of knowledge base on productivity. Assumption testing included testing for linearity, independence of residuals, outliers, homoscedasticity and normality. None of these assumptions were violated. Linear regression results showed that knowledge base accounted for 4% of the variation in productivity, although a small effect size (adjusted $R^2 = 4\%$), knowledge base significantly predicted productivity, $F(1,148) = 6,53, p = 0,01$. For every 0,16 increase in knowledge base, there was a one unit increase in productivity, with a prediction equation of: $Productivity = 2,39 + 0,16 * knowledge\ base$.

Appendix F: Inferential Statistics on the Relationship Between Level/Quality of Leadership and Decision-Making

Notes:

Level/ quality of leadership: A level/ quality of leadership variable was created using questions 3.30-3-38 and 3.42-4.45. The mean of these variables was calculated, a higher mean indicates a higher level/ quality of leadership

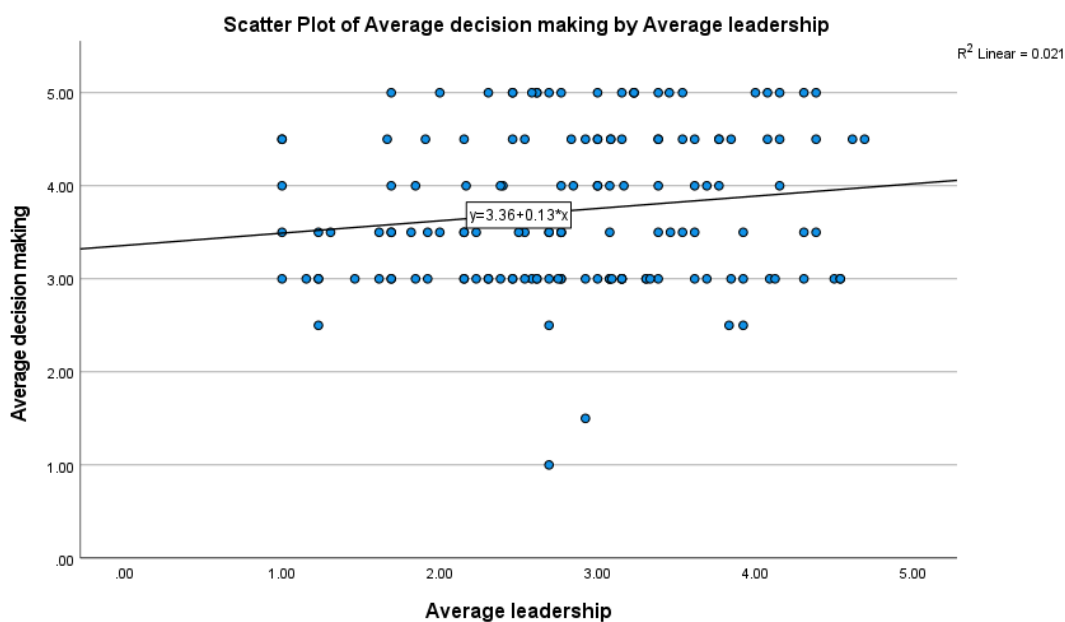
Decision making: Question 4.11 was reverse coded and used together with question 4.12 to create a decision-making variable. The mean of the two variables were calculated, a higher mean indicates a higher level of decision making.
Statistical significance was accepted at $p \leq 0,05$

Simple linear regression

Assumption testing

Assumption testing is done before the results of the regression can be interpreted. This makes sure there are no violations in your data that could influence the test results.

Testing for linearity:



A scatterplot of knowledge base against productivity was plotted. Visual inspection of the scatterplot indicated a linear relationship between the variables.

Testing for independence of residuals:

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.146 ^a	0.021	0.015	0.81717	1.129

a. Predictors: (Constant), Average leadership

b. Dependent Variable: Average decision making

There was independence of residuals, as assessed by Durbin-Watson statistic of 1,13.

Note: A value close to 2 indicates that there is no correlation between residuals.

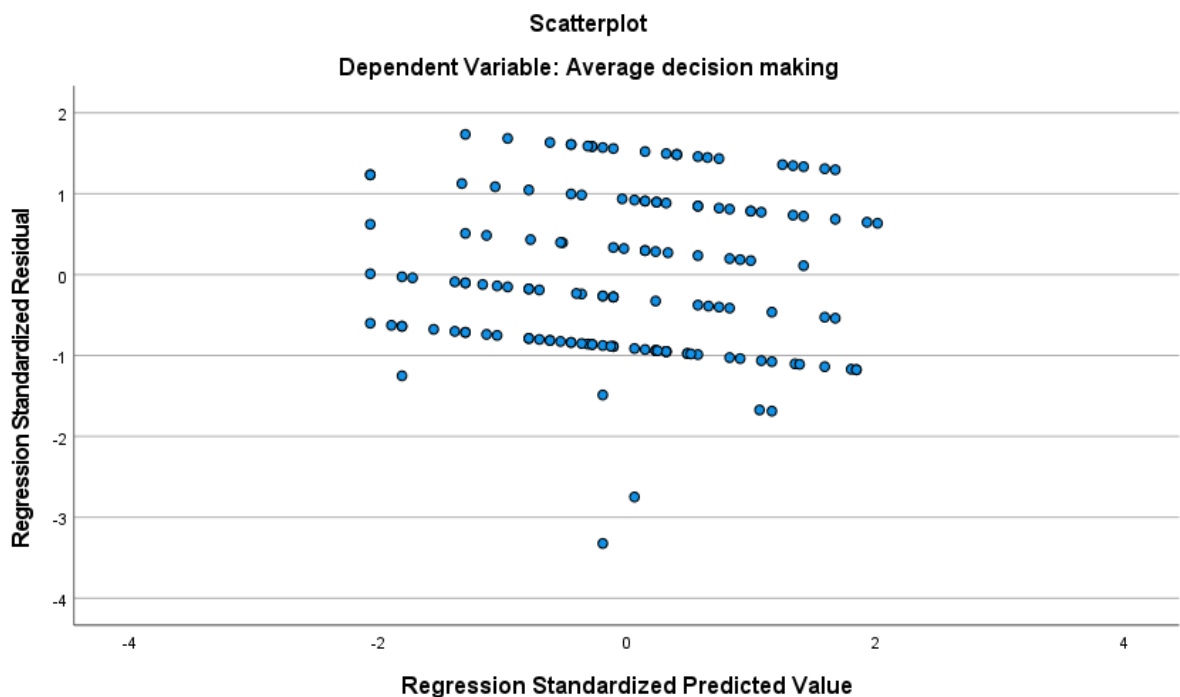
Testing for outliers:

Case Number	Std. Residual	Average decision making	Predicted Value	Residual
60	-3.323	1.00	3.7153	-2.71535

a. Dependent Variable: Average decision making

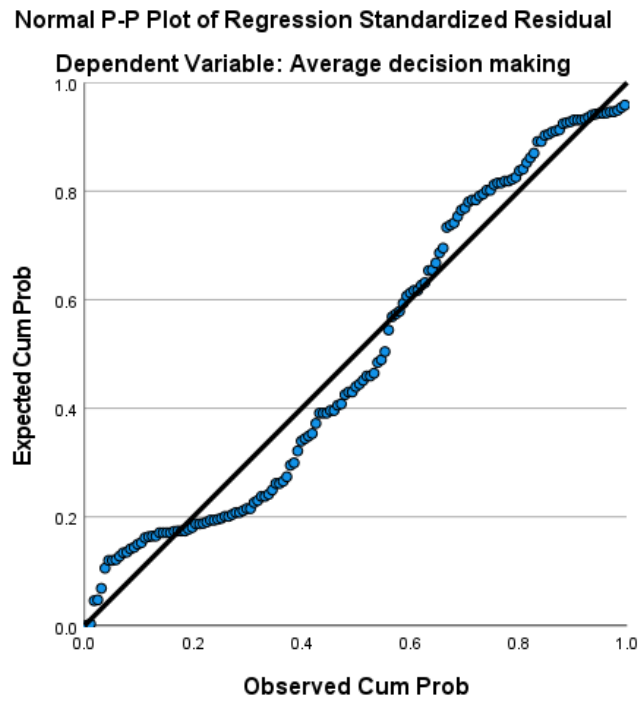
Casewise diagnostics revealed one outlier, but since it was an actual data point was included in the analysis.

Testing for homoscedasticity:



There was homoscedasticity, as assessed by visual inspection of a plot of standardized residuals versus standardized predicted variables.

Testing for normality:



Residuals were normally distributed as assessed by visual inspection of a normal probability plot.

Linear regression results

All assumptions were met (no violations), therefore the results of the linear regression can be interpreted.

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.146 ^a	0.021	0.015	0.81717	1.129

a. Predictors: (Constant), Average leadership

b. Dependent Variable: Average decision making

The model summary table shows that leadership accounted for 2% (R^2) of the variation in productivity, with a small effect size (adjusted $R^2 = 2\%$).

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.130	1	2.130	3.190	.076 ^b

Residual	98.162	147	0.668		
Total	100.292	148			

a. Dependent Variable: Average decision making

b. Predictors: (Constant), Average leadership

The ANOVA table shows that leadership did not significantly predicted decision making $F(1,147) = 3,19, p > 0,05$.

Summary

A linear regression was run to understand the effect of leadership on decision-making. Assumption testing included testing for linearity, independence of residuals, outliers, homoscedasticity and normality. One outlier was detected but included in analysis as it was an actual data point. Linear regression results showed that leadership accounted for 2% of the variation in decision making. In line with the small effect size (adjusted $R^2 = 2\%$), leadership did not significantly predict decision making, $F(1,147) = 3,19, p > 0,05$.

Appendix G: Inferential Statistics on Community vs Government Comparisons

Chi-square test of independence:

Is there an association between participant's village and the community having a plan to improve production

Area/Village: * The community had a plan to improve production on the scheme in the past. Crosstabulation

			The community had a plan to improve production on the scheme in the past.			Total
			Yes	No	Don't know	
Area/Village:	Sediba	Count	40	7	11	58
		Expected Count	45.8	4.7	7.5	58.0
		% Within Area/Village:	69.0%	12.1%	19.0%	100.0%
		% Within The community had a plan to improve production on the scheme in the past.	34.5%	58.3%	57.9%	39.5%
		% Of Total	27.2%	4.8%	7.5%	39.5%
	Woodbridge	Count	44	4	5	53
		Expected Count	41.8	4.3	6.9	53.0
		% Within Area/Village:	83.0%	7.5%	9.4%	100.0%
		% Within The community had a plan to improve production on the scheme in the past.	37.9%	33.3%	26.3%	36.1%
		% Of Total	29.9%	2.7%	3.4%	36.1%
	Feloana	Count	32	1	3	36
		Expected Count	28.4	2.9	4.7	36.0
		% Within Area/Village:	88.9%	2.8%	8.3%	100.0%
		% Within The community had a plan to improve production on the scheme in the past.	27.6%	8.3%	15.8%	24.5%
		% Of Total	21.8%	0.7%	2.0%	24.5%
Total	Count	116	12	19	147	
	Expected Count	116.0	12.0	19.0	147.0	
	% Within Area/Village:	78.9%	8.2%	12.9%	100.0%	
	% Within The community had a plan to improve production on the scheme in the past.	100.0%	100.0%	100.0%	100.0%	
	% Of Total	78.9%	8.2%	12.9%	100.0%	

The crosstabulations above show that the assumption of expected cell counts above 5 was violated. The results were however interpreted and showed no statistical association between participant's village and the community having a plan to improve production, $\chi^2(4) = 6,41, p > 0,05$.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6.406 ^a	4	0.171
Likelihood Ratio	6.651	4	0.156
Linear-by-Linear Association	4.778	1	0.029
N of Valid Cases	147		

a. 4 cells (44.4%) have expected count less than 5. The minimum expected count is 2.94.

Is there an association between participant's village and the government having a plan to revitalize the irrigation scheme

Area/Village: * The government currently has a plan to revitalize the irrigation scheme. Crosstabulation

		The government currently has a plan to revitalize the irrigation scheme.			Total	
		Yes	No	Don't know		
Area/Village:	Sediba	Count	50	2	6	58
		Expected Count	47.8	3.1	7.1	58.0
		% Within Area/Village:	86.2%	3.4%	10.3%	100.0%
		% Within The government currently has a plan to revitalize the irrigation scheme.	41.0%	25.0%	33.3%	39.2%
		% Of Total	33.8%	1.4%	4.1%	39.2%
	Woodbridge	Count	42	4	7	53
		Expected Count	43.7	2.9	6.4	53.0
		% Within Area/Village:	79.2%	7.5%	13.2%	100.0%
		% Within The government currently has a plan to revitalize the irrigation scheme.	34.4%	50.0%	38.9%	35.8%
		% Of Total	28.4%	2.7%	4.7%	35.8%
	Feloana	Count	30	2	5	37
		Expected Count	30.5	2.0	4.5	37.0
% Within Area/Village:		81.1%	5.4%	13.5%	100.0%	

	% Within The government currently has a plan to revitalize the irrigation scheme.	24.6%	25.0%	27.8%	25.0%
	% Of Total	20.3%	1.4%	3.4%	25.0%
Total	Count	122	8	18	148
	Expected Count	122.0	8.0	18.0	148.0
	% Within Area/Village:	82.4%	5.4%	12.2%	100.0%
	% Within The government currently has a plan to revitalize the irrigation scheme.	100.0%	100.0%	100.0%	100.0%
	% Of Total	82.4%	5.4%	12.2%	100.0%

The crosstabulations above show that the assumption of expected cell counts above 5 was violated. The results were however interpreted and showed no statistical association between participant's village and the government having a plan to revitalize the irrigation scheme, $\chi^2(4) = 1,30, p > 0,05$.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.295 ^a	4	0.862
Likelihood Ratio	1.311	4	0.859
Linear-by-Linear Association	0.430	1	0.512
N of Valid Cases	148		

a. 4 cells (44.4%) have expected count less than 5. The minimum expected count is 2.00.

Summary

	Sediba	Woodbridge	Feloana	p-value
Community has a plan to improve production	69%	82%	84%	0.17
Government has a plan to revitalize the irrigation scheme	86%	78%	79%	0.86

Note: These percentages are found in the descriptive statistics

Summary

Most participants from all villages said that the community has a plan to improve production

and that government has a plan to revitalize the irrigation scheme. When the villages were compared, it was found that Feloana had the highest percentage of participants saying the community has a plan to improve production, but there was no statistically significant association between village and the community having a plan to improve production, $\chi^2(4) = 6,41, p > 0,05$. Similarly, Sediba had the highest percentage of participants saying that the government has a plan to revitalize the irrigation scheme, but again, there was no statistically significant association between village and the government having a plan to revitalize the irrigation scheme, $\chi^2(4) = 1,30, p > 0,05$.

Appendix H: Inferential Statistics for the Need for a Toolkit (N =150)

From Q6.14 and Q6.15 descriptive statistics:

Most participants (58%) agreed to some extent (agreed or strongly agreed) that the irrigation committee is capacitated to lead the community in the revitalization process. In addition, 75% of the participants agreed to some extent that a complete handbook on smallholder irrigation can assist the irrigation committee in making better decisions in the revitalization process.

Note: Inferential statistics was only done for the latter observation

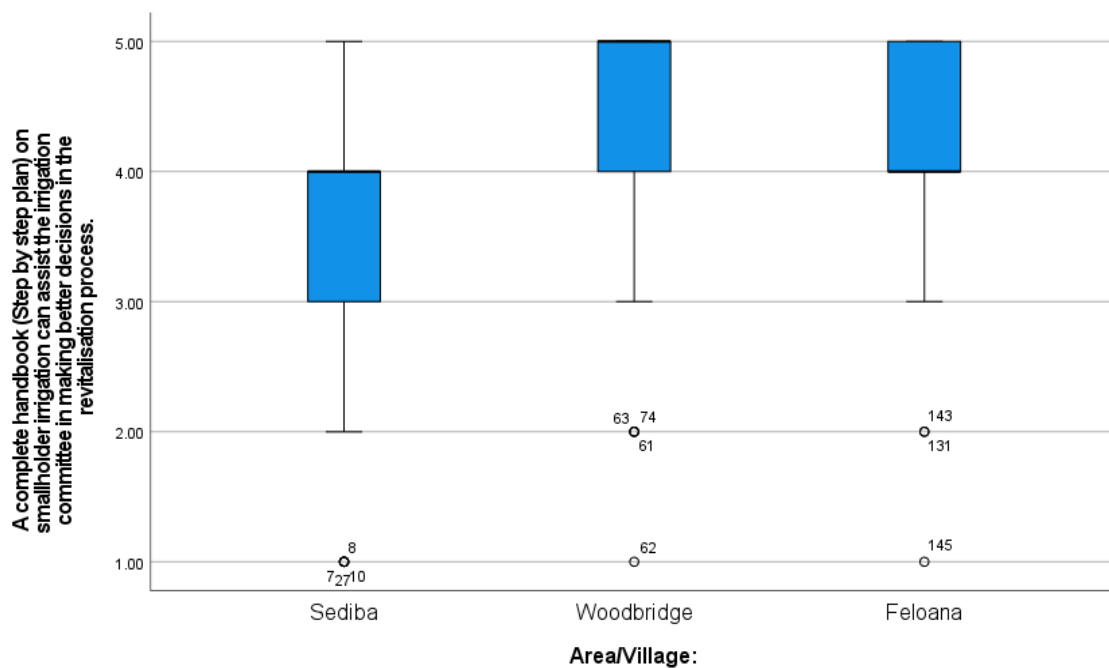
ANOVA: Analysis of variance

Is there a statistical difference between participant's village and the level of agreement towards a complete handbook on smallholder irrigation assisting the irrigation committee in making better decisions in the revitalization process

Assumption testing

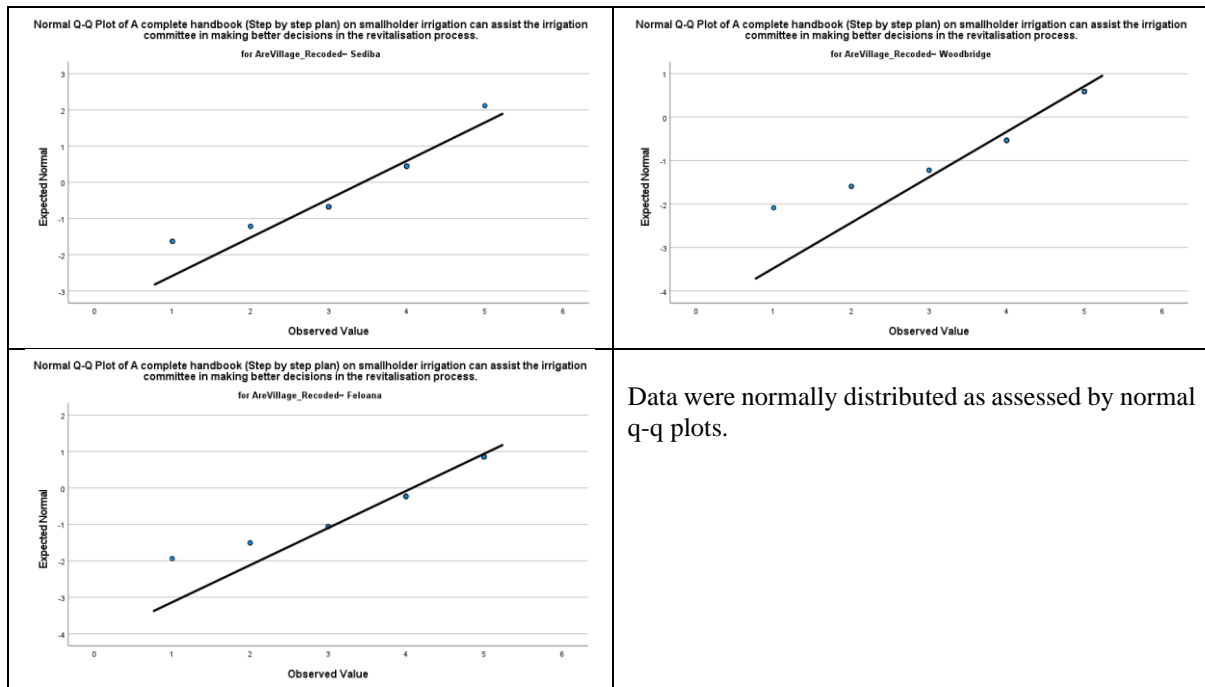
Assumption testing is done before the results of the ANOVA can be interpreted. This makes sure there are no violations in your data that could influence the test results.

❖ Testing for outliers



Upon visual inspection of the above boxplot, no extreme outliers were identified.

❖ Testing for normal distribution



❖ Tests of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.	
A complete handbook (Step by step plan) on smallholder irrigation can assist the irrigation committee in making better decisions in the revitalization process.	Based on Mean	0.087	2	144	0.917
	Based on Median	0.147	2	144	0.864
	Based on Median and with adjusted df	0.147	2	137.847	0.864
	Based on trimmed mean	0.007	2	144	0.993

❖ Descriptives

A complete handbook (Step by step plan) on smallholder irrigation can assist the irrigation committee in making better decisions in the revitalization process.								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Sediba	57	3.4386	0.94524	0.12520	3.1878	3.6894	1.00	5.00
Woodbridge	53	4.3208	0.95623	0.13135	4.0572	4.5843	1.00	5.00
Feloana	37	4.0811	0.98258	0.16154	3.7535	4.4087	1.00	5.00
Total	147	3.9184	1.03043	0.08499	3.7504	4.0863	1.00	5.00

Key: 1=strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree, 5=completely agree

From the table above and below: The results of the one-way ANOVA showed that the level of agreement towards a complete handbook (Step by step plan) on smallholder irrigation assisting

the irrigation committee in making better decisions in the revitalization process was statistically different for the villages, $F(2, 144) = 12,34, p < 0,001$. Woodbridge had the highest level of agreement ($4,32 \pm 0,96$), followed by Feloana ($4,08 \pm 0,98$) and Sediba ($3,44 \pm 0,95$).

❖ ANOVA

A complete handbook (Step by step plan) on smallholder irrigation can assist the irrigation committee in making better decisions in the revitalization process.					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	22.681	2	11.341	12.340	0.000
Within Groups	132.339	144	0.919		
Total	155.020	146			

Multiple Comparisons							
Dependent Variable:							
(I) Area/Village:			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	Sediba	Woodbridge	-.88216*	0.18293	0.000	-1.3154	-0.4489
		Feloana	-.64248*	0.20239	0.005	-1.1218	-0.1632
	Woodbridge	Sediba	.88216*	0.18293	0.000	0.4489	1.3154
		Feloana	0.23967	0.20537	0.475	-0.2467	0.7260
	Feloana	Sediba	.64248*	0.20239	0.005	0.1632	1.1218
		Woodbridge	-0.23967	0.20537	0.475	-0.7260	0.2467
Tukey post-hoc analysis showed that there was a statistical difference between Sediba and Woodbridge ($p < 0,001$) and Sediba and Feloana ($p = 0,005$), but not between Woodbridge and Feloana ($p > 0,05$).							

❖ Summary

A one-way ANOVA was conducted to determine if there was a statistical difference between participant's village and the level of agreement towards a complete handbook on smallholder irrigation assisting the irrigation committee in making better decisions in the revitalization process. The assumptions of no outliers, normal distribution and homogeneity of variance were met. The level of agreement towards a complete handbook (Step by step plan) on smallholder irrigation assisting the irrigation committee in making better decisions in the revitalization process was statistically different for the villages, $F(2, 144) = 12,34, p < 0,001$. Woodbridge had the highest level of agreement ($4,32 \pm 0,96$), followed by Feloana ($4,08 \pm 0,98$) and Sediba ($3,44 \pm 0,95$). Turkey post-hoc analysis showed that there was a statistical difference between Sediba and Woodbridge ($p < 0,001$) and Sediba and Feloana ($p = 0,005$), but not between Woodbridge and Feloana ($p > 0,05$).