SMALLHOLDER FARMER DROUGHT COPING AND ADAPTATION STRATEGIES IN LIMPOPO AND WESTERN CAPE PROVINCES

Report to the
WATER RESEARCH COMMISSION

by

BONGANI NCUBE
Cape Peninsula University of Technology

WRC Report No. 2716/1/20
ISBN 978-0-6392-0204-4

November 2020

Obtainable from
Water Research Commission
Private Bag X03
GEZINA, 0031

orders@wrc.org.za or download from www.wrc.org.za

EXECUTIVE SUMMARY

Introduction

Smallholder farmers are a generally heterogeneous grouping, but in South Africa, the diversity is especially pronounced due to a history of unequal distribution of resources. Since 1994, the government has tried to address issues of inequality in accessing water, land and other natural resources. Unfortunately, because of repeated policy changes and the sometimes misinformed implementation of farmer livelihood strategies, the South African state has achieved limited success in the sustainable development of smallholder farmers.

Project Objectives

This project sought to characterise smallholder farmers and to identify the coping and adaptation strategies to which they resort during periods of drought. The specific objectives of the research were to:

1. Assess smallholder farmer characteristics and livelihood strategies in rural parts of the Limpopo and Western Cape provinces.
2. Explore the coping and adaptation strategies for agricultural water use adopted by smallholder farmers during drought periods.
3. Explore smallholder farmers' coping with and adaptation to drought in crop farming and livestock systems in the Limpopo and Western Cape provinces.

As the project progressed, smallholder farmer support during drought was also assessed in the Western Cape, while field activities in Limpopo continued beyond the project. The two provinces experienced some of the worst impacts of drought during the period 2015-2018.

Research approach

The research began with an extensive document review process. A review of smallholder farming in South Africa was carried out, focusing on the challenges faced by the sector in relation to the impacts of drought and climate change. Surveys were then carried out in both the Limpopo and Western Cape provinces to identify the various types of smallholder farmers. These surveys were conducted in two districts in the Limpopo Province and two districts in the Western Cape. Two hundred farmers were surveyed in Limpopo and 78 farmers were surveyed in the Western Cape. The approach in the Western Cape was essentially one-on-one interviews, while in Limpopo questionnaires were administered to the farmers with the help of agricultural extension officers. The Sustainable Livelihoods framework was used to assess the farmers' livelihoods.

The third step was to explore the coping and adaptation strategies for agricultural water use adopted by smallholder farmers during drought periods. Based principally on the 2015-18 drought but including farmers' experience of past droughts, adaptation strategies (particularly successful ones) that they employed were documented. In addition to interviews and surveys,

several participatory action research tools were used, including focus group discussions, institutional analysis, stakeholder analysis and network mapping. The role of organisations in livelihood support and promoting drought coping and adaptation strategies for smallholder farmers were then explored in the Western Cape. Surveys and focus group discussions were carried out to assess the extent of this support.

The last activity in the research was an evaluation of drought management programmes in the Western Cape. The objectives of the evaluation were to determine the activities of the drought implementation agency and its relationship with the Western Cape Department of Agriculture (WCDoA). The study also sought to understand how farmers viewed the drought relief scheme (DRS). A desktop analysis was carried out, followed by face-to-face interviews.

Results

Smallholder farming in South Africa

The literature indicates that, since 1994, government efforts to promote smallholder farmers have not yielded the intended results. Supportive institutions such as the Agricultural Research Council, the Land Bank, and the Provincial Departments of Agriculture have sought to assist with agricultural development but have struggled to deal with the complex circumstances and needs of smallholder farmers.

There is limited access to agricultural credit. Private sector financial services are generally unavailable to farmers without collateral, and their inability to use the land they farm as collateral precludes them from access to funds from commercial banks. The government institutions mentioned above are not in a position to assist smallholder farmers with all their financial needs. The farmers are too poor to satisfy loan requirements. The government cannot afford to fund individuals (a practice in any case regarded as high risk and expensive) and believes that cooperatives are the way to go. Yet the lack of facilitation in the formation of producer associations or other partnership arrangements makes it difficult for smallholder producers to participate in formal markets in this way.

Any effort to increase the contribution of smallholder farming to poverty reduction needs to appreciate that smallholder farmers are not a homogeneous group. An effective smallholder agricultural development strategy must recognise that there are different categories of smallholder farmer requiring different support and approaches. Technological and institutional packages should be tailored for each category of farmers. This can only be done if the characteristic challenges and limitations faced by the farmers are understood, and the packages are strategically developed according to their livelihoods and resource endowment.

Characteristics of smallholder farmers: Western Cape and Limpopo provinces

Several interesting trends were discovered in the provinces investigated. In both provinces, it was the elderly who were mostly involved in farming, but their gender differed: in Limpopo,

about 61% of the farmers were female, while in the Western Cape more than 90% of the farmers were male.

Education levels were also different. While about 6% of the farmers in the Western Cape had never been to school, in Limpopo this proportion was about 32%. In both provinces, a larger number of farmers had attained primary level education (40% in Limpopo, and 28% and 43% in the Overberg and West Coast districts, respectively). About 10% of the farmers had achieved tertiary educational qualifications.

There was a huge disparity in land size distribution between the two provinces. About 80% of the farmers were using less than 4 ha of land in the Limpopo province, while in the Western Cape farm sizes varied from 50 m^2 to 6 000 ha in the West Coast district and 0.5 ha to 2 000 ha in the Overberg district. In the Western Cape, most of the farmed land was leased from the municipality. Group dynamics played a very important role in both provinces, with about 70% of the smallholder farmers belonging to a farming group in both provinces.

Most farmers in the Western Cape obtained water from dams (45% in the Overberg district and 31% in the West Coast). The farmers in Limpopo also drew upon surface water sources. For potable water, boreholes were important sources (about 22%) in both provinces.

About 50% of the respondents in Limpopo depended on social grants as their main source of income, with only 7% of them relying wholly on farming income. In contrast, 49% and 43% of the farmers in the two Western Cape districts were dependent on income from farming.

About 62% of the farmers in Limpopo had to resort to public transport, while in the Western Cape many farmers had contracts with commodity companies who took their produce to the markets. There was a huge difference in the energy sources used by the farmers for both domestic and farming purposes. In Limpopo, 85% of the farmers used electricity, in contrast to 40% for Overberg and 53% for the West Coast districts. In the Western Cape farmers also relied a lot on gas and wood.

Coping strategies for reducing agricultural water use by farmers in the Limpopo province included crop diversification, using drought-tolerant crops and – for livestock farmers – reducing their herds through selling. The Western Cape farmers adopted strategies such as drip irrigation and reducing crop areas. Livestock numbers were also reduced and some farmers transported water for their livestock from other areas. In both provinces, the drilling of boreholes was seen as a long-term strategy to ensure water supply in the event of future droughts. Changing livestock systems from larger to smaller stock was also mentioned in both provinces.

Role of organisations in supporting farmer livelihoods during drought: Western Cape
Some government departments supported smallholder farmers in the Western Cape. These included the Western Cape Department of Agriculture, Department of Human Settlements, the Department of Water and Sanitation (DWS), the Department of Agriculture, Forestry and Fisheries (DAFF), and the Department of Rural Development and Land Reform (DRDLR). The Breede-Gouritz Catchment Management Agency (BGCMA) also had specific programmes set up to support smallholder farmers. Due to the commodity approach of Western Cape agriculture, there were also several private organisations supporting farming. The organisations provided various kinds of support including financial, technical, information, advice, markets and facilitation. Also offering support were the communities themselves, mentors and individual commercial farmers, abattoirs and municipalities.

When it came to the drought the support systems showed a different picture. The WCDoA was the main provider of drought relief, through the Cape Agency for Sustainable Integrated Development in Rural Areas (CASIDRA), the implementing agency for the Drought Relief Programme. DWS advised farmers on how to improve in saving or managing water to achieve desired outcomes. Water restrictions were nevertheless imposed, resulting in farmers not being able to access sufficient water for agricultural purposes. Private organisations supported smallholder farmers with information on drought mitigation, funding, facilitation of access to resources and lobbying. However, some private organisations reported that there were no specific interventions focused on drought relief for smallholder farmers.

WCDoA and CASIDRA fulfilled their mandate of implementing the DRS in the province to assist smallholder farmers with fodder for livestock during drought. WCDoA coordinated the efforts of all stakeholders, as outlined in the Provincial Drought Management Plan of 2016 and the Drought Implementation Plans of 2017/18 and 2019/20. Evaluations have also been conducted since 2015 by the Department. It was, however, a challenge to determine the extent to which the DRS was being implemented at the provincial level. What was evident was that CASIDRA was only involved in the administration of the funding on behalf of the WCDoA. CASIDRA was not directly involved with the smallholder farmers, nor with the extension officers, but only with the management staff at the WCDoA. CASIDRA was also directly involved with the suppliers of animal feeds, for example, KaapAgri and Cape Feeds. The achievement of CASIDRA seemed to be limited, with no apparent influence for change at the level of the farmers. The connections among those involved in the implementation of the DRS as stipulated by the DIP in 2018/2019 and 2019/2020 was also generally limited. There were gaps in the liaison, probably the result of a breakdown in communication and the delegation and execution of duties. It must be conceded, however, that this conclusion was based on the testimony of the few individuals who were interviewed.

Regarding the recruitment of farmers, the process seemed to be haphazard and exclusive of those who did not meet certain requirements, though some of the reasons for this were beyond CASIDRA's control. There was a need to cushion smallholder farmers through proper planning

and investment in programmes that empowered them to be able to take advantage of future support interventions. Challenges experienced during implementation of the DRS included misappropriation of support by beneficiaries, lack of capacity in terms of human resources, and a lack of coordination and communication among stakeholders at the level of CASIDRA, the WCDoA directorates and the farmers themselves.

Agri Western Cape was involved in the DRS implementation through the WCDoA and offered support through information and technical advice. The organisation had a drought fund which was meant specifically for its members to enable them to keep activities running during the drought period. Generally, Agri Western Cape supported the government departments by leveraging their efforts through lobbying and other forms of policy influence and promotion. The two main organisations working closely with them were Hortgro and Vinpro, whose goals Agri Western Cape committed themselves to achieve. The major challenge identified was lack of capacity, which meant that direct involvement with the organisation's clientele (both smallholder and commercial farmers) was limited.

Conclusions and recommendations

The South African government has developed and implemented several policies to support smallholder farmers, but these policies have achieved limited success because of many challenges. The policies are usually inadequate or inappropriate because the smallholder farmers are treated the same despite their diversity in terms of resource endowment. In addition, the fact that smallholder farmers lack access to land, and are held back by poor physical and institutional infrastructure and poor access to proper roads, means that they remain isolated from the markets.

Coping and adaptation strategies adopted by smallholder farmers in crop and livestock systems during drought depend on the farmers' resource endowment. In many cases, their choices are extremely limited. There is government provision of fodder for the worst affected livestock farmers, but the processes are inefficient, and often the assistance comes too late.

While many organisations provide support to smallholder farmers, the support is not coordinated and is sometimes duplicated. Support during drought is provided by various government departments, but the Department of Agriculture provides the most. Private organisations' commodity-based assistance is available for some but not all the farmers.

The drought relief scheme (DRS) faced implementation challenges, even in the Western Cape, where certain structures have been established. More work should be done on strengthening the process of implementing the DRS, and this should be followed by systematic data collection for continued monitoring and further evaluations.

There is a need to consolidate and synthesise the research done so far on drought management in smallholder farming systems to inform policy development. The current efforts to revise the National Drought Plan should also recognise the vast knowledge that has already been collected on smallholder farmer livelihoods. This will allow for recognition of the diversity of these farmers and the creation of relevant and appropriate policies and strategies to assist them.

Other areas that need further research include consolidation of smallholder farmer drought support systems at the provincial level, youth empowerment, strengthening extension, and exploring the integration of indigenous knowledge and drought early warning systems.

ACKNOWLEDGEMENTS

REFERENCE GROUP

Prof. NS Mpandeli	Water Research Commission – Project Manager
Dr SN Hlophe-Ginindza	Water Research Commission
Ms LN Masilela	Water Research Commission
Dr B Ncube	Cape Peninsula University of Technology – Project Leader
Prof. AJ Jordaan	University of the Free State
Ms E van Rooyen	Breede-Gouritz Catchment Management Agency
Mr W Burger	Western Cape Department of Agriculture
Dr S Adey	Western Cape Department of Agriculture
Prof. R Schulze	University of KwaZulu-Natal
Prof. K Ayisi	University of Limpopo
Dr PI Maponya	Agricultural Research Council
Dr C Nhemachena	International Water Management Institute
Dr I Kgakatsi	Department of Agriculture, Forestry and Fisheries
Dr L Nhamo	Water Research Commission

The following project team members are acknowledged for their contribution to the success of the project:

Mrs M Fanadzo	Cape Peninsula University of Technology – PhD Student
Mr S Shikwambana	Cape Peninsula University of Technology – PhD Student
Mr CPR Carelsen	Cape Peninsula University of Technology – MSc Student
Ms O Pili	Cape Peninsula University of Technology – MSc Student
Mr K Mugejo	Cape Peninsula University of Technology – MSc Student
Mr Joao Alberts	Cape Peninsula University of Technology – Administrator

At the time of writing up the project, the students were at various stages of nearing the completion of their studies.

This page was intentionally left blank

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

This page was intentionally left blank

1 INTRODUCTION

1.1 Rationale of the Research

Smallholder farmers[1] are generally heterogeneous and use diverse strategies to sustain a livelihood. Countries in Sub-Saharan Africa have implemented various policies and strategies to support smallholder farmers. In South Africa, several legislative and strategic efforts have been made to assist smallholder farmers to progress in farming and better their lives, yet the sheer diversity of smallholder farmers poses serious challenges for any developmental efforts. The strategies introduced are usually one-size-fits-all in design, development, and implementation. Linear and largely top-down approaches that do not sufficiently recognise the fundamental heterogeneity of smallholder farming result in agricultural research and development efforts generating lower than expected impacts (Chikowo et al., 2014). This result is largely due to gross mismatches between intention and reality caused by the widely varying conditions of farming households (Chikowo et al., 2014).

According to Pienaar and Traub (2015), smallholder agriculture in South Africa has been identified as the vehicle through which the goals of poverty reduction and rural development can be achieved. Unfortunately, several challenges limit smallholder farmers from achieving the desired degree of poverty reduction. These include, but are not limited to, inadequate funding from the government, the inadequacy of extension support services, inappropriate agricultural policy and support programmes, weak institutions and organisational structures (Fanadzo and Ncube, 2018), and exclusive and restrictive water rights/permit systems that have impeded rather than enabled access to water by small-scale farmers (Fanadzo and Ncube, 2018; Ncube 2018; Schreiner and Van Koppen, 2020). To support smallholder farmers to achieve their livelihood outcomes, there is a need to understand their livelihood strategies, so that any support can consider the diversity and heterogeneity of farming households.

Livelihoods approaches have been the subject of much debate in recent years (Chapman et al., 2003; Olivier, 2019). The growing donor and development agency experience of implementing such approaches suggests that they have considerable potential for improving the focus of programmes, policies and the overall strategic coherence of interventions designed to promote poverty reduction and food security in developing countries (Chapman et al., 2003). It is widely acknowledged that a livelihoods approach provides a useful, logically consistent framework for thinking through the complex issues influencing the lives of smallholder farmers. In particular, it draws attention to ways in which policies, institutions, and decision-making

[1] **Smallholder farmer**

In this study the definition of smallholder farmers that has been adopted is the one used by the South African Department of Agriculture (2015). Smallholder farmers are those who produce for household consumption and markets subsequently, earning ongoing revenue from their farming businesses, which form a source of income for the family. Farming is not always the main source of income; diverse non-farm sources of income exist to sustain the family. They have the potential to expand their farming operations and to become commercial farmers but need access to comprehensive support (technical, financial, and managerial instruments).

processes influence resource access and ownership, and determine strategic livelihood options available to poor households (Chapman et al., 2003).

There is a general perception that technologies developed at research stations have often failed to improve productivity at the farm-scale. Part of the problem has been the blanket promotion of single technologies and a concomitant failure to address production objectives and constraints across different types of farms (Chikowo et al., 2014). Approaches that accommodate the diversity of smallholders will encourage the formulation of effective policy interventions based on farmer livelihoods and capabilities. The government should conduct detailed livelihood analyses to gain an understanding of the livelihood strategies reflecting the various forms of diversification among smallholder farming households.

The adoption of livelihoods approaches to smallholder farmer support can, therefore, enhance the development of tailor-made strategies of support for the farmers. This should begin with a proper characterisation and classification of smallholder farmers. An understanding of the various farmer typologies will then allow for the design of livelihood strategies that are based on assets and means of production. The livelihoods approach to farmer support also has the advantage of drawing attention to how policies, institutions and decision-making processes influence resource access and ownership and determine the strategic livelihood options available to poor households (Chapman et al., 2003). Additionally, disaggregating farms or farmers into typologies is a useful tool to assist in unpacking and understanding the wide diversity among farms, enabling identification of interventions that should be targeted at specific livelihoods (Chikowo et al., 2014).

Typologies have often been used to understand structural changes in farming regarding output, employment, farming intensity and impacts of policy reforms (Pienaar and Traub, 2015). Similarly, some frameworks have been used to understand the structure and complexity of farming systems. One of these is the Sustainable Livelihoods Framework (Scoones, 1998; Department for International Development [DFID], 2000), which seeks to characterise livelihood diversification amongst rural households, including agricultural activities, but not neglecting economic, social, environmental and political perspectives (Pienaar and Traub, 2015). Figure 1.1, below, presents the Sustainable Livelihood Framework (SLF).

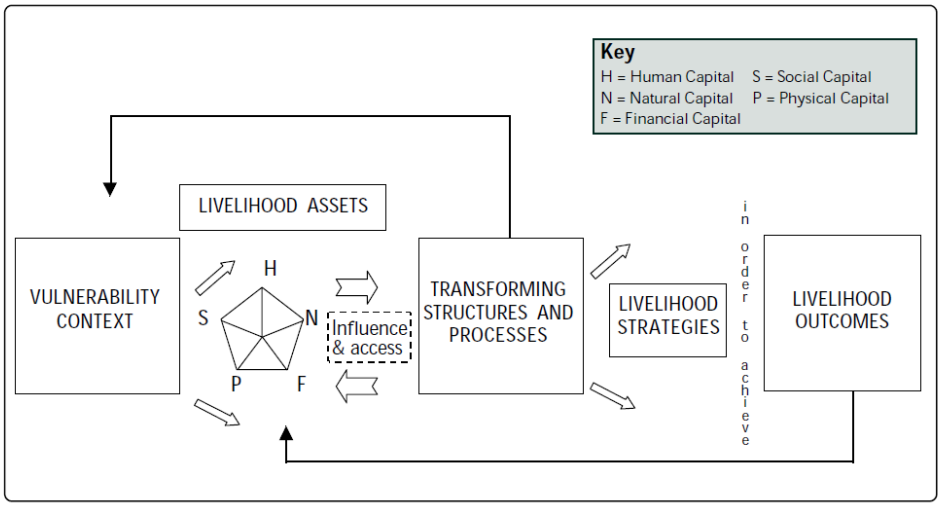

Figure 1.1 Sustainable Livelihoods Framework (DFID, 2000)

The sustainable livelihoods approach (SLA) is a way of thinking about the objectives, scope, and priorities for development activities (Serrat, 2017). The SLA is informed by certain principles for developmental activity:

- People-centred: beginning with people's own views of their priorities, opportunities and needs, the approach works out technically and financially feasible responses. In this way, it seeks to be responsive and participatory;
- Differentiated: it recognises that the characteristics of poverty, and appropriate policy responses, differ among different groups of the poor;
- Multi-level: it recognises that poverty cannot be addressed by local action alone – approaches are needed that link the local level perspectives obtained through the SLA with higher-level processes of designing and implementing policies which impinge on the poor;
- Conducted in partnership: between public and private sectors – both NGOs and private commercial agencies have roles to play which complement those of government;
- Sustainable: in several dimensions – economic, institutional, social and environmental, though this does not imply set patterns of livelihoods which must be sustained indefinitely; on the contrary, livelihoods are recognised as …
- Dynamic: in the sense that the poor manage complex 'portfolios' of a number of (usually) part-time activities, changing the balance among them with changes in the opportunities and constraints they face. (Krantz, 2001; Adeniran and Aristide, 2020).

1.2 Objectives of the Research

The project sought to characterise and classify the different types of smallholder and emerging farmers, explore options to assist these farmers to cope with drought, while at the same time seeking to build relations with institutions which have a mandate to assist the farmers. The main objectives of the research were therefore to:

- Assess smallholder farmer characteristics and livelihood strategies in rural Limpopo and Western Cape provinces
- Explore the coping and adaptation strategies for agricultural water use adopted by smallholder farmers during drought periods
- Develop and test options for smallholder farmer coping and adaptation during a drought in crop farming systems in Limpopo and Western Cape
- Develop and test options for water-conserving fodder production strategies for smallholder livestock production
- Develop a livelihoods-based package for the response to drought for smallholder farmers in South Africa

The project covered the Western Cape and Limpopo provinces. The project added to the work already taking place in the Breede-Gouritz Catchment Management Agency (BGCMA), Western Cape. Limpopo province is semi-arid, with economic activity mainly centred on livestock farming and irrigation, together with increasing mining operations (Limpopo Business Case, 2011). Since the province was one of the worst-hit by the 2015/16 drought there was an urgent need to develop interventions to ensure farmer resilience during future droughts. The severity of the drought in both Limpopo and the Western Cape was such as to hamper efforts to conduct research in the field. The research on options for water-conserving fodder production strategies for smallholder livestock production and crop farming systems has continued in the Limpopo province beyond the lifespan of the project and will be presented in the form of two master's theses and journal articles. The impacts of organisations on livelihoods and drought coping and adaptation strategies for smallholder farmers were then explored in the Western Cape. Surveys and focus group discussions were carried out to assess the extent of the support of organisations. The effectiveness of extension services was also assessed through focus group discussions held with the farmers in sites in the Overberg and West Coast districts. Additionally, interviews, questionnaires and focus group discussions were conducted with the Extension Officers in both districts. The revised approach was approved by the Reference Group Meeting (RGM) held on the 13 September 2018.

2 REVIEW OF CURRENT KNOWLEDGE OF SMALLHOLDER FARMING IN SOUTH AFRICA

Ncube, B., Fanadzo, M., Shikwambana, S., Carelsen, C.P.R.

2.1 Introduction

This chapter considers definitions of smallholder farmers and then offers a review of policies that have governed smallholder farming in South Africa since 1994. Finally, there is an extended description of the characteristics of smallholder farmers in South Africa.

2.2 Defining Smallholder Farmers

According to HarvestSA (2018), there are around 35 000 white and 5 000 black commercial farmers in South Africa feeding a population of about 55 million. The World Wide Fund for Nature (https://www.wwf.org.za/) estimates the smallholder farmers in the country to number about 2 million. The government policy framework targets 300 000 smallholders for support through government programmes (African Centre for Biodiversity [ACB]), with an emphasis on commercialisation and public-private partnerships (PPPs) aimed at creating about 145 000 jobs in agro-processing (WWF, 2020).

Smallholder farmers can be characterised as rural cultivators practising intensive, permanent, diversified agriculture on relatively small farms in areas of dense population (Robert, 1993). Smallholder farmers can be defined in many ways, depending on the context, country, and even ecological zone. They comprise a diverse set of households and individuals who face various constraints on their ability to undertake potentially profitable activities in the agricultural sector (Van Averbeke et al., 2011). The term smallholder is often used interchangeably with small-scale, resource-poor, and peasant farmer (LDA, 2005). Generally speaking, the term "smallholder" refers to these farmers' inadequate resource endowment relative to other farmers in the sector. Smallholder farmers can also be construed as those farmers owning small-based plots of land on which they grow subsistence crops and one or two cash crops, relying almost exclusively on family labour (Zeidler et al., 2010).

Smallholder farmers are also known as subsistence farmers, who self-provide livelihood strategies through agricultural produce (Morton, 2007). The land size of farms is usually small and held under traditional or informal tenure. Farmlands may also be geographically marginalised and in risk-prone environments (Morton, 2007). This group is highly reliant on natural resources, with access, availability, and quality constantly threatened by land management practices, human activities, and development trends such as population growth rates (Zeidler et al., 2010; Barnes et al., 2012).

Although definitions of smallholders differ between countries and between agro-ecological zones, they typically cultivate less than one ha of land – although they may cultivate 10 ha or

more in semi-arid areas – or manage 10 head of livestock (Dixon et al., 2004). DAFF (2012) has attempted to define smallholder farming by focusing on the characteristics of smallholder producers. They argue that the bulk of the labour in smallholder farming comes from the family within the household. Female-headed households are prominent. According to Cousins (2010), the literature fails to define smallholder farming because the various types of smallholder farmer are not distinguished. According to Cousins (2010), farmers should be ranked according to the following criteria:

- Farming constitutes only a partial contribution to their social reproduction;
- Farming meets most of their social reproduction requirements;
- Farming produces a significant surplus, allowing profits to be reinvested and even for some capital accumulation to begin.

Cousins concludes that: "Smallholders are small-scale farmers who use farm produce for home consumption to some degree and use family labour within the farming operation to some degree, but for whom farming contributes a highly variable amount of cash income via marketing of farm produce. Levels of mechanisation, capital intensity, and access to finance are also variable amongst such farmers."

It is clear from the definitions considered in this section that there is no all-encompassing definition for smallholder farmers in South Africa. It is necessary to incorporate other variables distinguishing the farmers in order to characterise and classify them. In this project, a livelihoods approach was adopted for this purpose, as well as to explore the options for helping the farmers cope with drought, while at the same time seeking to build relationships with institutions who have the mandate to support such farmers.

2.3 Policies and Strategies for Smallholder Farming since 1994

In South Africa, there is no specific policy that governs smallholder farming: such policy as exists is embedded in the national agricultural sector policies and/or strategies. This section reviews the national agricultural policy with a specific focus on elements of the policy pertinent to smallholder farming.

During the transition to democracy, there was some debate on the relative merits and demerits of pursuing a smallholder strategy. There was general agreement amongst insiders that it was necessary to continue with policy reforms – started under apartheid – to wean commercial agriculture off state support and enable markets to drive the sector in future. The architects of the policy succeeded in convincing the political leadership that restructured commercial agriculture would be able to accommodate black farmers using the market as a key mechanism for providing services and infrastructure. However, seemingly because of a lack of resources and political will, the smallholder component of the resulting strategy was not implemented in any meaningful way (DAFF, 2013).

According to a status report on land and agricultural policy in South Africa, renewed emphasis was placed on a smallholder strategy following the African National Congress National Conference in Polokwane in 2007 (DAFF, 2013). However, there was insufficient financial support for the agricultural sector, which meant that this and other agricultural plans could not be carried out. The national government, faced with economic contraction, responded by reallocating resources from agriculture to other priority areas of the economy (DAFF, 2013). Whether this was the correct decision or not, it indicates that, despite the rhetoric of rural development, when it came to the crunch, agriculture and rural development were not really seen as potential drivers of the economy. If additional resources were to come into the sector, the emphasis would be placed on boosting the capacity of provincial departments to deliver, with more skilled and decentralised staff being the primary concern (DAFF, 2013). Shifting from a racially exclusive agricultural system to a racially inclusive one would take time, and patience would be required (DAFF, 2013).

2.1.1 The Agricultural Policy Framework

The democratic elections in 1994 and the lifting of international economic sanctions against South Africa opened the way for broad liberalising reforms. The underlying principle for virtually all government policy was to bring the previously excluded black community into the mainstream economy through job creation and entrepreneurship (OECD Policy Brief, 2006). South Africa defines agricultural policy objectives in the context of broad economic reforms. The government's vision for the sector entails sustainable and profitable participation in the South African agricultural economy by all stakeholders. It recognises the importance of maintaining and developing commercial production and strengthening international competitiveness, and at the same time, it stresses the need to address the historical legacies and biases of apartheid (OECD Policy Review, 2006). Agricultural and rural development are to make a critical contribution to this broad vision of economic growth and macroeconomic stability. The dismantling of apartheid signified a strong commitment to develop a new class of black farmers and to integrate them into a market economy (OECD Policy Review, 2006).

White Paper on Agriculture, 1995

The goals of the White Paper were:

- To develop a new order of economically viable, market-directed commercial farmers, with the family farm as the basis;
- To broaden access to agriculture via land reform through adequate agricultural policy instruments and the provision of appropriate services;
- To focus financial systems on resource-poor and beginner farmers, enabling them to purchase land and agricultural inputs (DAFF, 2012).

The Integrated Growth and Development Plan

The Integrated Growth and Development Plan (IGDP) of 2012 is the national Department of Agriculture, Forestry and Fisheries Sector Plan, which replaced the 2001 Strategic Plan for South African Agriculture (DAFF, 2012). It sets outs out a vision for agriculture and related

sectors and provides strategic direction regarding all the critical issues that affect how this sector performs, is to be governed and concerning its contribution to the economy of the country. It, therefore, serves as an important strategic reference document for provincial departments responsible for agriculture. The IGDP, consistent with the NDP and other policy frameworks seeks to promote food security, the development of agriculture, and (especially rural) economic development.

Livelihoods Development Support Programme

The Farmer Settlement Programme (FSP), which was responsible for post-settlement agricultural support to land reform beneficiaries, had no dedicated budget until 2004 (DAFF, 2012). The FSP, now renamed the Livelihoods Development Support Programme, has a reach and impact too limited to allow it to function as a mechanism for restructuring the economic and market environment for smallholder and subsistence farmers (DAFF, 2012).

Accelerated and Shared Growth Initiative for South Africa

The Accelerated and Shared Growth Initiative for South Africa (AsgiSA), 2006, and the National Industrial Policy Framework (NIPF), 2007, both emphasise the importance of promoting and developing small enterprise as a strategy to stimulate growth in the second economy and meet the Millennium Development Goals (DAFF, 2012).

National Infrastructure Plan: Strategic Integrated Projects

Strategic Integrated Projects (SIPs) have been identified and cover a range of economic and social infrastructure. In relation to agriculture, forestry and fisheries, SIP 11 for the agro-logistics and rural infrastructure aims to improve investment in agricultural and rural infrastructure to support the expansion of production and employment, small-scale farming and rural development, including facilities for storage, transport links to main networks, fencing of farms and irrigation schemes to poor areas (DAFF, 2012).

Second Economy Strategy Project

The Second Economy Strategy Project (SESP, 2007) is an initiative of the Presidency, hosted by Trade and Industrial Policy Strategies (TIPS), providing a framework for addressing inequality and economic marginalisation in South Africa (DAFF, 2012). It specifically draws attention to the "centralised, monopoly structure of SA's core economy, including the labour market legacies of pass laws, as well as the highly skewed distribution of assets such as land and capital; the spatial legacy of Bantustans and apartheid cities; and the legacies of deep inequality in the development of human capital."

In response to this economic dualism, the SESP framework presents a strategy for promoting structural change to create a more broad-based economy (DAFF, 2012). A top priority is to improve the situation of subsistence or poor farmers, mostly in the former Bantustan areas, who, despite engaging in productive work, derive too little benefit from it (DAFF, 2012).

Agricultural Broad-Based Black Economic Empowerment

As the name implies, Agricultural Broad-Based Black Economic Empowerment (AgriBEE, 2012), encapsulates the agricultural sector's approach to Broad-Based Black Economic Empowerment (DAFF, 2012). AgriBEE seeks to complement other initiatives such as farmer development support and land reform, by incentivising the sector to integrate black people in different ways and at different points in the agricultural value chain, broadly speaking (DAFF, 2012). While the rationale for AgriBEE is clear enough, to date it appears to have had little impact because it is not enforceable: the charter is not legally binding and only indicative scorecards are in place (DAFF, 2012). The DAFF was therefore in the process of consulting the DTI to have sector codes published in terms of section 9 of the Act, which would allow DAFF to apply binding sector codes (DAFF, 2012).

The New Growth Path

Agriculture is identified as one of the key job drivers within the New Growth Path (NGP, 2010). This targets opportunities for 300 000 households in agricultural smallholder schemes plus 145 000 jobs in agro-processing by 2020, while it sees potential to upgrade conditions for 660 000 farm workers (DAFF, 2012). The NGP advocates for broad policy guidelines for agriculture, forestry and fisheries, including the restructuring of land reform to support smallholder schemes with comprehensive aid in the areas of infrastructure, marketing, finance and extension services (DAFF, 2012).

The National Development Plan (Vision 2030)

The National Development Plan (NDP) vision for 2030 argues that "rural communities should have greater opportunities to participate fully in the economic, social and political life of the country. People should have access to high-quality basic services that enable them to be well-nourished, healthy and increasingly skilled. Rural economies will be supported by agriculture, and where possible by mining, tourism, agro-processing and fisheries…better integration of the country's rural areas, achieved through successful land reform, job creation and poverty alleviation" (DAFF, 2014).

To achieve this, the NDP proposes the following policy imperatives for smallholder farming:

- Invest substantially in providing innovative market linkages for small-scale farmers in the communal and land reform areas, with provisions to link these farmers to markets in South Africa and further afield in the sub-continent
- Create tenure security for communal farmers. Tenure security is vital to secure incomes for all existing farmers and new entrants. Investigate the possibility of flexible systems of land use for different kinds of farming on communal lands
- Improve and extend skills development and training in the agricultural sector, including entrepreneurship training. This should include the training of a new cadre of extension officers that will respond effectively to the needs of smallholding farmers and contribute to their successful integration into the food value chain (DAFF, 2012).

In South Africa, agriculture is built on the back of dispossession of the African population, and their social, economic and political marginalisation (DAFF, 2013). It is built on extractive methods that deplete the soil, the water and the natural vegetation. Agricultural policy in post-apartheid South Africa had to grasp these contradictions, simultaneously strengthening the positive features of agriculture while abolishing those that rely on the immiserating of human beings and the destruction of the environment for its survival (DAFF, 2013). Political developments opened the space to reconsider approaches to land and agriculture in South Africa (DAFF, 2013). As a result of compromises made in political negotiations, land reform and agriculture have followed a path that generally has suited large-scale commercial agriculture and agribusiness, with a few necessary compromises along the way (DAFF, 2013). The process has been controlled tightly from the top, and markets in both land and agriculture have reigned supreme. These are not really under threat in the current conjuncture, although there is a willingness to question how well the present arrangement is working in meeting national goals, which arguably have more to do with economic and social stability than with redistribution and transformation (DAFF, 2013). As identified within the National Development Plan and New Growth Path, agriculture remains critical for employment and food security. It delivers more jobs per Rand invested than any other sector, and the NDP estimates that agriculture could potentially create 1 million jobs by 2030 (DAFF, 2014).

It is important to distinguish between the different needs and requirements of various types of smallholder farmers, and not attempt to meet all those needs through the same policies and programmes. Differentiated policies and programmes must be well fitted to the diverse farming systems practised by a differentiated population. At the same time, it is important to create flexibility in policies and programmes and not to box farmers into silos; rather, policies should allow routes for successful producers to increase the scale and intensity of their farming systems when they can do so.

Smallholders who are mainly engaged in producing extra food for domestic consumption, usually in homestead gardens or from small herds and flocks of livestock, are in the majority in South Africa today. Their greatest need is for effective support in the form of fencing, water supplies, some simple inputs and veterinary support for their livestock, plus appropriate technical advice. The main outcome will be enhanced food security, not a great deal of extra production for markets. The challenge is to provide support services to subsistence-oriented smallholders on a large scale, in a variety of contexts that include communal areas, farmworkers on their own plots on commercial farms, and informal settlements in urban and peri-urban areas.

Market-oriented smallholders in loose value chains rely heavily on family labour, and usually sell their fresh produce to bakkie traders or hawkers or sell surplus livestock to neighbours or others nearby. They also need assistance with fencing, water supplies and veterinary support for their livestock, and appropriate advice including detailed information on pests and diseases and how to use expensive inputs such as crop chemicals and livestock remedies.

2.1.2 Strategies for Smallholder Farming

Strategic Agriculture Sector Plan (2001)

Since 1994, economic policies adopted by the democratic government have done little to develop the smallholder sector and may even have contributed to its long-run decline (Lahiff and Cousins, 2005). Over the years, a range of interventions has been made by the South African state and others to develop smallholder agriculture, with limited success (Lahiff and Cousins, 2005). Most have reached only a small elite, and many have proved unsustainable in the absence of major state support. Since 1994, development programmes such as the Integrated Sustainable Rural Development Programme have tended to downplay land-based livelihoods in general, and smallholder agriculture in particular (Lahiff and Cousins, 2005). Limited support is offered by provincial Departments of Agriculture, but this reaches only a minority of existing smallholders and new land reform beneficiaries (Lahiff and Cousins, 2005).

An evaluation of the implementation of the 2001 Strategic Agriculture Sector Plan, which assessed the extent to which the intended objectives and outcomes had been realised over a period of five years, was conducted in 2012. The performance scorecard suggested that good progress was made in some areas, such as sustainable resource management, while other areas, such as equitable access and participation, still required urgent attention. Although all strategies devised by the department since 1995 have stated the importance of support for commercial and smallholder farmers (smallholder and subsistence), at the time of the evaluation they received less support from the state than their counterparts in every industrial country in the world, with the exception of New Zealand (DAFF, 2012). Direct support to agriculture, as measured by the Organisation for Economic Cooperation and Development (OECD), is expressed as a percentage of gross farming income (DAFF, 2012). This is referred to as the Producer Support Estimate (PSE): from 2005 to 2007, this was 6% for South Africa, considerably lower than the OECD average of 26% (DAFF, 2012).

The review also identified access, participation, competitiveness and profitability, and sustainable resource management, as being the main areas where intervention was required (DAFF, 2012). The same review indicated that many of these goals had not been adequately addressed, and this was attributed to the slow pace of implementation, the limited capacity within government to implement many of the programmes, and the limited coverage and inadequate funding of some critical programmes (DAFF, 2012). The review team also identified as contributing factors, inadequate leadership in directing the Strategic Plan with a focused sense of urgency and commitment, implementation capacity (institutional and management capacity and skills), as well as the lack of a comprehensive implementation plan (DAFF, 2012). Key areas identified as requiring urgent strategic attention included food security, sustainability, resilience to climate change, land reform, support services and the participation of vulnerable groups (DAFF, 2012).

South Africa was in the initial stages of building a black farming class, and many lessons could be drawn from the way in which the state had supported farmers in the past (DAFF, 2013). However, the intention should have been to go a step further than merely reproducing the commercial agricultural model on a wider basis (DAFF, 2013). A strategy that seeks to insert smallholders into the large-scale, industrial, export-oriented model can only succeed in broadening and diversifying the producer base slightly (DAFF, 2013). The large-scale model also brought with it the deepening problems of concentration in the value chain, which, in turn, entrench the production model (DAFF, 2013). The government identified the major contours of the challenge, but its response tends towards seeking to deracialise that model while keeping its core intact (DAFF, 2013). An alternative has to confront the existing economic power of commercial agriculture and agro-industry to transform it in the interests of the poor. De-racialisation is necessary but is not sufficient to realise this (DAFF, 2013). The logic of a smallholder strategy must be followed beyond the farm gate, to the institutions that support agriculture and the value chains that feed off it (DAFF, 2013).

The Comprehensive Agricultural Support Programme (2004)

The Comprehensive Agricultural Support Programme (CASP) came into effect in 2004 (Xaba and Dlamini, 2015). It is a government-funded grant aimed at assisting emerging farmers after settlement by providing the necessary support and training for increased production, poverty alleviation and subsequent job creation, resulting in the reduction of inequalities (Xaba and Dlamini, 2015). The Micro Agricultural Financial Institutional Scheme of South Africa (Mafisa) programme was launched in 2006 to provide micro and retail agricultural financial services, and to facilitate access to public-sector programmes. The government's response to the inability of farmers to repay loans correctly emphasised the need for proper support and mentorship to enable farmers to become financially self-sufficient (Greenberg, 2010).

Pillars of CASP

- Information and knowledge management
- Technical and advisory assistance
- Financing mechanisms
- Training and capacity building
- Marketing and business development
- On and off-farm infrastructure (Xaba and Dlamini, 2015).

Impact Evaluation of the CASP

An impact evaluation was conducted by Business Enterprises at the University of Pretoria (Pty) Ltd on behalf of DAFF, for the period covering its inception in 2004 to February 2013. The summary findings were as follows:

i. Reaching the target population: The programme had succeeded in reaching most of the target groups, but not enough to include other groups who are part of the primary target population for CASP.

ii. Support*:* Support was not comprehensive on the project level, and also government officials pointed out that CASP places too much emphasis on the infrastructure pillar at the expense of other pillars. Support was always too late and not tailor-made. It had done a good job of identifying markets for beneficiaries' products, but it had not achieved much success in terms of linking the beneficiaries to markets. It focused on quantity rather than quality and comprehensiveness of support, resulting in the support being thinly spread among a large number of beneficiaries. On-farm infrastructure provision is one area in which CASP had made progress. There was an improvement in the availability of both on-farm and social infrastructure after CASP.

iii. Capacity for ongoing management and resilience (self-reliance): CASP had made a positive but insufficient contribution to capacity building for ongoing management and self-reliance through skills and knowledge transfer. Project managers had benefitted more from skills and knowledge transfer than employees. Areas in which capacity building was least sufficient included cultivar selection, livestock marketing, livestock disease control and produce marketing.

iv. Impact on agricultural production: The area cultivated for most crops increased after CASP, but the increase was small. The production of major crops such as maize, wheat and sugarcane increased in less than half the provinces covered in the evaluation. Vegetable production increased in most (6) provinces included in the evaluation CASP. The number of animals kept on CASP-supported projects increased significantly after CASP. The increase in livestock numbers occurred in all nine provinces for livestock such as broilers, cattle, goats and sheep.

v. Impact on livelihoods: Employment increased after CASP, but the increase was insignificant. Also, the increase in employment was not sustainable as it had promoted largely part-time employment. Most respondents agreed that CASP had contributed positively to employment in neighbouring rural communities. CASP's contribution to food security was limited in nearly all provinces.

vi. Impact on market access: Overall, market access for the farms included in the evaluation had not improved after participating in CASP. A significant proportion of farmers who experienced problems with market access before CASP continued to experience these problems. Market access was one of the weakest areas of CASP support.

vii. Impact on farmer development (commercialisation): Little progress had been achieved in terms of promoting commercialisation of the farms/projects – only about 33% of the farms could be considered to be commercial, based on their participation in formal markets. Limited progress in commercialisation was linked to the failure of the programme to promote market access.

viii. Achievement of objectives: CASP had made progress towards achieving some of its intended objectives (e.g. enhancing agricultural support, increasing production, etc.), but insufficient progress had been made in promoting commercialisation, market access, employment and achieving food security. There was limited coordination of CASP within DAFF and the provincial departments of agriculture, and the programme was not aligned with other government programmes (e.g. those of DRDLR, Water and Sanitation, etc.). Within DAFF, there was a lack of active participation from key directorates.

2.1.3 Policy and Strategy Implementation Challenges

Agricultural programmes implemented by the government since 1994 to improve the livelihoods of the formerly underprivileged have had a low success rate (Rootman et al., 2015). Systematic support for smallholder agriculture resurfaced on the agenda after being discussed and essentially shelved in the early-to-mid-1990s (DAFF, 2013). This opened up a space for contestation. The dominant model of smallholder agriculture concentrates on the efficiency of production and integration into national and global circuits of capital, but the debate allows for alternative visions of smallholder agriculture to emerge (DAFF, 2013). These are oriented towards the grassroots, rather than towards concentrated economic and political power. They identify the potential for smallholder agriculture to transform the structure of land ownership and production in South Africa, while simultaneously securing food production and bringing access to food and economic activity closer to direct, grassroots control (DAFF, 2013).

The structural factors underpinning the current global economic crisis would not go away when the short-term 'green shoots of recovery' finally arrive (DAFF, 2013). These factors include deepening immiserating of the world's poor; skyrocketing food and resource prices caused by market manipulation and growing resource scarcity; ecological damage that threatens the existence of the human species; and a crisis of political representation, where private economic agents overshadow the public interest (DAFF, 2013). Regardless of the short-term fortunes of the global economy, these factors are set to deepen the increasingly apparent contradictions in the global economic and political system (DAFF, 2013). Any approach to smallholder agriculture that can be sustained beyond crises will need to respond to these structural factors in its design and implementation (DAFF, 2013).

There is a general concern that the current approach followed by the government to strengthen the small-scale farming sector has continued to rely on a linear technology transfer approach rather than the use of collective intelligence where stakeholders interactively learn from each other. It has been recognised in other parts of the world that a continuous process of innovation is essential if food security is to be addressed (Stevens and Letty, 2014). The agriculture sector worldwide is moving into an era of rapidly changing markets and technological, social and environmental circumstances that are evolving in often unpredictable ways. Coping with these challenges of this new era will require extension change agents, researchers, policymakers, consumers and entrepreneurs seamlessly to intermesh their activities to mobilise knowledge and continuously innovate in the face of change (Stevens and Letty, 2014).

Factors such as the lack of access to land, water, markets, finance, communications infrastructure, education and skills training, still prevent marginalised South Africans from making substantive progress in primary farming, forestry and fisheries, as well as in upstream and downstream enterprises associated with them (DAFF, 2014). These are some of the factors that conduce to a cycle of skills deficit, crushing poverty, underdeveloped markets, low rates of public and private sector investment and a lack of infrastructure, crippling the ability of black communities to engage in meaningful rural-based economic activities (DAFF, 2014). Broad-based black economic empowerment and land reform initiatives are regarded as vitally important catalysts to address these imbalances (DAFF, 2014). Most national programmes explicitly targeting the so-called second economy within agriculture, forestry and fisheries, with the expected outcome of transforming the sector and building equity, fall short because they were not designed to impact on the scale required to make a difference at a socioeconomic level. Moreover, they have tended to act in isolation from each other, leaving beneficiaries seeking support from a fragmented array of projects and programmes (DAFF, 2014).

There is a lack of capacity within government and state-owned enterprises to reach and offer efficient and sufficient support on the scale required (DAFF, 2014). In agriculture, there has been a significant growth in budgets to provide direct support to black and disadvantaged smallholder farmers in the form of grants for infrastructure, production inputs and other items, and recently through an extension service recovery programme (DAFF, 2014). However, these interventions have not been sufficiently far-reaching (DAFF, 2014).

The indications are that after all the land redistribution efforts, there are lands that remain underutilised once transfers have occurred. This has been blamed on unplanned and poorly executed land reforms (Hall, 2013). Over two decades into democracy, there is near consensus that the National Land Reform Programme has been unsuccessful (Rootman et al., 2015). It has fallen short of both public expectation and the official targets that were set since the envisaged programme of rural development failed to materialise (ibid.). Most importantly, rural developmental efforts have failed to make any significant inroads into rural poverty. Institutional efforts have also not provided a strategy to reduce agrarian dualism in South Africa (ibid.). Because the number of smallholders and subsistence producers is so vast relative to the extension corps, the actual support rendered to smallholders and subsistence producers has been patchy and generally inadequate (DAFF, 2012). Contrarily, DAFF (2012) argues that since 1994 state support has largely shifted away from the large-scale commercial farming subsector, in favour of smallholders and subsistence producers (DAFF, 2012).

2.2 Characteristics of Smallholder Farming in South Africa

SA is classified as a water-scarce country, which means that even with the highest feasible efficiency and productivity, the country will not have sufficient water resources to meet its agricultural, domestic, industrial and environmental needs by the year 2025 (Machethe et al., 2004). Rainfall is unreliable, droughts are common and crop production in most of the country

is inherently risky, making irrigation important for a range of field and tree crops (Cousins, 2013). Yet despite the threat to water resources, irrigation water continues to be an important resource in crop production (Machethe et al., 2004). The agricultural potential of most land in SA is limited, with over 60 per cent of the country receiving less than 500 mm of rain per annum on average, and only 10 per cent receiving more than 750 mm (Cousins, 2013). Despite these challenges, smallholder farming remains an important industry in South Africa.

Studies show that smallholder farmers are vital for maintaining food security, creating job opportunities and alleviating poverty, predominantly in the rural areas where these farms are located (Sinyolo et al., 2014; Khulisa, 2016; Van Averbeke et al., 2011). Since the dawn of democracy, the South African government has made significant investments in smallholder farms located in communal areas (Van Averbeke et al., 2011). The goal is to ensure household food security and alleviate poverty through the creation of job opportunities (Sinyolo et al., 2014). Smallholder farmers can play an important role in the creation of sustainable livelihoods amongst the rural poor, but the efficiency of this subsector is quite low (Zeidler et al., 2010).

2.3 Smallholder Irrigation Farming in South Africa

Irrigation farming is undertaken by two broad categories of farmers: modern commercial operations mostly run by white men and traditional subsistence activities by blacks (the majority of whom are women) (Backeberg, 2006). South Africa's smallholder irrigation sector comprises five to eight per cent of the total arable irrigated area (Machethe et al., 2004). Despite this small proportion, smallholder irrigation is an important component of the government's rural development strategy (Machethe et al., 2004). In 2006, the total area under irrigation was estimated to be approximately 1.3 million ha of which some 100 000 ha were food plots and smallholder irrigation schemes (SIS) (Backeberg, 2006). Denison and Manona (2007) estimate that there are about 33,000 plot holders on these schemes, each cultivating an average of around 1.5 hectares (Cousins, 2013). The land concerned is spread across different rainfall regions, with a highly variable average annual rainfall of 500 mm. There were 1 675 822 ha of registered irrigation land in 2008, of which 1 399 221 ha was irrigated, consuming an estimated 62% of water abstracted from the national surface and groundwater resources (Denison et al., 2016). The number of black irrigation farmers was a small fraction of the national irrigation total, estimated at 150 000 to 250 000 individuals who farm on schemes, independently, or in home and community gardens (Denison et al., 2016). By 2013, about 1.3 million hectares, or under 10 per cent of all arable land, was under irrigation. About 7.7 per cent of the irrigated land, or 100,000 hectares, was used by smallholder farmers, mostly in the former Bantustans (Cousins, 2013). Around half of this consisted of small home gardens, the other half located in smallholder irrigation schemes, of which there were 317 in total (Cousins, 2013).

According to Cousins (2013), little has changed since 1994, despite new laws that have separated land and water rights and declared water a national resource, and there has been no attempt to date to integrate land and water reform. In the past, the distribution of irrigation

water was as inequitable as the distribution of land, with white commercial farmers holding rights to over 90 per cent of the water supply, supported by massive state investment in irrigation infrastructure (ibid.).

2.3.1 Categories of smallholder irrigation farmers in South Africa

Farmers on irrigation schemes: Irrigation schemes can be defined as multi-farmer irrigation projects with landholdings of more than 5 ha, predominantly located in the former homelands and other resource-limited areas (Msibi and Dhlamini, 2011). A scheme is thus a conglomeration of farms that share a bulk irrigation water supply system (Denison et al., 2016). Plots that were part of irrigation schemes were estimated to cover 47 667 ha (Denison et al., 2016).

Independent irrigators: These farmers are not involved in community projects. Each has their own "private" water supply which may be pumped directly from a river or borehole (Msibi and Dhlamini, 2011). Their lands have been estimated to cover 30 to 40 000 ha (Denison et al., 2016). Often these farmers are involved in other business ventures (Msibi and Dhlamini, 2011). Little is known about this sub-sector in SA, which has not received as much attention as communal irrigation schemes (Denison et al., 2016). Although there are no statistics on this group of farmers, they are still thought to form a considerable proportion of smallholder irrigation farmers and thus the agricultural economy (Msibi and Dhlamini, 2011). They have a substantially different set of financial, institutional, transactional and water-security issues from the other smallholder farmers. The sector may be much larger than is currently estimated (Denison et al., 2016).

Community gardeners: Community gardens have been described as a success story in agricultural development in SA (Msibi and Dhlamini, 2011). Their biggest contribution to the economy lies in making fresh, locally produced vegetables easily available to millions of people around the country at a reasonable price while at the same time enabling growers to supplement their family income (Msibi and Dhlamini, 2011). This is especially critical when it is considered that the majority of community gardeners are women (Msibi and Dhlamini, 2011).

Home gardeners: A significant number of people around the country grow vegetables in small gardens, usually less than 0.25 ha, for home consumption (Msibi and Dhlamini, 2011). Irrigated gardens (each of very small total size) have been estimated to cover 10-20 000 ha (Denison et al., 2016).

Before the restructuring of state assets began in the late 1990s, irrigation schemes were managed by government agencies and received substantial subsidies for production and marketing arrangements, infrastructure and production loans (Machethe et al., 2004). The development of smallholder irrigation schemes in this era was based on improving the lives of previously disadvantaged populations in rural areas and informal settlements (DAFF, 2012).

The focus was on poverty alleviation and food security at the community level (DAFF, 2012). Sixty-two schemes covering 2 400 ha were developed, where the main irrigation technology included the use of mechanical pumps and sprinklers (DAFF, 2012). The major challenge affecting smallholder irrigation continued to be sustainability. Post-1994 provincial governments dismantled agricultural homeland parastatals inherited from the apartheid government (Muchara, 2014), which affected the performance of most schemes, especially the large and complex schemes that had been centrally managed from inception (Muchara, 2014). Some schemes collapsed and others faced management challenges following the end of support from the government (Muchara, 2014). After the collapse, for various reasons, of several smallholder irrigation schemes, the new South African government undertook a programme to revitalise these in the late 1990s (DAFF, 2012). At that stage, smallholder irrigation schemes included those located both in the former homelands and in commercial farming areas where white farmers were previously settled (DAFF, 2012).

2.3.2 Challenges Facing Smallholder Irrigation Schemes (SIS) in South Africa

Most researchers who have studied South African smallholder irrigation schemes have concluded that the performance of the majority of these projects was well below potential (Van Averbeke et al., 2011; Fanadzo and Ncube, 2018). A review on smallholder irrigation by Van Averbeke et al. (2011) found out that 90 of 302 schemes were not operational and that the likelihood of being operational was 81% for gravity-fed canal schemes, 70% for pumped surface irrigation schemes, 65% for overhead irrigation schemes and 56% for micro-irrigation schemes. This indicated that the likelihood of being operational was inversely related to the degree of complexity of operating and maintaining the schemes. Generally, the performance of smallholder schemes has been well below expectation, with a few exceptions, and human capacity and social institutional problems have been at the heart of this disappointing performance (Van Averbeke et al., 2011).

According to Van Averbeke and Mohammed (2006), factors that contributed to poor SIS performance included:

- Poor infrastructure
- Limited knowledge of crop production among smallholders
- Limited farmer participation in the management of water
- Ineffective extension and mechanisation services
- Lack of reliable markets
- Lack of effective credit services
- The predominance of subsistence-oriented farming. Food security remains the major objective for many plot holders and subsistence-oriented crop production patterns have never been changed (Van Averbeke and Mohammed, 2006).

Years later, the issue of infrastructure remains, while other factors have emerged. Van Averbeke and Denison (2011) report that, typically, the poor performance of SIS was

associated with a range of factors including poor maintenance of infrastructure and equipment; high energy costs where pumping was involved; lack of institutional support in terms of credit, marketing and draught power; lack of extension and farmer training; conflict; and weak local organisation (Van Averbeke et al., 2011; Fanadzo and Ncube, 2018).

2.3.3 Revitalisation of Smallholder Irrigation in South Africa

The fact is that, despite ongoing annual government investment, many irrigation schemes have collapsed or remain under-utilised. The reasons for failure are diverse and the debate on possible solutions to the situation continues unabated (*The Water Wheel*, Nov-Dec 2007). It seems that there is no simple answer to why these schemes have collapsed and continue to collapse, the constraints that they face being more complex than initially thought. In sum, experience with programmes across the country since 1994 shows clearly that unlocking potential through revitalisation initiatives is far more difficult, time-consuming and costly than many professionals and politicians had realised (*The Water Wheel*, Nov-Dec 2007). There has nevertheless been clear and committed political intent to finance irrigation revitalisation initiatives and expansion at national, provincial and municipal levels. The funding of these schemes is likely to continue and even increase (*The Water Wheel*, Nov-Dec 2007).

Limpopo province undertook to revitalise the smallholder irrigation schemes under the Revitalisation of Smallholder Irrigation Schemes (RESIS) Programme between 2001 and 2004, and subsequently the RESIS Recharge Programme from 2005-2007 (DAFF, 2012). The RESIS programme focused on infrastructure rehabilitation and 'joint ventures' as ways of rebuilding and ensuring the uplifting of communities involved in the irrigation schemes. The aim was to stimulate agribusiness through a comprehensive programme that would include the training and capacity building of farmers to enable them to run their businesses profitably and sustainably (DAFF, 2012).

The WRC has developed guidelines for the revitalisation of SIS, based on three years of research and documenting best South African and international practice. The guidelines specifically target government decision-makers, technical and extension staff, consultants, development practitioners and scheme leadership (*The Water Wheel*, Nov-Dec 2007). The Rough Guide (Volume 1) is a quick reference guide that covers policy implications and revitalisation objectives, as well as recommended principles, approaches and methodologies for scheme diagnosis, participative planning, feasibility evaluation and the formulation of farmer support programmes. Concepts and Cases (Volume 2) contains the theoretical rationale for the guidelines. The central theme of the guidelines is the critical need to appreciate and address the complexity of these schemes, that infrastructure development alone or as the dominant element in an intervention is highly unlikely to succeed (*The Water Wheel*, Nov-Dec 2007).

Challenges regarding land tenure and irrigation holding size are also discussed in the guidelines (*The Water Wheel*, Nov-Dec 2007). It is noted that farmers who work small plots are forced to

pursue a number of income and livelihood endeavours, among which irrigation may be a minor element, with negative implications for their commitment and interest. The guidelines set out to achieve what many argue cannot be done and some suggest is a fundamentally flawed concept, i.e. smallholder irrigation in the South African financing, procurement and political context (*The Water Wheel*, Nov-Dec 2007; Ncube and Fanadzo, 2018).

Smallholder irrigators are not homogeneous and different types of smallholder farmers need different kinds of support intervention to meet their priority needs (Trollip, 2017). Modelling responses for smallholders only on successful approaches in the large-scale highly commercialised agricultural sector will serve some but not the majority of smallholder farmers (ibid.). A suite of interventions which can be tailored to be responsive to smallholder diversity is essential if the opportunities for smallholder agricultural entrepreneurial development are to be more successfully exploited (ibid.).

Irrigation can, it seems, provide much sought-after development outcomes, but it will require a new political will to re-set the development direction, drive profitability initiatives and re-institutionalise the smallholder irrigation sector from a land and water perspective (Trollip, 2017).

The state has disengaged from irrigation management in favour of the end-users taking charge of maintenance and service costs through the Water User Associations and Irrigation Committees (Machethe et al., 2004). There have been successful farmer-managed irrigation projects in the sugar industry of KwaZulu-Natal and Mpumalanga, with the success being attributed to smallholders enjoying access to credit, input supply, markets and capacity (Machethe et al., 2004). The example of these smallholders indicates that resource-poor farmers can manage their irrigation schemes provided they offer the promise of viability and livelihood improvement (Machethe et al., 2004).

In a review conducted on SIS in SA concerning this, Van Averbeke et al. (2011) reported that weak support services were a recurrent theme in smallholder irrigation scheme assessments. There was general agreement that human and social capacity development among smallholder irrigators is a pre-condition for turning the current downward trajectory of smallholder schemes into an upward trajectory. Critical issues were the training of farmers and their collectives in the domains of farm and scheme management, and the provision of support through reliable networks for the marketing of produce beyond the local (Van Averbeke et al., 2011). Where new irrigation farmers are settled, or when new crops are introduced, production (agronomic) training was also a critical success factor (Van Averbeke et al., 2011).

South Africa ought to develop a policy on irrigation management transfer that recognises that farmer management of smallholder irrigation schemes can become sustainable provided broader and holistic strategies are adopted (Machethe et al., 2004). Emphasis should be placed

on a people-driven development approach suited to the needs of end-users, taking into account farmer groups and their diversified cultures (Machethe et al., 2004):

- Relocation of promising farmers onto well-established (previously white-owned) schemes
- Fundamental reforms in communal land tenure systems on smallholder schemes
- Investment in water management institutions
- Marketing support
- Water management interventions.

All these interventions need to be pursued in parallel to achieve results (Trollip, 2017). Smallholder irrigators are heavily constrained by a reality of institutional 'chaos' on the ground, due to widespread uncertainties regarding land-leasing arrangements and water-use rights (ibid.). Land-tenure arrangements are quasi-legal in most situations; there are diverse interpretations of the law, with high transaction and financial costs for farmers (ibid.). While smallholder irrigators face serious hurdles in terms of production knowledge, financing and marketing, bringing institutional order to questions of tenure, in respect of both land and water, would greatly reduce farming risks and increase smallholders' resilience in the face of other livelihood shocks (ibid.).

Trollip (2017) also maintains that younger agri-business entrepreneurs have a new vision of agriculture very different from that of a parochial agrarian existence: irrigation means business and production, crops are planted with money and markets in mind, and farming is seen as a means to achieve success. It is the view of the authors that perceptions of irrigated farming are indeed in transition, shifting towards a view of agriculture as a way out of poverty and a pathway to a better life. Yet these post-millennial young farmers need more than market forces to get established: much like the successful mid-twentieth century approaches to settling and establishing unemployed workers and soldiers, a medium-term view and state support are unavoidable (Trollip, 2017).

2.4 Impacts of Drought on Smallholder Farming

This section is covered in detail in the short-term review project, WRC Project No. TT 723/17.

2.4.1 Drought Occurrence

Drought is a normal recurrent climatic feature that occurs in almost every climatic zone around the world. It has the potential to reduce agricultural production to levels that threaten the livelihoods of subsistence farmers (Mniki, 2009). Drought and the longer-term drying of the cropping region are some of the many challenges facing local farmers (Kiem and Austin, 2013). Scientists have started to link intense droughts to climate change, even though droughts can have different causes, depending on the area and other natural factors (Moeletsi et al., 2013; Mpandeli and Maponya, 2013; Kandjingaa et al., 2010; Bourne et al., 2012; Calzadilla et al., 2014; Chishwakwe, 2010). Climate patterns play a vital role in shaping natural ecosystems, human economies, and the cultures that depend on them. Because so many systems are tied to

climate, a change in climate can affect many associated aspects of where and how people, plants and animals live, e.g. food production, the availability and use of water, and health risks (Chishwakwe, 2010).

The direct impacts of drought on water resources can be hidden within natural climate variability. With a warmer climate, droughts may become more frequent, severe, and longer-lasting. The potential increase in drought is a great concern, given the stresses being placed on water resources as well as the impact on the smallholder farming sector. Calzadilla et al. (2014) are of the view that poverty alleviation approaches and viable agriculture in smallholder farming practice are seriously hindered by drought in South Africa. Maponya and Mpandeli (2012) conclude that changes in climate will result in hotter temperatures and lower rainfall in South Africa, negatively impacting on food production. South Africa, therefore, needs to establish new approaches to dealing with the environmental and socio-economic impacts of drought in smallholder farming systems.

Although South Africa has sufficient food, it should be noted that most poverty-stricken households remain at risk as a result of increasing food prices, which preclude many people from gaining access to safe and healthy food. In addition, many smallholder farmers in South Africa, as in other emerging economies, depend heavily on agriculture for survival and will, for that reason, be at risk in the event of drought. Drought thus has significant implications for food security and malnutrition.

2.4.2 Impacts on Crop Production

The majority of southern Africa's farmers are smallholders who engage in low-input farming, often in addition to other livelihood activities (Eriksen et al., 2008). Smallholders rely on subsistence agriculture and have limited access to natural resources and economic assets (Zeidler et al., 2010). These features make them extremely vulnerable to drought. For instance, the small size of fields reduces opportunities to exploit diverse agricultural strategies (Newsham and Thomas, 2009).

Mpandeli et al. (2005) found that adverse climatic conditions have a bearing on the agricultural production of smallholder farmers in Limpopo who produce fruit and vegetables for their livelihood. However, Ziervogel (2014) concludes that the largest footprint of drought on agriculture will probably be its effect on essential crops such as maize and rice. One of the main worries is the anticipated increase in irrigation as most parts of the country become drier. Mongi et al. (2010) report that farmers respond to the impact of climate change and variability through various local adaptations including the expansion of the areas under cultivation to compensate for reduced yields, reducing fallow periods, and switching to more drought-resistant crops such as sorghum and cassava. Some farmers reported growing alternative crops such as sunflowers, although the increasing incidence of pests and diseases hindered such efforts.

South Africa faces a challenging task of working in the direction of achieving the UN sustainable development goals (SDGs) 1 and 2. To sustain food security in South Africa, progressive agricultural policies that make available information and appropriate technology to smallholder farmers in rural communities must be put into place. The impacts of drought on agriculture will result in food scarcity. Attaining SDGs 1 and 2 in the middle of drought seems to be a serious task facing smallholder farmers in South Africa.

2.4.3 Impacts on Livestock

Efficient water use and the management of water resources become a critical issue during droughts. Water availability is the single most important factor for livestock health and survival during droughts and is experienced as the primary limiting factor of herd size. Animals need up to 12 times more than their normal intake of water during warm and dry periods (Jordaan, 2011). Jordaan (2011) claims that this can be costly, especially if farmers have to transport water over long distances.

Coping with drought is different for communal farmers from what it is for commercial farmers because they do not have access to additional resources, and what they have in terms of land is limited and, in most cases, already degraded. Communal farmers depend more on social structures and networks for their survival during drought (Jordaan, 2011). In a study conducted in the North West province, Jordaan (2011) confirmed the differences in coping strategies between communal and commercial farmers. The study reports that 44% of commercial farmers reduce stock numbers as a first drought strategy compared to only 3% of communal farmers. About 23% of communal farmers, on the other hand, indicated that they first buy fodder compared to only 16% of commercial farmers. The study concluded that communal farmers only started selling animals under severe conditions, for instance, if they needed money to buy feed and fodder to keep the remaining animals alive. By then the animals would be in such a poor condition that they would receive way below market prices for them.

Smallholders face several individual risks such as the disease, injury and death of animals, as well as common or aggregate risks such as drought, epidemic and economy-wide shocks that affect everyone in the locality. The consequences of these risks can be extremely severe, including malnutrition, disease, starvation or even death (Thapa and Gaiha, 2010). Communal or smallholder farmers are more vulnerable to drought than commercial farmers and do not have the resources and means to cope with drought without the support of others, whether it be family members, friends or the government (Jordaan, 2011). In most cases, farmers sell cattle under duress due to a lack of fodder when the drought is already at an advanced stage, and cattle sales remain the major coping strategy during drought. At this stage the supply of poorly conditioned and unhealthy cattle surpasses the demand; prices are highly deflated and farmers are unable to reconstitute their stock after the drought (Jordaan, 2011; Roncoli et al., 2001).

The high price of agricultural commodities coupled with a scarcity of water greatly reduces women's earnings from traditional dry season activities such as food processing and beer

brewing. Even village grain traders were not benefiting from high grain prices. Jordaan (2011) found that households not only reduce consumption and exhaust their assets in the wake of natural shocks, but they also lose the ability to rebuild productive assets and recover to their original state. Jordaan (2011) reports that cattle holdings in Ethiopian households only approached two-thirds of original cattle numbers ten years after a drought. Households that lost animals during drought remained vulnerable and poor six years after the 1998-2000 drought in Ethiopia, and poor families had to borrow animals to restock their herds (Jordaan, 2011).

The impact of droughts is measured by the loss of production during the drought year and the loss of productive capacity for subsequent years. For example, the loss of draft power during the drought year results in reduced future production due to the inability to cultivate the same area, delayed sowing, and adoption of less intensive methods of cultivation in the following years with adequate rains (Verchot et al., 2007). Roncoli et al. (2001) report that farmers complained that much of their seed was eaten by birds and insects as it was left in the dry soil. Because crops repeatedly failed to become established, farmers had to replant their fields as many as 8 times, sometimes replanting with shorter duration varieties as the season progressed.

2.4.4 Socio-Economic Impacts

Another marker of vulnerability among smallholder farmers is their lack of awareness and understanding of drought and adaptation strategies (David et al., 2013). A study by Muller and Shackleton (2014) indicates that smallholder farmers in the Eastern Cape province of South Africa receive less information on, and have a more limited understanding of, climate change (such as drought) than commercial farmers. It should be noted that the latter also possess more economic and physical assets to respond to the fluctuation in rain patterns and other climatic features.

There is often a lack of effective agricultural extension services and support for farmers. This is certainly the case in Limpopo (Moeletsi et al., 2013; Mpandeli and Maponya, 2013). Extension officers are not only critical for providing agricultural advice but can also play a role in building adaptive capacity, thus contributing to the reduction of drought impacts. Yet, this support is missing in many places because of a lack of financial and human capacity at the local level (Amadhila et al., 2013).

Poor quality of infrastructure and weak service delivery in rural areas, as observed for instance in the Limpopo river basin, are also the result of the limited human and financial capacities of local institutions (Newsham and Thomas, 2011; Archer et al., 2008; David et al., 2013; Koch et al., 2007; Pasquini et al., 2013). The meagre resources allocated to local and decentralised entities by national authorities can explain why local authorities are unable to provide adequate development support on the ground (Moeletsi et al., 2013). For example, the SA Department of Agriculture does not allocate sufficient resources to local agricultural structures in Limpopo, limiting the scope of extension officers' activities (Mpandeli and Maponya, 2013).

Adger (2009) claims that the ability to adapt to change is determined in part by the availability of technology and the learning capacity, but essentially by the ethics of the treatment of vulnerable people and places within societal decision-making organisations. This is an important observation when planning adaptation strategies for and with communal subsistence and commercial farmers who hold different views. What is imperative to note is that the adaptive capacity of smallholder farmers is determined by education or human capital, i.e. wealth, material resources, societal entitlements, information, technology and infrastructure (Belliveau, 2006; Easterling et al., 2007; Adgar, 2009). The occurrence of shocks such as droughts endangers already fragile food production systems, but the mere likelihood of their occurrence makes some smallholders more risk-averse and more likely to pursue more subsistence-oriented activities, thus causing smallholder poverty to persist (Kiem and Austin, 2013).

A study by Fan et al. (2013) in Malawi shows that smallholder farmers suffer greater drought and flood-induced economic losses than medium- and large-scale farmers. For example, smallholder farmers are more likely to produce drought-sensitive maize, while medium and large-scale farmers grow more drought-resistant tobacco. This difference in cropping patterns means that smallholders experience greater economic losses during droughts. Drought impacts are felt most by the rural poor in developing countries, who are the most vulnerable because of their low adaptive capacity. The adaptive capacity of farmers in developing countries is severely restricted by heavy reliance on natural factors and a lack of complementary inputs and institutional support systems.

Verchot et al. (2007) claim that simple and well-adapted agro-ecosystems are less vulnerable to climate change, as these systems tend to be run by specialised farmers with access to the resources that will facilitate adaptation. More diversified farming systems suffer less from shocks and maintain the preparedness of farmers to adapt to changing conditions. Poverty and limited technical capacity have been identified as the major impediments to integrating coping and adaptation in developing countries, particularly in Africa. Because the poor are considered the most vulnerable to climate change impacts, it is often believed that financial capital is the most important indicator of adaptive capacity (Nyong et al., 2007).

2.5 Smallholder Farmer Challenges in Accessing Agricultural Water in South Africa

The demand for and use of water are placing water resources under pressure. This is because of population growth, growing demand for water for sanitation, water services, agriculture, and mining activities, as well as increased urbanisation and land transformation (WRC, 2001). Pressures that cause these impacts are driven by the interactions between humans and the environment, as well as changes in climate. This places additional constraints on the river ecosystems and other water resources (such as groundwater) and can result in an increased abstraction of water from both ground and surface sources beyond the ecological reserve. This

leads to conflict as a result of competition for water resources, as well as deterioration of the ecological integrity of ecosystems beyond the critical threshold. The consequence is a cumulative reduction in the quality and quantity of ecosystem goods and services, with the construction of infrastructure and modification of river channels leading to a direct loss of habitat. The degradation of aquatic ecosystems and contamination of the quality of water in the watercourse also occurs, leading to unfit use and deterioration of ecological functions and service provision. This, in turn, can lead to a lack of access to clean water.

2.5.1 Water authorisation

In South Africa, little progress has been made with water allocation reforms. The National Water Act (1998) proposes a set of possible water rights but it has been unclear which category of water rights applies to smallholder farmers (Perret, 2002). Under the National Water Act, only Water User Associations (WUAs) may apply for a license and may be granted the right to use water under specified conditions. Failure to become a member would limit individuals' right to use water other than as specified in Schedule 1.

Several factors significantly affect transaction costs incurred by irrigation water users. Research shows that irrigation water users involved in WUAs were likely to incur higher transaction costs than non-members. Farmers who complied with water pricing were also likely to experience higher transaction costs than those who did not. This suggests that compliance with water policy is indeed underlined by transaction costs (Njiraini, 2016). At a household level, rural people are automatically granted a free and unregistered right to "reasonably" use water for irrigation (Schedule 1). The National Water Act (NWA) urges smallholding irrigation farmers to form WUAs, which will be registered, licensed and charged. However, WUAs are likely to enforce water management rules and schedules, which are often sources of conflict and discontent in farming communities (Perret, 2002).

Water access entitlements themselves comprise various bundles of conditional rights to access water. These comprise, inter alia, the right to take or receive water, the right to a defined quality of water, the right to have the water delivered, the right to use the water, the right to build, operate or have an interest in works to take and control the water, and the right to return the water. Each of these components may have value, which may vary between users and uses. Many of the components of water use have been "bundled" together in one licence (Van Der Walt, 2011). Denby (2013) mentions that if a farmer possesses or secures a water right from the government, it does not necessarily secure their access to water. The availability of water, and people's access or lack of access to it, are ultimately a function of the effectiveness of policies and institutions.

Denby (2013) highlights several factors that hinder emerging farmers' access to water. Power imbalances, the inability to effectively participate, cultural differences, lack of knowledge surrounding the formal water policy, and failed accountability and integration at the institutional level all affect the most marginalised farmers' ability to access water. Furthermore,

access to technology, capital, markets, labour, knowledge, authority, identity, and social relations, affect and can limit a person's ability to access water.

2.5.2 Rising water charges

Rising water charges have a negative impact on farmers' well-being. Small-scale farmers are more adversely affected by rising water costs and license fees increases than their large-scale counterparts (Abunnour et al., 2016). The negative impact of water pricing on small-scale farmers' well-being could suggest the need for different pricing strategies for different farmer groups (Abunnour et al., 2016). In Tunisia, small-scale farmer livelihoods were endangered by increases in water prices that resulted in their using more land and less water, while their more technically efficient large-scale counterparts could easily afford higher water prices (Njiraini, 2016). Similarly, water price increases have adversely affected smallholder farmers in Limpopo, in turn diminishing their ability to pay for water rights reforms. Differential water pricing could, therefore, be a solution, but only if water demand is elastic and other policies are in place to support resource-poor farmers to adapt to changing water prices (Abunnour et al., 2016).

2.5.3 Compulsory licensing

Since the abolishment of the riparian rights system for water allocation and use, the Water Act requires the registration of all water users, followed by compulsory licensing and payment for use (Njiraini, 2016). To use water, a person must be issued with a licence by the Department of Water and Sanitation. This water use licence will specify the water user, the property or area where the water may be used, the specific use authorised, and in most instances, conditions of use (Speelman and Veettil, 2013). The compulsory licensing process in SA has been criticised for several reasons, including the five-year review period. This is regarded as too short to allow proper investments by farmers because of insecurities arising from possible changes at the end of every review period (Speelman and Veettil, 2013; Njiraini, 2016). The second source of anxiety is that there is no guarantee that quantities and qualities indicated for abstraction on licenses will be available for supply. Thirdly, the current water rights are limited in terms of transferability from one user to the other, as the transfer process is laden with administrative procedures for each transfer. This raises the transaction costs of transfer and renders the process less efficient (Njiraini, 2016).

Groundwater was converted into public property by the South African National Water Act, (RSA, 1998). However, for smallholder farmers, groundwater governance does not seem to be working. Seward and Yxu (2015) argue that this is possibly because of the complex tools that are employed, the lack of capacity to implement and poor management on the part of the Department of Water Affairs (DWA). The authors mention that the implementation of the National Water Act groundwater licensing process has been described as a "nightmare" by one local groundwater expert. Illegal use of groundwater is reported to be progressing, as it is perceived that the DWA is failing to license the use of groundwater and this is clearly not promoting its sustainable and proficient use.

2.5.4 Existing lawful use and insecure water rights

Existing Lawful Use was originally intended as a temporary arrangement. However, nearly 20 years since the National Water Act was promulgated, it continues to cover the biggest volume of water used in the country (DWS, 2018). The restitution of agricultural land has been slower than intended, and the reallocation of water has not always kept pace with the transfer of land (DWS, 2018). In most instances, the previous owners traded away their existing lawful water use rights, so that the water allocation was not transferred to land reform beneficiaries. Transformation of representation in water governance has also been slow. Membership of water user associations generally reflects land ownership and water use, so that the governance of those associations is mainly in white farmers' hands (DWS, 2018).

The post-apartheid South African government established a new water governance framework that was intended to put an end to racial inequalities in accessing water and address key challenges relating to water security (Förster et al., 2017). The absence of well-defined and secure water rights is still hindering smallholder farmers from accessing water and increasing their vulnerability (Speelman and Veettil, 2012).

2.5.5 Access to land without guarantee to water

Smallholder farmers are facing the problem of having access to farming land without access to water and water rights. The connection between land and water in this regard has largely been ignored. The handing over of farming land to smallholder farmers without access to water has created many challenges for the BGCMA and WUAs (Ncube, 2018). Smallholder farmers' participatory inclusion in water access, as well as access to information and different degrees of organisation around water issues, remain problematic (Förster et al., 2017).

2.5.6 Lack of information resulting in conflicts

One of the major findings by Ncube (2018) was the lack of information sharing among the institutions supporting smallholder farmers as well among the farmers themselves. Förster et al. (2017) also note that a lack of knowledge is a challenge for emerging farmers who want to access water. They tend not to be familiar with water legislation and administrative processes (Ncube, 2018).

A study by Mpandeli and Maponya (2014) revealed that farmers' misuse and mismanagement of water causes water shortages, especially during drought periods. Sometimes farmers closer to a dam unfairly denied others access to water from the dam. This appears to be not only the case with irrigation schemes but also with dryland farmers, among whom competition for water is stiff and conflicts are numerous.

2.6 Other Challenges Facing Smallholder Farming in South Africa

Although they make some contribution towards ensuring food security, smallholder farmers in South Africa face various challenges that impede their growth and ability to contribute as effectively to food security as commercial farmers do (Directorate Co-operative and Enterprise Development, 2012). Population growth, lack of funding and climate change are among the major general factors hindering their capacity to increase food production (Dube and Sigauke, 2015). Pests and disease outbreaks, extreme weather events and market shocks (Harvey et al., 2014), poverty, lack of access to credit, lack of savings, insecure property rights and lack of insufficient access to markets are among the further challenges they face. Farmers also report as problems a lack of information and knowledge of appropriate adaptation measures (Ringler et al., 2011; Fan et al., 2013), a lack of access to agricultural inputs, the intense labour demands caused by lack of mechanisation, and the lack of capital to invest in building productive soils in harsh environments (Pablo and Ken, 2013).

The constraints faced by smallholder farmers also stem from limited access to land, poor physical and institutional infrastructure, lack of access to proper roads (Directorate Co-operative and Enterprise Development, 2012), lack of human capital and limited access to infrastructure and technologies. But smallholders are also becoming increasingly vulnerable to a spectrum of emerging climatic, health, price, and financial risks and challenges (Kiem and Austin, 2013). The latter include attending to infrastructure and technology deficits and high marketing and transport costs (Fan et al., 2013).

Because smallholder farmers typically depend directly on agriculture for their livelihoods and have limited resources and capacity to cope with shocks, any reduction in agricultural productivity can have significant impacts on their food security, nutrition, income and well-being (Harvey et al., 2014). In comparison with commercial farmers, smallholder farmers' productivity is poor and often the quality of produce does not measure up to market standards. This because of weak management and technical skills, poor access to information and, in some cases, illiteracy. Reasonably efficient smallholder farmers are nevertheless unable to develop their farms due to their ineligibility for credit from financial institutions. Other difficulties smallholder farmers face include high transaction costs and problems with access to high-value reliable markets and appropriate and affordable means of transport (Hendriks, 2014).

2.6.1 Poor infrastructure

The absence of proper roads limits the ability of a farmer to transport inputs and produce and obtain information. Infrastructure is very poor and appropriate sources of agricultural inputs and markets for outputs are often absent or unreliable. Even if there are potentially lucrative markets, a lack of assets, information and access to services hinder smallholder participation (Directorate Co-operative and Enterprise Development, 2012).

The geographic dispersion and limited access to infrastructure (including transportation networks and market facilities) in many rural areas drive up transaction costs, lower smallholders' profit margins, and lead many smallholders to pursue more subsistence-oriented production practices (Fan et al., 2013).

High transaction costs also constitute a major factor constraining the growth of smallholder farmers and this is largely attributed to poor infrastructure, information inefficiencies and institutional problems such as the absence of formal markets (Directorate Co-operative and Enterprise Development, 2012). A poor road network and resultant unreliable distribution, for example, will force farmers to grow their food and produce fewer perishable commodities, reducing productivity generally. The high cost of transport will also affect the inputs used and the market strategies adopted by farmers. Smallholder farmers do not own machinery such as tractors or cars. Vegetables are planted manually or by using inexpensive equipment such as shovels. Product enhancers such as fertiliser and insecticides are also not utilised (Hendriks, 2014).

2.6.2 Lack of formal and reliable markets

Hendriks (2014) states that the changing market in South Africa in the previous century involved the rise of supermarkets and wholesalers who introduced tough quality and safety standards, and volume and consistency demands. This has made access to formal markets increasingly difficult for smallholder farmers. Meanwhile, smallholder farmers did not adapt or adapted only minimally their farming practices, and now face difficulties with supplying their products to these newly established markets. This has, in turn, led smallholder farmers to continue supplying informal markets, mostly in urban areas.

Smallholders often have limited access to markets for both inputs and outputs, and this has a significant effect on their production capacities (Fan et al., 2013). They actually consume much of what they produce themselves, as food security is a major problem reflecting chronic poverty and unemployment (Hendriks, 2014). The majority of smallholder farmers are also not capacitated with financial and marketing skills and, as indicated above, are unable to meet the quality standards set by fresh produce markets and food processors (Directorate Co-operative and Enterprise Development, 2012).

As a result of meagre investment in production factors, such as land, water and capital assets, most smallholder farmers produce small quantities of products that are equally of poor quality and unsuited to output markets. Increasing concentration in the food value chain is a global trend, caused by increasingly demanding consumers and concerns about food safety. These factors make it very difficult for smallholder farmers to enter high-value markets (Directorate Co-operative and Enterprise Development, 2012).

Even though small-scale farms should be able to produce at least as efficiently as commercial farms, the policy framework in South Africa, mainly regarding regulations involving access to markets, input services and credit, favours large scale farms (Hendriks, 2014).

2.6.3 Access to education

Smallholders' productivity is also affected by their lack of access to education, which could help build the skills needed to manage farm production systems more efficiently and raise the rate of adoption of innovative and high-return technologies (Fan et al., 2013). According to Hendriks (2014), it is in any case difficult for smallholder farmers to accept instruction, especially those who need to transform their farming habits completely, cultivating different products, using different soil, and timing their planting differently. Smallholder farmers cannot handle large chunks of information: they tend to ignore or forget innovation and change that are recommended and continue to farm inefficiently (Hendriks, 2014). Lack of production knowledge leads to lower quality in production (Directorate Co-operative and Enterprise Development, 2012).

Smallholders are often illiterate with poor technological skills, which can be serious obstacles in gaining access to formal institutions that spread technological knowledge (Directorate Co-operative and Enterprise Development, 2012).

2.6.4 Poverty

Smallholders have become increasingly vulnerable to a spectrum of emerging climatic, health and financial risks and challenges. These emerging challenges lead many smallholder farmers to pursue livelihood strategies that involve lower-yielding agricultural activities, which may cause poverty to persist, trapping smallholders in a cycle of little or no profit, with limited opportunities to undertake more productive and innovative activities (Fan et al., 2013). Small farmers are also constrained by their general poverty in respect of assets such as education and infrastructure, but also specific assets, such as irrigation or the specialised horticultural knowledge that is needed to cater to modernising domestic and export markets (Reardon et al., 2012).

2.6.5 Access to credit

Access to credit is often necessary for daily expenditure in an agribusiness. Especially in the period between planting and harvesting, smallholder farmers have little working capital available, because a great part of their savings has been spent on farm inputs. The lack of capital makes the farm also more susceptible to shocks. Smallholder farmers are unable to invest in capital intensive equipment such storage facilities, traceability systems, process monitoring systems and (repeated) capital investments to satisfy the developing quality and safety requirements of buyers (Hendriks, 2014; Barrett, et al., 2011).

Smallholder farmers often do not have access to credit because they lack the collateral to acquire loans. Moneylenders are more willing to provide capital to large firms than too small firms. Fan et al. (2013) observe that many smallholders are excluded from productivity-enhancing financial services and are unable to secure much-needed fixed and working capital, for needs ranging from land and buildings to machinery, high-yielding seeds and fertiliser. This limited access to capital leads to limited opportunity for change among smallholder farmers (Kiem and Austin, 2013). They experience difficulty with purchasing basic agriculture inputs and are incapable of investing in their businesses. Savings are non-existent because when a farmer does earn some income, every cent needs to go on household expenditure.

Farmers may be encouraged to change the intensity and variety of inputs such as fertiliser and improved seed used in response to climate change, but small farmers in Asia and elsewhere in the developing world (including SA) are constrained by "personal market failures" (Bocher, 2016). Credit, input, information, and insurance markets exist, but small farmers often cannot access them on favourable terms (Reardon et al., 2012). As Ringler et al. (2011) argue, adaptation to climate change is both costly and labour intensive. Lack of financial resources keeps farmers from acquiring the necessary technologies to allow them to adapt. Smallholder farmers are also seemingly more resistant to technological change than large-scale farmers (Hendricks, 2004).

Marketing smallholder agribusiness encounters higher transaction costs than large scale agribusinesses. These high transaction costs are responsible in part for farmers' poverty and missing links to the market. The disadvantages of scale are exacerbated by smallholder farmers' poverty, health uncertainty, lack of access to capital and low levels of education. Poor communication systems and the low density of economic activity in the remote areas where smallholder farmers are located further increase transaction costs (Hendriks, 2014).

2.6.6 Theft

Hendriks (2014) says that smallholder farmers are commonly affected by theft, with about 50% of farmers suffering incidence of theft over two years. When a theft occurs on a small-scale farm – for example, when vegetables are stolen – the consequences are severe. The farmer suffers a loss of income and food security.

Theft and animal intrusion is common on smallholder farmers due to their inability to keep intruders out: security to protect the borders of the farm, such as barbed or plain wire fences, is present on most small-scale farms, but often lacking in quality. Security fencing is often holed, unfinished or weak (Hendriks, 2014).

2.6.7 Weather Extremes

Smallholder farmers are vulnerable to both droughts and heavy rainfall in areas like Grabow (Hendriks, 2014). Protecting smallholder farmers against these extremes of weather is difficult because of a lack of resources and knowledge. Smallholder farmers are usually not insured

against weather events and suffer heavy income shocks as a result of them (Hendriks, 2014). Smallholder farmers have been modifying their practices to adapt to the changing climate, but traditional coping mechanisms are not sufficient for dealing with the medium- to long-term impacts of weather extremes (Etwire et al., 2013).

2.7 Complexities in Smallholder Farmer Support Systems

2.7.1 Limitations of Current Support Systems

Various farmer support programmes (FSP) were launched in 1986 to assist smallholder farmers or rural households to improve their agricultural production in the former homeland areas (Van Rooyen et al., 1987). The programmes were introduced by the Development Bank of Southern Africa (DBSA) as an initiative to address constraints faced by farmers (Kirsten and Van Zyl, 1998), alleviate poverty and stimulate economic development and growth (Nel et al., 1997). The government implemented various programmes such as National Land Care Programme (NLP), Strategic Plan for Smallholder Support (SPSS), Comprehensive Agricultural Support Programme (CASP), Revitalisation of Smallholder Irrigation Schemes (RESIS), and Micro Agricultural Financial (MAFISA). Unfortunately, only a few of the services provided managed to reach the intended beneficiaries (Aliber and Hall, 2010).

2.7.2 Governmental support

The support of farmers has been an issue since 1994, but efforts to promote smallholder farmers have not yielded the results required and expected of them. The differing roles of organisations in service provision need to be defined by realistic criteria that depend on smallholder farmer livelihoods. The organisations or instruments involved include the Agricultural Research Council, the Land Bank, and the Provincial Departments of Agriculture. However, these institutions are still learning how to deal with the special circumstances and needs of smallholder farmers (Hall and Aliber, 2010). Furthermore, government assistance has so often been unreliable or late in coming that in many areas the situation has grown worse than before (Jacobs, 2009).

2.7.3 Cooperatives

Most smallholder farmers fail to register as cooperatives or groups of farmers to access facilities to take their goods for sale, processing and storage (Ortmann and King, 2006). Smallholder farmers are still required by funders to provide collateral in the form of fixed property or actual funds to prove that they will be able to repay the loan requested. This they are seldom able to do. The government believes that cooperatives can help farmers and are advising them to register as cooperatives. Most farmers for various reasons have no access to the means and relevant information to register as cooperatives and consequently do not qualify for financial assistance from the government. The government does not fund individuals as this is considered high risk and expensive. The absence of facilitation in the formation of producer associations or other partnership arrangements makes it difficult for smallholder producers to participate in formal markets.

2.7.4 Skills development

Agricultural technology in rural areas is another factor affecting agricultural production. Few institutions are prepared to provide skills development to smallholder farmers because of a lack of funds. It is difficult to keep records without the necessary skills, and inputs can easily be used inefficiently. Because agriculture is clearly one important avenue for redressing past inequalities, the challenge facing South Africa is to bring previously excluded black farmers into the mainstream economy through job creation and entrepreneurship. Higher economic growth will not be possible without addressing, among other issues, the low education and skills development levels typically found in rural South Africa. That is where agriculture is most likely to play an important role in resolving the livelihood challenges of the poor.

2.7.5 Lack of infrastructure

Limitations that block smallholder farmers from greater market access to agro-food output markets are associated primarily with weak infrastructure (Fanadzo and Ncube, 2018). Infrastructure is one of the keys to profitable development. Machethe (2004) emphasises the importance of developing and maintaining the physical infrastructure (together with recognising and addressing high transaction costs) as one of the major factors constraining the growth of smallholder agriculture (Oladele and Mudhara, 2016). Kherallah and Minot (2001) explain that high transaction costs can be largely attributed to poor infrastructure and lack of telecommunication networks. In rural areas, transport contractors are reluctant to service smallholders due to the poor quality of feeder roads in rural villages. The infrastructure development gap in rural areas had led to the failure of smallholder farmers to adopt new technologies that could enhance their potential to produce good quality products.

Smallholder farmers have been neglected in terms of infrastructural support by past governments. The present democratic government is trying to redress this (Makhura, 2001), but obstacles to market access persist. The focus of government on increasing food staples in irrigated and high potential areas does not benefit smallholder farmers. This is because many of them live in rural areas that lack the infrastructure to take advantage of improved technologies. Even when they reside in high potential areas, smallholder farmers lack control over land, water, labour, credit, and other critical assets necessary to take advantage of improved technologies.

Smallholder farmers are additionally constrained by basic technology such as agricultural tools used in the field like hoes, spades and picks. The number of hand tools available is limited and many of them are unserviceable and need replacement. There is also a lack of basic technical information among smallholder farmers on suitable means of restoring and maintaining soil fertility as well as limited extension services.

2.8 Conclusions

Any effort to increase the contribution of smallholder farming to poverty reduction needs to appreciate that smallholder farmers are not a homogeneous group. An effective smallholder agricultural development strategy must recognise that there are different categories of smallholder farmers requiring different support approaches. Technological and institutional packages should be tailored for each category of farmers. This can only be done if the characteristics and livelihoods of the farmers are understood, and the strategies are developed according to their livelihoods and resource endowment. Not all farming areas in the former homelands have the same agricultural potential. Therefore, diverse strategies will need to be developed to ensure that each smallholder farming area is assisted to reach its agricultural potential.

3 SMALLHOLDER FARMER LIVELIHOOD STRATEGIES IN THE LIMPOPO PROVINCE

Ncube, B., and Shikwambana, S.
Also part of a PhD thesis by S. Shikwambana

This chapter presents the general characteristics of smallholder farmers in the Limpopo province, outlining the site selection and research methodology used, and presenting and discussing the results pertaining to smallholder farmer livelihoods in the Mopani and Vhembe districts.

3.1 Introduction

Smallholder farmers in Limpopo have relied on crop and livestock farming systems under communal management for a long time. Deteriorating agricultural performance is a major driving force behind increasing poverty in Limpopo, and its recovery offers the greatest prospect for the rural population to escape poverty (LDA, 2004). Food insecurity among the vulnerable poor rural farming populations induces a risk-minimising conservative attitude towards farming and livelihood systems.

Disregarding the large number of smallholder livestock farmers in communal landscapes and their potential, institutional development agendas have adopted a significantly different focus (LDA, 2004). An analysis of the interventions funded through the Food Security Programme (FSP) and the Comprehensive Agricultural Support Programme (CASP) implemented since 2000 across all municipalities in Limpopo shows that the most prominent agricultural activities funded were poultry and vegetables (LDA, 2004).

There is no livelihood classification of smallholder farmers in Limpopo. The CASP programme motivated for the development of smallholder farming in the province through the creation of infrastructure in rural villages to start poultry and vegetable production enterprises. This included chicken houses for broiler production, irrigation systems, boreholes and fences for vegetable production (LDA, 2005). A project approach was followed to mobilise beneficiaries into groups in selected villages in the former homeland areas.

On the other hand, relatively few grazing livestock development interventions were initiated. Those that were included boreholes, fencing and animal handling facilities (LDA, 2004). This illustrates that the preferred institutional approach was to implement externally developed interventions through the imposition of new and foreign technologies. The overall impression is that consultation processes with villagers managed to mobilise them into groups of beneficiaries, but the villagers did not have a complete understanding of the shape, form and extent of the intended projects (Machete et al., 2004).

In the case of irrigation development, previous social segregation and separation policies had ensured that white farmers received the biggest share of irrigation schemes (Van Averbeke et al., 2012). In most cases, black farmers were allocated a relatively small plot for irrigation, an average of 1.5 ha. Therefore, smallholder irrigation schemes in Limpopo were defined as irrigation schemes specifically constructed for occupation and use by black farmers (Van Averbeke et al., 2012). These schemes and the allocation of plots were designed in such a way that they catered for a variety of target farmers in the former homelands of Gazankulu, Venda, and Lebowa. Smallholder farms with plots bigger than 1 ha were prepared for those who wanted to produce for consumption and sell for surplus (LDA, 2004). In addition, owners with plots bigger than 1 ha were encouraged to give employment to local people. For a long time, smallholder irrigation schemes were associated with subsistence farming and seen to have a limited role to play in the stimulation of the economy (LDA, 2004). However, irrigation schemes that are strategically located in communal areas have considerable potential to alleviate poverty and create employment. Without them, farmers in a dryland/rainfed system have limited choices in terms of livelihood and farm productivity. The farmers rely on rainfall which is simply not reliable. During periods of drought, such farmers are the hit hardest, as has been seen just recently.

Extreme weather conditions such as drought and floods that are closely intertwined with climate change can affect agriculture and livelihoods in many ways that include harvest reduction or total failure and extensive livestock mortality (CARE, 2009; Muller, 2009; Stringer et al., 2009; Elum et al., 2017). The Limpopo province is relatively dry with an average annual rainfall of 400mm (LDA, 2010). The LDA (2010) points out that drought is a very serious problem in Limpopo as most of the province is semi-arid with low and erratic rainfall. Low rainfall in this region has resulted in the loss of livestock, a shortage of drinking water, low yields and a shortage of seeds for subsequent cultivation. The loss of these natural assets among smallholder farmers reduces their ability to cope with climatic changes and renders them vulnerable to fundamental and enduring climate change.

Limpopo is a drought-prone province which faces intermittent challenges (Maponya and Mpandeli 2013). According to Mpandeli et al. (2016), smallholder farmers in Limpopo face multiple sources of stress besides extreme climatic events, high climatic variability and change. They also have to deal with wildfire outbreaks that affect livestock grazing and threaten human lives. Maponya & Mpandeli (2013) also note that severe drought conditions negatively impact grazing and water for livestock and irrigation activities and the agricultural sector in general.

Limpopo was the province in South Africa worst affected by drought in the past 8 years, with dams only 50% full, compared to 84% in the late 1980s (Maponya & Mpandeli, 2013). This has severely affected the agricultural sector, especially smallholder farmers who are vulnerable because they have a low adaptive capacity. Commercial farmers have more choices during drought than subsistence and small-scale farmers (Mpandeli, 2015). Subsistence and

smallholder farmers have limited options because they do not have financial resources, nor the collateral or security needed to obtain loans from banks.

3.2 Site Characteristics

A week-long scoping visit was made to Limpopo in October 2017. The main purpose of the visit was to set up a collaboration with the University of Limpopo and consult the Limpopo Department of Agriculture on collaboration and site selection. The University of Limpopo had some students conducting similar work in the province. The criteria for site selection were discussed at length and further consultation in the field was recommended. The project was also presented to various offices of the Limpopo Department of Agriculture, including district offices. The department welcomed the project and also wrote a letter to confirm that the research could be conducted. Further consultation with extension officers on the ground ensured that representative villages were selected for the study.

The study began with a desk review of available literature and reports on Limpopo. The review identified the Mopani and Vhembe districts as the primary areas for conducting the study. The Limpopo Department of Agriculture and Rural Development did a thorough assessment of agricultural climatic conditions in the province and found that severe drought conditions occur in most parts of the province (LDA, 2016). The worst affected areas are Musina, Thulamela and Mutale Municipalities in the Vhembe District, Greater Letaba, Greater Giyani, and Ba-Phalaborwa Municipalities in the Mopani District, and Fetsakgomo and Makhuduthamaga in the Sekhukhune District (LDA, 2016).

Smallholder farmers in the Mopani, Vhembe and Sekhukhune districts were the hardest hit during the recent drought (LDA, 2016). A study on coping with climate variability in Limpopo had already been carried out in the Sekhukhune District, and for that reason, Sekhukhune was excluded from the study. The Greater Tzaneen and Greater Giyani local municipalities in Mopani and the Thulamela Municipality in Vhembe were selected for the study. These municipalities were selected both because of the large numbers of smallholder farmers living there who depend on agriculture for their livelihoods and the high-temperature variations experienced in the areas. Drought occurrence was the main criterion used to select the sites. Drought is a regular phenomenon in the Limpopo Basin. The region has more than a century's recorded data, which indicates that drought occurs at intervals of about 10-20 years, although the periodicity of droughts is not necessarily predictable (FAO, 2004). Defining and monitoring drought is a difficult task because of its diverse geographical and temporal distribution. Based on rainfall events, the Standardised Precipitation Index (SPI) is the tool most often used to investigate drought. The SPI gives the deviation of rainfall events in a selected time scale from the long-term mean. Figure 3.1 shows the Standardised Precipitation Index for South Africa for December 2016. Parts of the Mopani and Vhembe districts fell into the severe to extreme drought categories. Other criteria used to select the sites included farm size, farming under rainfed conditions and the agro-ecological zone for the area. As reported by the LDA (2012), the Mopani and Vhembe districts are those most threatened by climate change in Limpopo. Figure 3.2 shows the location of the Mopani and Vhembe districts in Limpopo.

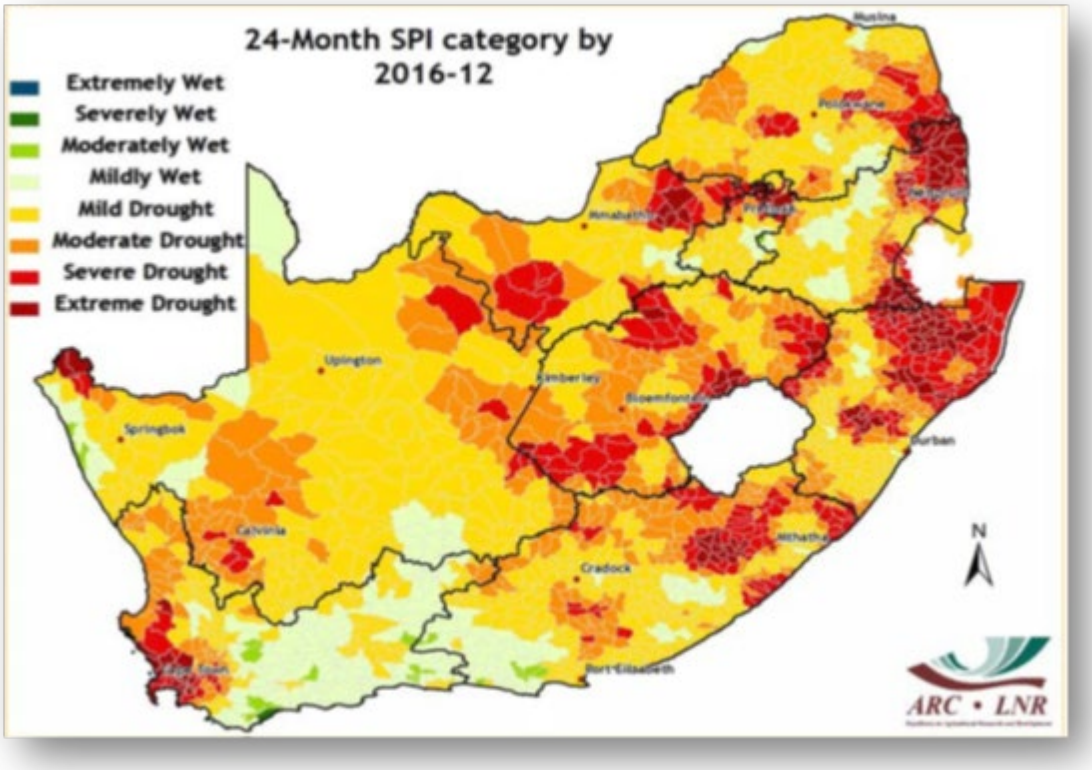

Figure 3.1 Standardised Precipitation Index for December 2016 (Source: SAWS, 2017)

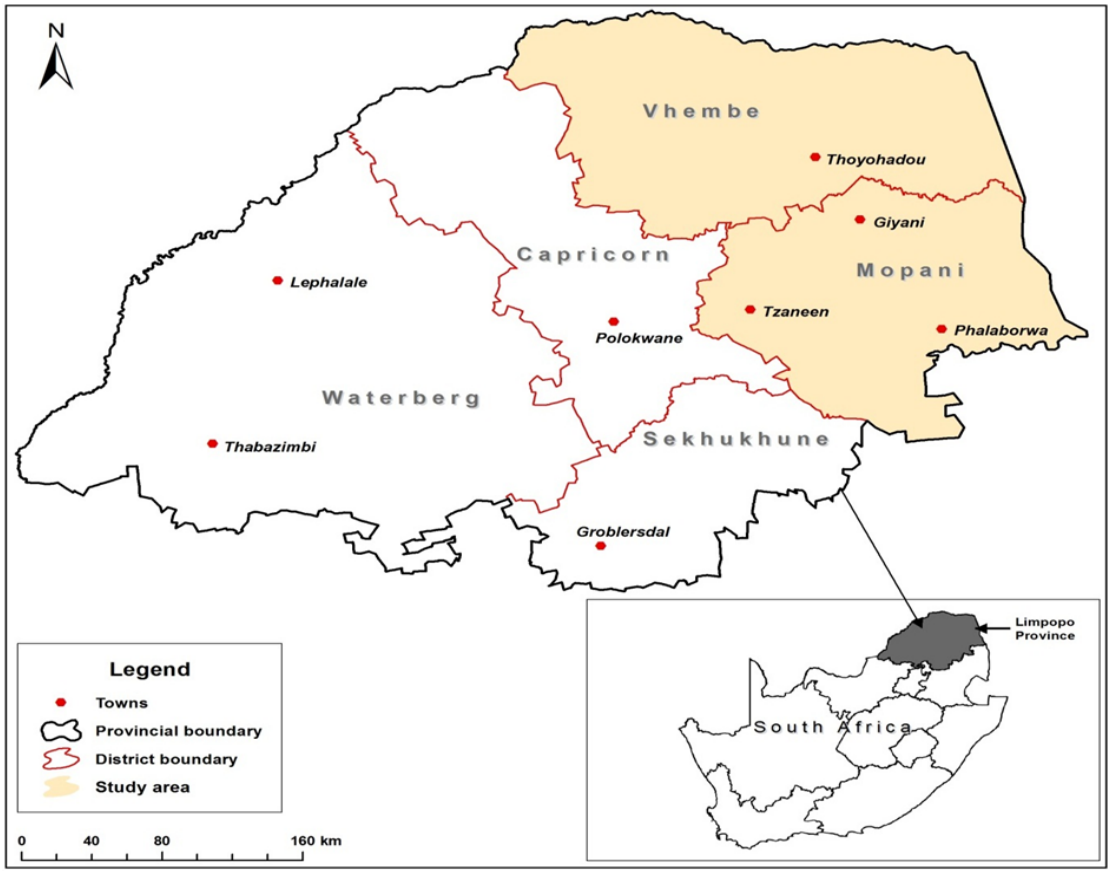

Figure 3.2 Locational map showing Mopani and Vhembe Districts in the Limpopo Province

Mopani District

The district was named Mopani after the abundance of nutritional Mopani worm found in the area (IDP, 2012). The district comprises five municipalities, Greater Tzaneen, Greater Giyani, Letaba, Maruleng and Ba-Phalaborwa, covering a total land area of approximately 1 437 734 ha (IDP, 2012).

The Mopani district is characterised by low rainfall, especially in the lower areas of Giyani and Ba-Phalaborwa municipalities. The main surface water resource is the Letaba River catchment and all its tributaries. There are several other rivers in the district, including Groot Letaba, Politsi, Debengeni, Thabina and Letsitele (Limpopo EDET, 2006), and over 20 large dams. Nine of these are used for primary consumption and the others for irrigation purposes (LDA, 2004). There is potential to use borehole water to augment the surface water.

The district experiences average maximum temperatures of between 21 ºC and 37 ºC in January, average minimum temperatures of between 5 ºC and 12 ºC in July, with an annual average temperature range of 13 ºC to 27 ºC (LDA, 2005). January is the hottest month and thus excessive heat is of concern. July is a cool month but not bitterly cold, and the occurrence of frost is not a major problem. A larger portion of the district, the eastward side of the Drakensberg escarpment, receives an annual average rainfall of 400-500mm while the areas at the foot and on the escarpment receive 600-800 mm and 800-1 000 mm, respectively (LDA, 2005). This pattern enables the district to accommodate a wide range of agricultural commodities, both livestock and crops.

The district is characterised by soils of depths ranging from <450 mm to >750 mm (Limpopo DFED, 2004). The areas in the south and centre of the district have soils with depths mainly less than 450 mm, while soils on the western side are mostly more than 750 mm. There are patches of the soil of depth between 450 mm and 750 mm on the northern side of the district (Limpopo DFED, 2004). The district is traversed by rivers, some of which are used for irrigation purposes. The Giyani area is generally water-scarce and hence the use of water for irrigation purposes is limited. Based on soil capability, the district is suitable for a wide range of crop and livestock production (LDA, 2005).

Farming activities include citrus, mango, vegetables, poultry and livestock. Mining has been the dominant sector since 1996, accounting in 2006 for 31% of GDP (IDP, 2012). Trade is also an active sector in the district, including tourism and finance, since it is at the border of the Kruger National Park. Agriculture is another key economic sector, predominant in the Tzaneen, Letaba and Maruleng municipalities. About 10 000 ha of citrus is grown in the areas of Tzaneen and Letaba and some areas of Ba-Phalaborwa, and the fruit is sold to the export market (Limpopo EDET, 2006).

Vhembe District

The Vhembe district municipality covers an area of 25 597 km² and is located in the northern part of Limpopo (StatsSA, 2015). It shares borders with Zimbabwe and Botswana in the north-west and Mozambique in the south-east through the Kruger National Park. The Limpopo River valley forms the border between the district and its international neighbours. It is comprised of four local municipalities: Musina, Lim 345, Thulamela and Makhado. Thulamela municipality was selected for the study. The Vhembe district has a total population of 1 248 369 people (StatsSA, 2015). The majority of the residents are women (53%), while 74.99% of the population is 35 years of age and younger (Nthakheni, 2006). All four municipalities are involved in both grazing (livestock) and arable (crop) activities. More land is used for grazing than for cultivation (Nthakheni, 2006).

The district experiences average maximum temperatures of between 24 ºC (in the south) and 37 ºC (in the north) in January, average minimum temperatures of between 8 ºC and 12 ºC in July, with annual average temperatures of 14 ºC to 29 ºC (Isaacs and Mohamed, 2000). January is the hottest month and thus excessive heat poses a risk to agricultural production. July is a cooler month with no frost occurrence. The District receives summer rainfall, with an annual average of 300-400mm in the north and 600-1000mm in the south (Limpopo DFED, 2004).

The Vhembe district features various types of soils of varying depths, the most widespread soils going to a depth of between 450 mm and 750 mm, followed by those with a depth of <450mm, and some patches with depths of greater than 750 mm (Limpopo DFED, 2004). These soils inform the selection of crops according to their rooting depths. Based on climate and soil conditions, the Vhembe district is suitable for a wide range of agricultural production, both crops and livestock (Nthakheni, 2006). The district has areas with particular suitability for tropical and subtropical fruits and is home to the Levubu Tropical Valley. Vegetables are produced in irrigation schemes that are spread along river valleys, with the Nwanedi Valley well known for tomato production (LDA, 2004). Accordingly, there has been a lot of investment in terms of production and value-adding infrastructure for fruit and vegetables, and also for poultry (Limpopo EDET, 2006).

Sample selection

The main purpose of sampling is to achieve representativeness, meaning that the sample should be assembled in such a way that it represents the entire population from which it is drawn (Jennings, 2001). A meeting was arranged with each municipality's agricultural office to decide the sampling units. All the centres in the selected municipalities were studied. A sample of 200 rural households was drawn from 8 centres (Guwela, Mhlava Welemu and Hlaneki service centres in the Greater Giyani Municipality; Berlyn, Naphuno, Mamitwa and Tzaneen service centres in the Greater Tzaneen Municipality; and Lambani service centre in Thulamela Municipality). The study was limited to smallholder farmers practising dry land and mixed farming systems.

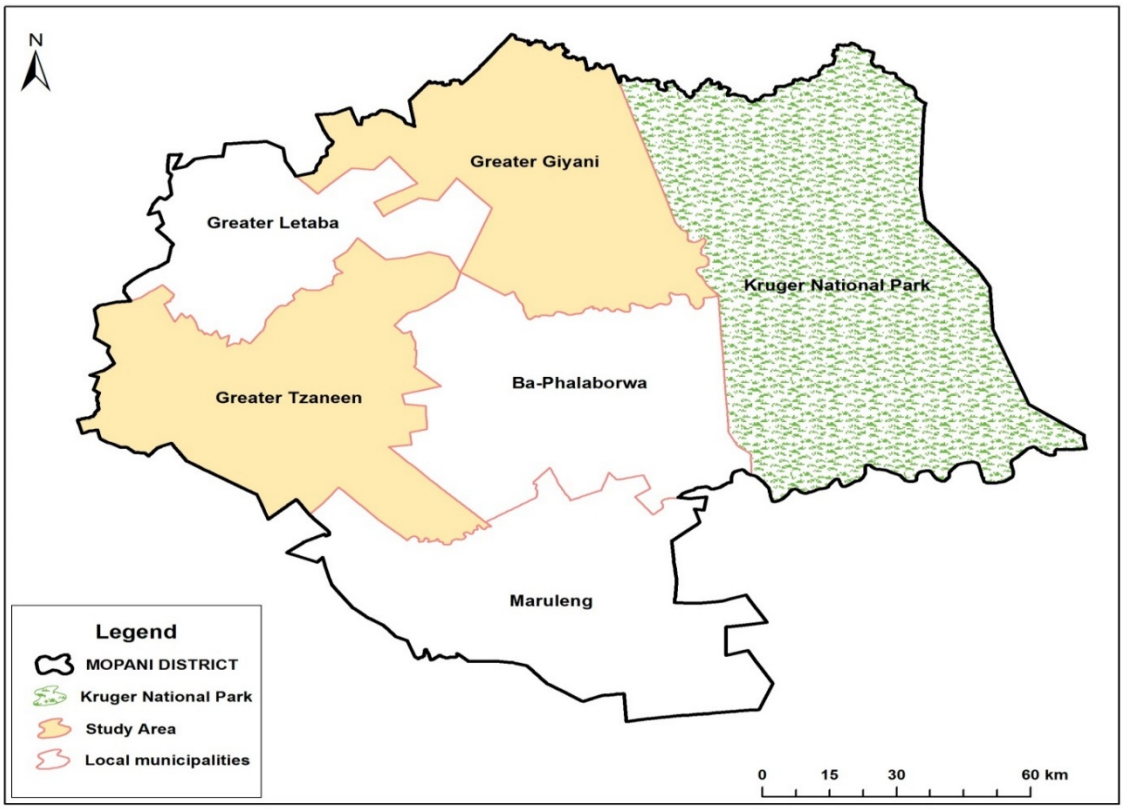

Figure 3.3 Locational map of Mopani district, showing the Greater Tzaneen and Greater Giyani municipalities

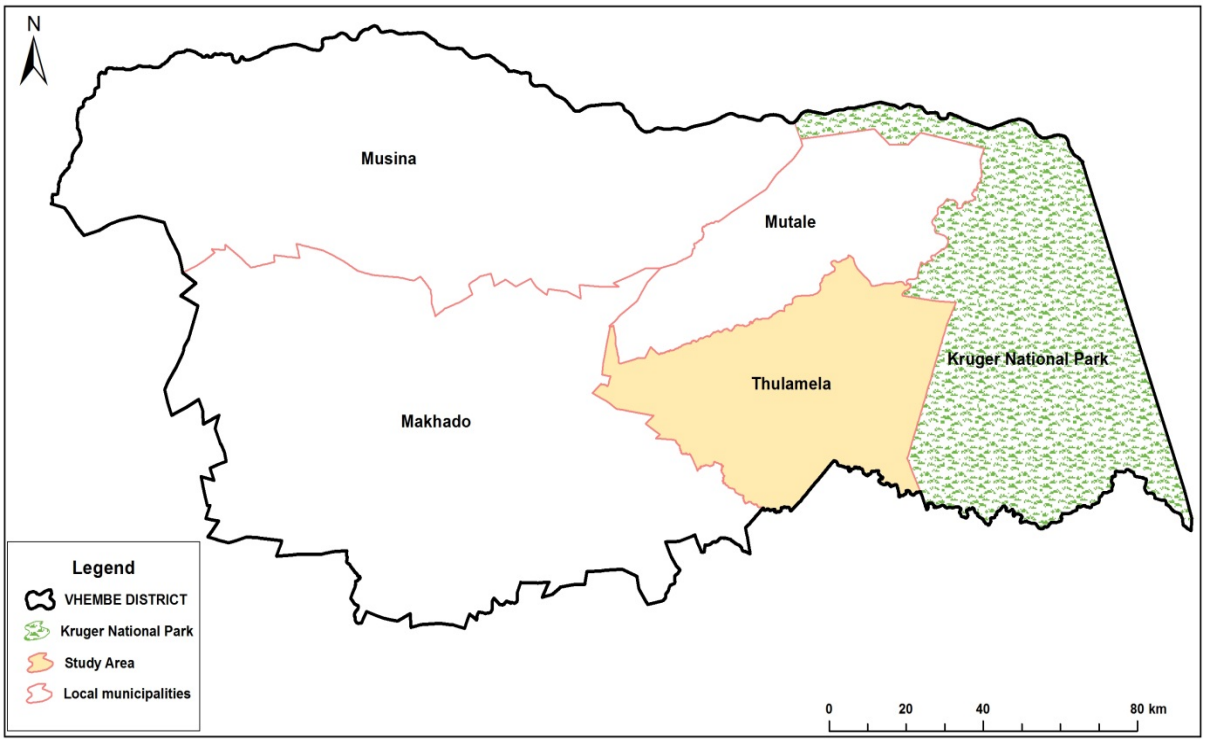

Figure 3.4 Locational map of Vhembe district, showing Thulamela municipality.

3.3 Questionnaire Design and Data Collection

The questionnaire was designed around the assets of the Sustainable Livelihoods Framework (DFID, 1999) as a means of exploring participants' livelihood strategies. The study collected both primary and secondary data to achieve the research objectives and to answer the research questions. Secondary data was acquired through sources of evidence including documents, archival materials, published and unpublished articles, internet sources and books, while primary data was collected through structured questionnaires. Open-ended questions allowed the participants to give detailed accounts of their experiences, opinions, beliefs, facts and attitudes about how smallholder agriculture contributed to providing food security for their households. Closed-ended questions, on the other hand, allowed the participants to choose the answers from the options provided to the questions, including the types of assets they possessed. The questionnaire consisted of five sections.

The questionnaires were distributed to all sampled households in the study area, and participants were helped with completing the questionnaires when necessary. Officials from the Department of Agriculture and Rural Development deployed their extension officers to assist in both approaching the participants to elicit their participation and in monitoring the administration of the questionnaires.

3.4 Characteristics of Smallholder Farmers in the Limpopo Province

3.4.1 Human assets

The demographic data collected included age, household size, education and gender. Figure 3.5 shows the percentage age group distribution among the surveyed smallholder farmers. The majority of the farmers (about 58%) were in the age group of 56 to 75 years old. There was a small much smaller percentage (6%) in the youth age group (18-35 years old). This suggests that smallholder farming is mostly practised and managed by elderly individuals in Mopani and Vhembe districts. The age of the farmers who manage farming activities could have profound effects on the farm's productivity: for instance, the elderly may lack the strength and stamina to carry out labour-intensive work.

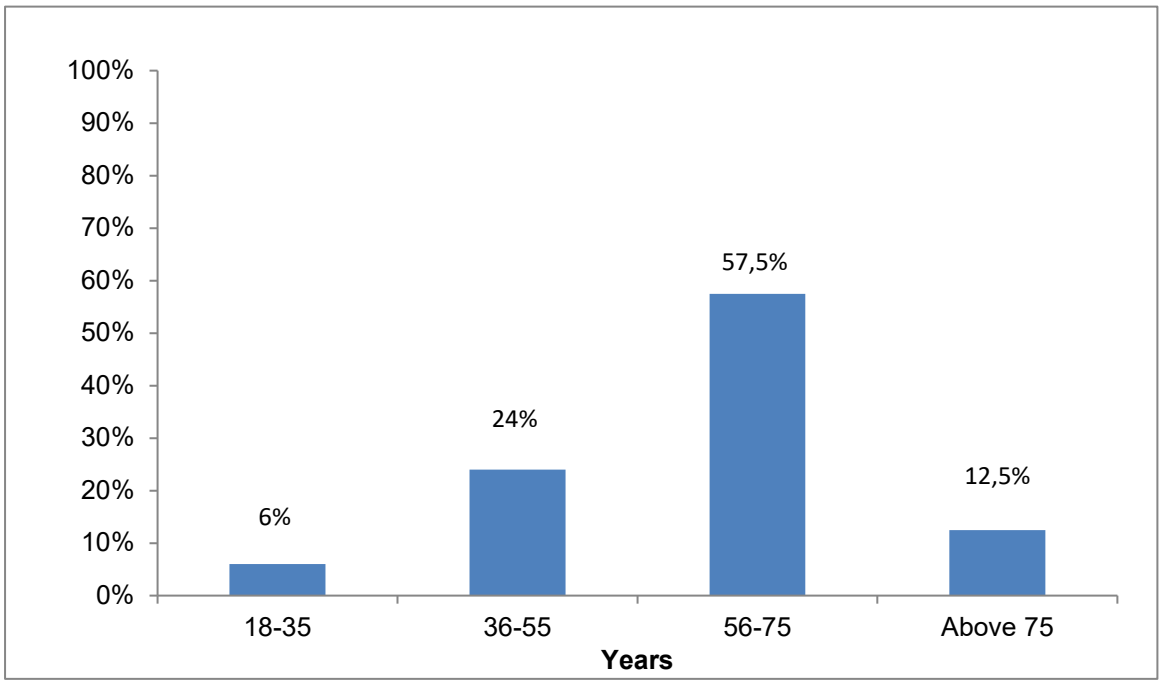

Figure 3.5 Age distribution of smallholder farmers in Mopani and Vhembe districts

Figure 3.6 shows the proportion of men and women engaging in smallholder farming in the study sample. Women dominate smallholder farming in the Mopani and Vhembe districts. Women represented 61.4% of smallholder farmers in the sampled population while men accounted for 38.6%.

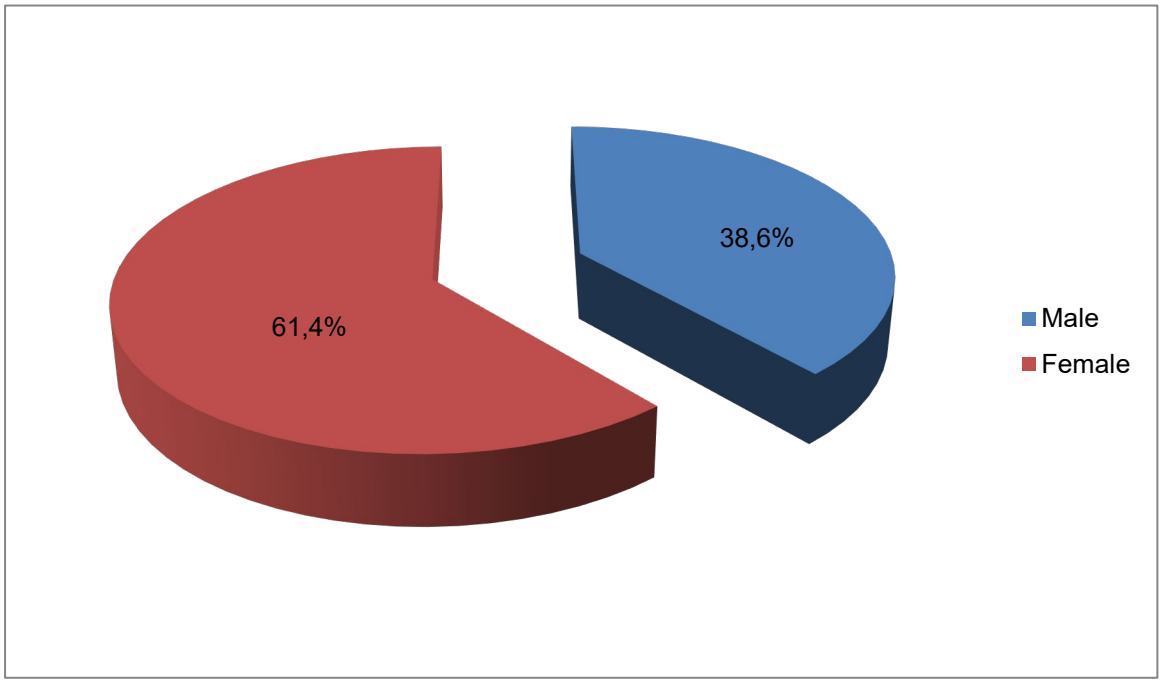

Figure 3.6 Gender of the sampled farmers in selected villages in Vhembe and Mopani districts (n=200)

There seems to be a perception that smallholder farming is mainly carried out by men (Msofi, 2014). However, women are increasingly resorting to smallholder farming to make up the

deficit in their household's food needs. Smallholder farming can be an attractive option for sourcing food and income for women.

Respondents were also asked how many people were in their household to distinguish between household members and those residing in the compound because sometimes more than one family shares a stand or compound. The intention was to determine the composition of the household in terms of the number of members, which could indicate the labour available for farming. Figure 3.7 presents the size of the households of the respondents.

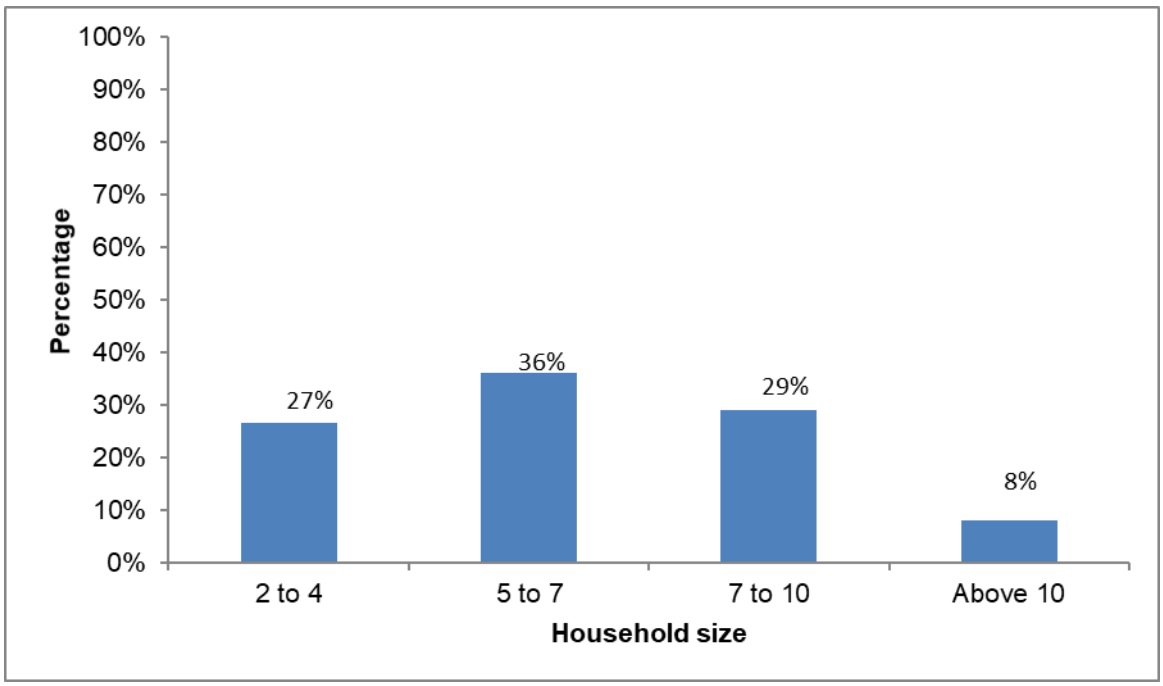

Figure 3.7 Household size of sampled farmers in Vhembe and Mopani districts

About 65% of the households have between five and ten family members, while 26.5% of the sample comprised households with fewer than five members, 8% reported having more than ten members residing in the household. The study noted that most households had at least two children, which probably raises the demand for nutritious food.

The study was also interested in finding out the level of education of smallholder farmers in the sampled areas. Figure 3.8 shows the level of education of the respondents in the study area.

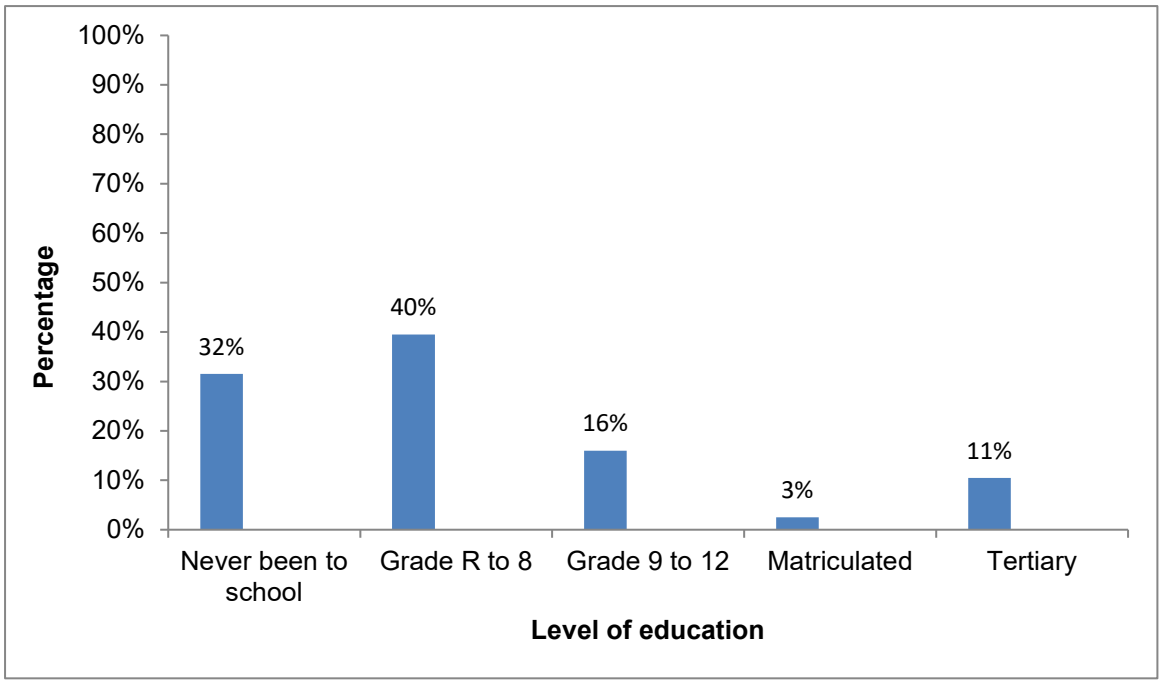

Figure 3.8 Education level of sampled farmers in Vhembe and Mopani districts

There is a perception that most smallholder farmers are illiterate or minimally educated (Pophiwa, 2012). This is not the case in Mopani and Vhembe districts. The results suggest that the majority of the farmers had some form of education, although about 32% of them did not. About 40% of the respondents had attended primary schooling while 16% had some secondary schooling. A few of the farmers even had some post-secondary education. It can be concluded that in the study area, most smallholder farmers have some formal education, which could positively influence the level of their productivity.

Low levels of education have often been linked to poverty and may limit the ability of the farmers in the study area to carry out certain farming activities requiring sophisticated understanding (Pophiwa, 2012). On the other hand, smallholder farming is a sector that can secure income for individuals who lack the educational qualifications to join the formal employment sector.

3.4.2 Social assets

The surveyed farmers were also assessed in terms of variables relating to their social assets, which included farmers' group activity and available communication channels. Figures 3.9, 3.10 and 3.11 show the findings in this regard. Above 70% of the respondents reported belonging to a farming group and those who did not have formal group members met as farmers to discuss farming activities. Extension services from the Department of Agriculture and Rural Development play a crucial role in facilitating such meetings. The functionality of these groups is reported to be in the region of 75%.

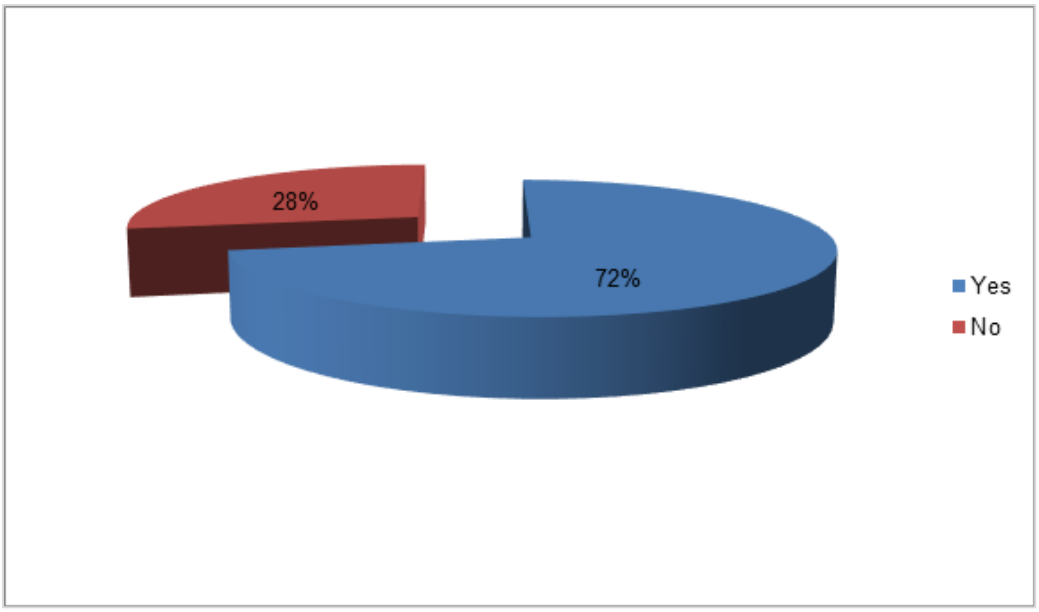

Figure 3.9 Distribution of farmers who are members of a group (Mopani and Vhembe districts, n=200)

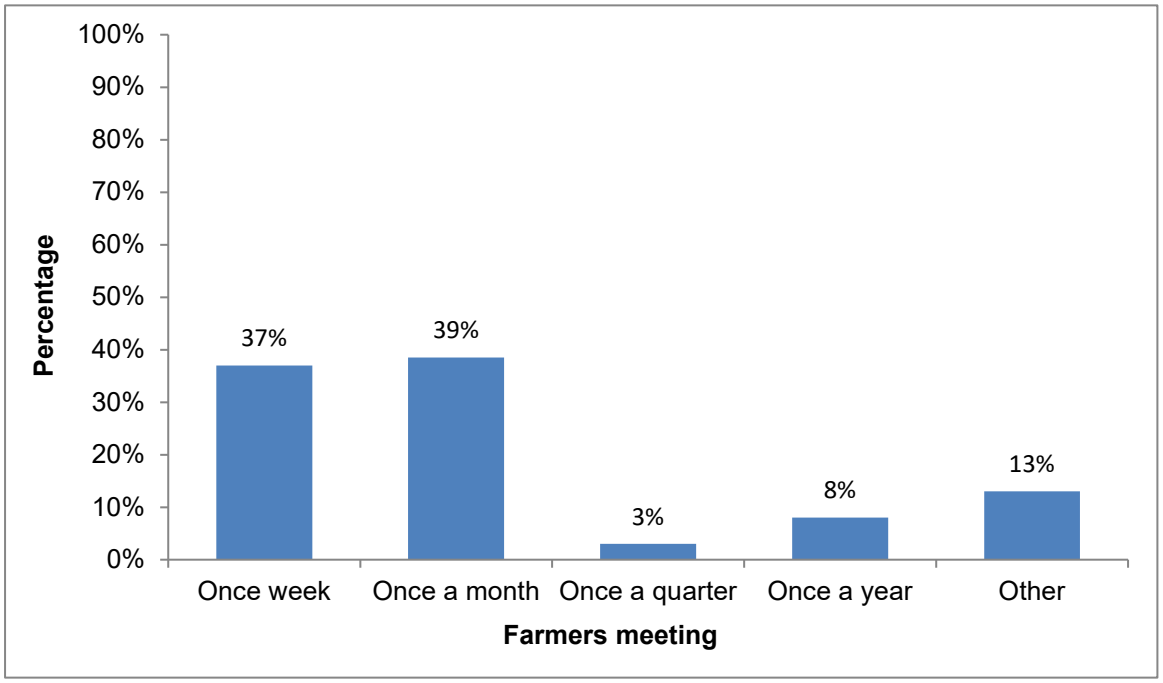

Figure 3.10 Frequency of farmer meetings as a group in Mopani and Vhembe districts (n=200)

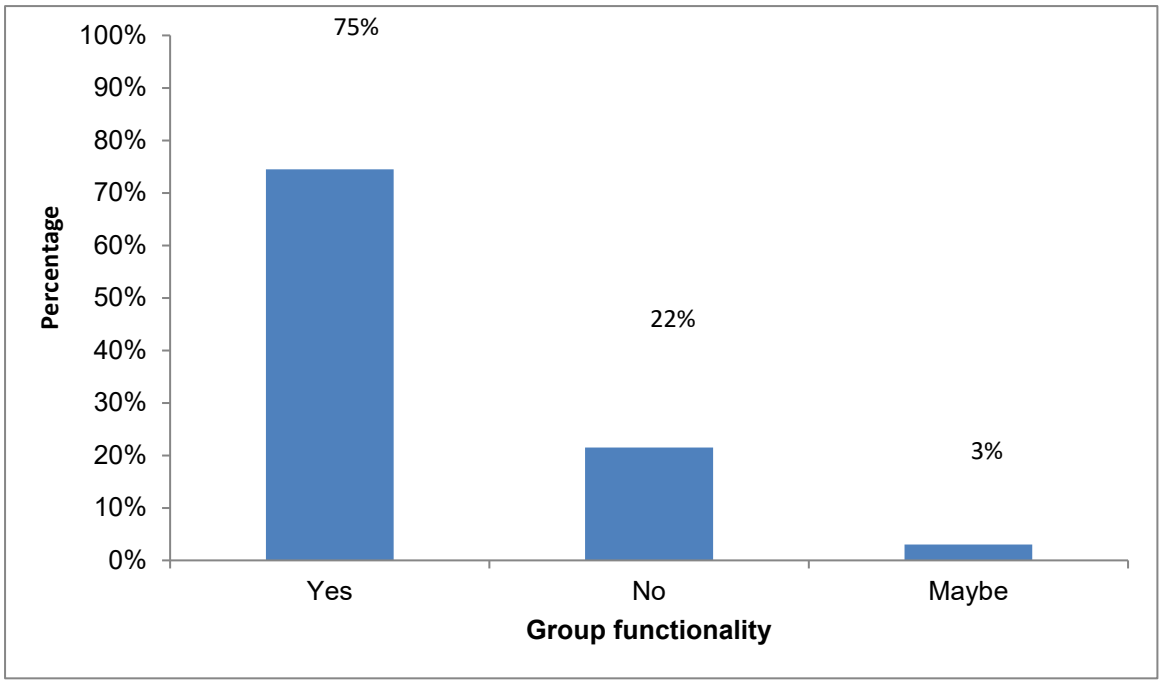

Figure 3.11 Smallholder agricultural group functionality in Mopani and Vhembe districts (n=200)

3.4.3 Physical capital

The respondents were also assessed on physical capital which included ownership of buildings, mode of transport and source of energy, among others. Figures 3.12, 3.13 and 3.14 present their responses. Only 17% of the respondents reported owning buildings such as storage and animal houses, compared to 83% who owned a house only (Figure 3.12).

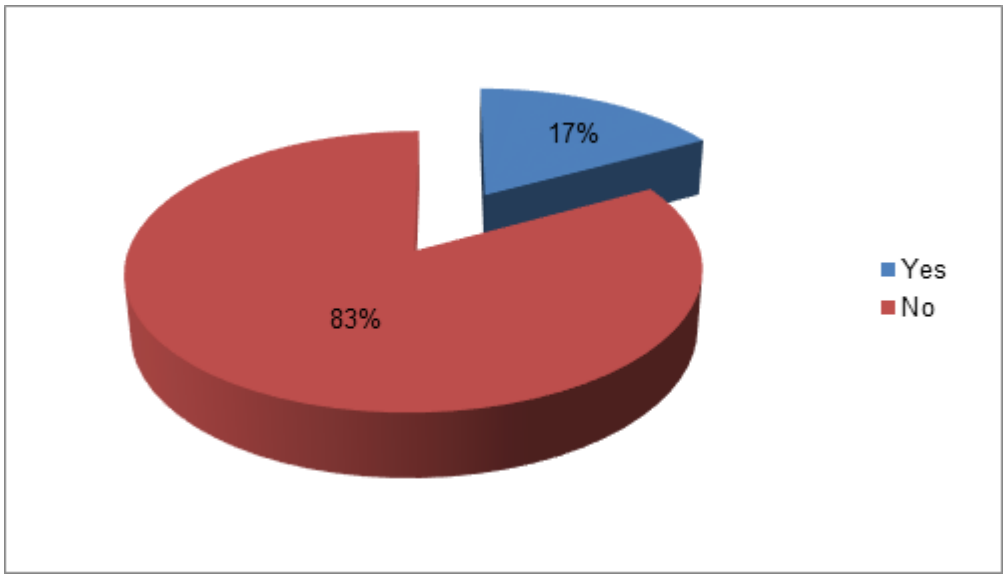

Figure 3.12 Farmers who owned properties (Mopani and Vhembe districts, (n=200)

Over 85 % of respondents have electricity in their homes (Figure 3.13), though about 14% of households still rely on firewood as a source of energy.

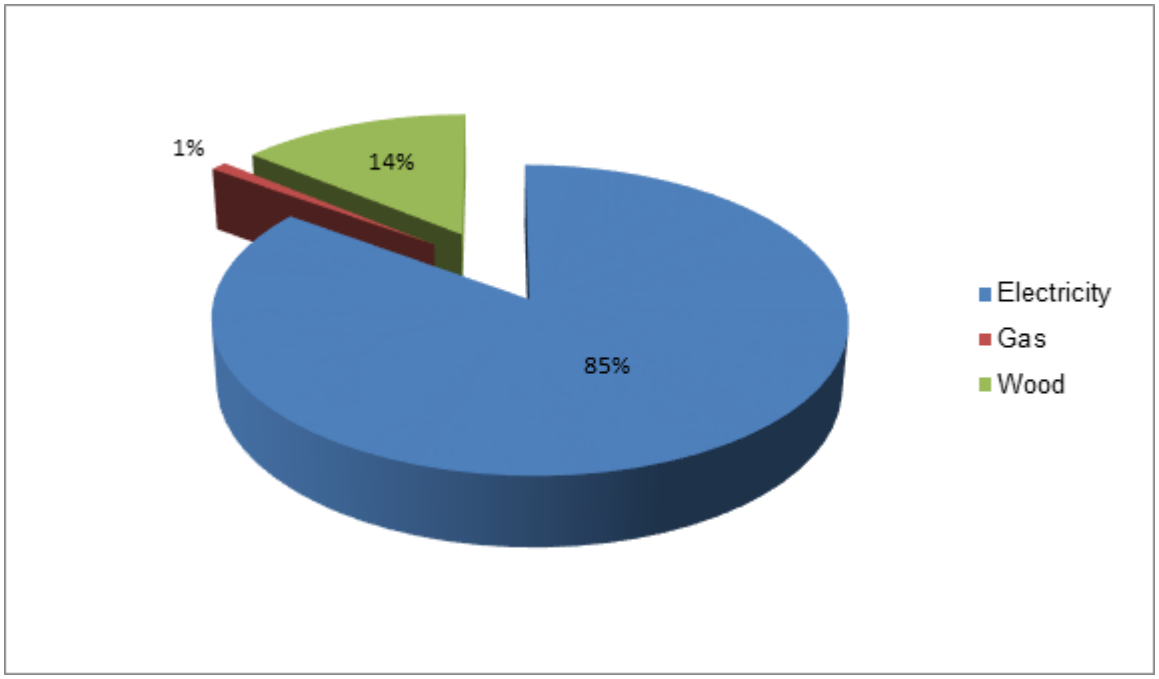

Figure 3.13 Source of the energy of the respondents (Mopani and Vhembe districts, n=200)

Above 60% of the respondents do not have their own transport and have to rely on public transport (Figure 3.14). About 25% of the respondents owned a car, pickup or motorbike.

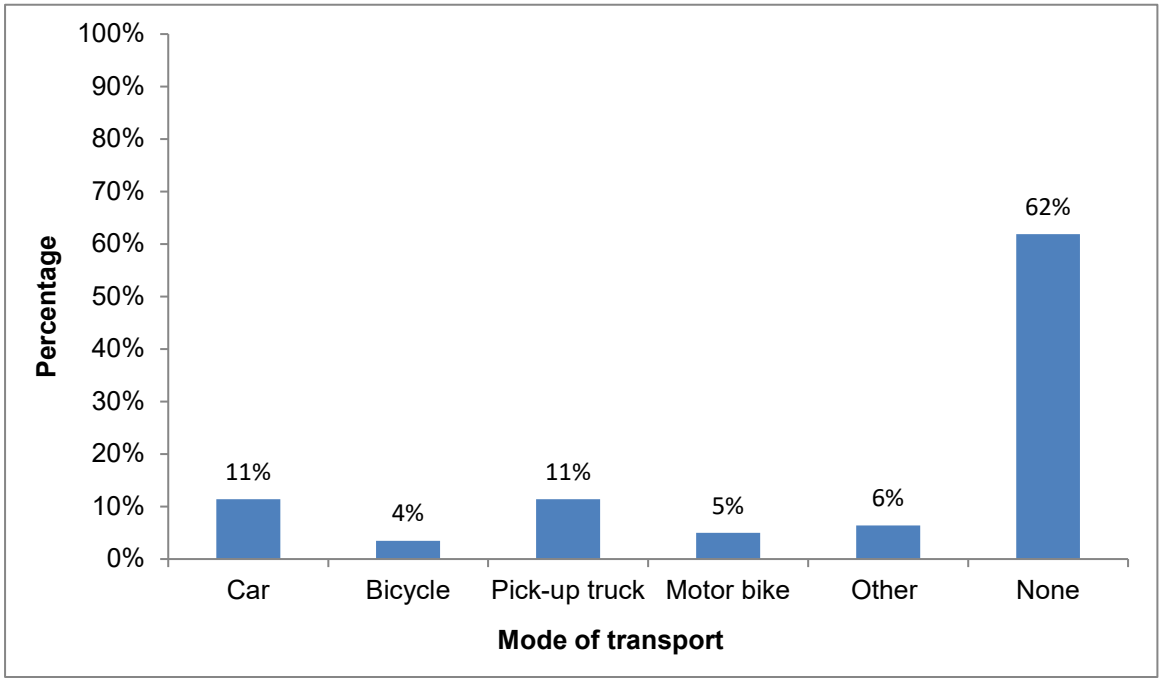

Figure 3.14 Mode of transport of the respondents (Mopani and Vhembe districts, n=200)

3.4.4 Natural capital

The respondents were also assessed on aspects of their natural capital, including farming area and water-related variables. Figure 3.15, below, presents the size of the respondents' farms.

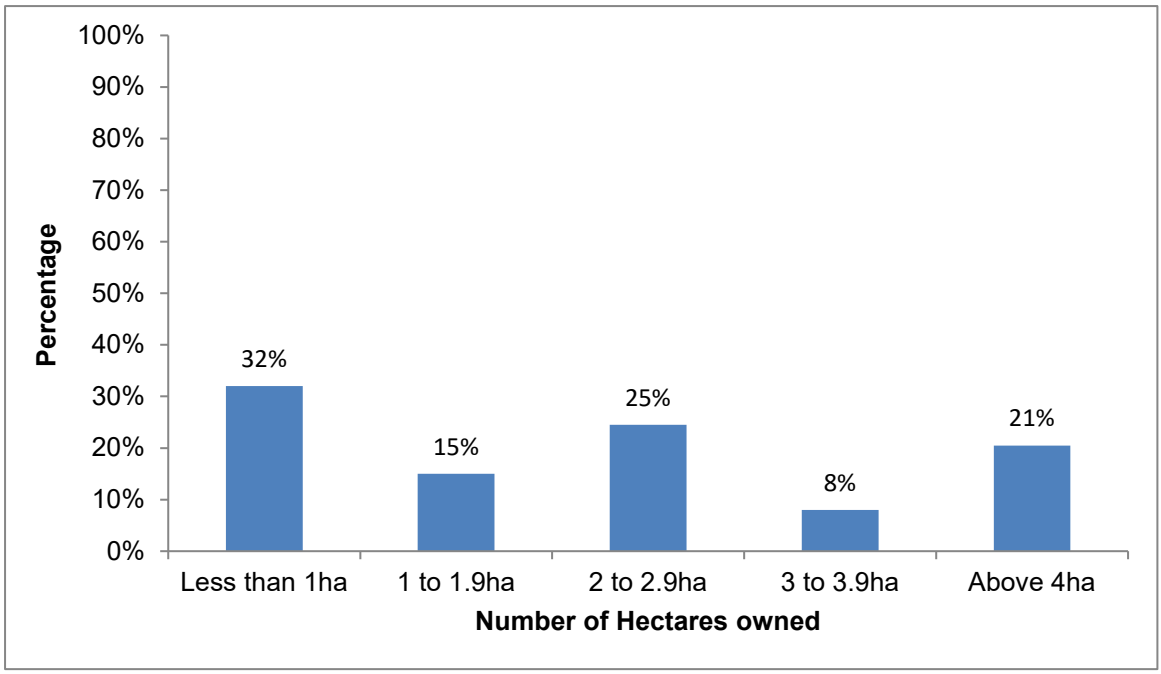

Figure 3.15 Size of land cultivated by smallholder farmers in Mopani and Vhembe districts (n=200)

Availability of land for farming is an important factor in the success of smallholder farming. The respondents were asked whether they farmed on the stand on which they resided, on another site outside their compounds, or both. Most farmers reported cultivating both on the site where they lived, and sites located elsewhere. Regarding the area cultivated, 32% of smallholders farmed on less than 1 ha, while 48% cultivated plots ranging between 1 ha and 4 ha. About 20% cultivate an area larger than 4ha. Smallholder farmers in the study may well be constrained by the size of their land, which is likely to have a bearing on its level of productivity.

This confirms the previous evidence that smallholder production mainly involves households producing on relatively small plots of land with limited resources, for household consumption and (to a lesser extent) extra income (Ngomane, 2012). The ability of individuals to work the area available for farming helps determine the extent to which smallholder subsistence agriculture can be practised by households.

The study also explored the question of where the water used for farming was sourced, and the results appear in Figure 3.16, below.

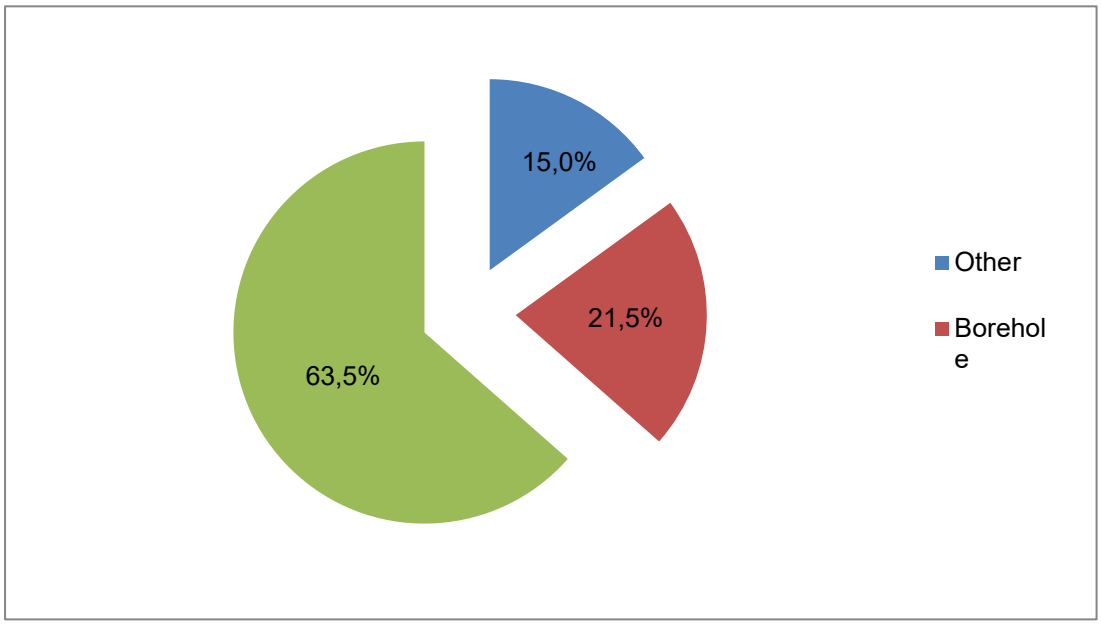

Figure 3.16 Water sources (Mopani and Vhembe districts, n=200)

Water plays a critical role in the success of smallholder farmers (Kubayi, 2016), and the respondents in this study all faced challenges with access to water, especially those in Greater Giyani. The research findings indicate that 63.5% of the farmers rely on rainfall for crop production and livestock, while 21.5% have boreholes on the premises where they reside. This could explain why their productivity is low and why their farming is mostly seasonal. They wait for the season suitable for their preferred type of crop.

3.4.5 Financial capital

The respondents were asked whether they were employed or not, and whether or not they had an extra source of income. Figure 3.17 shows that 71.5% of participants were unemployed. Most farmers relied on government grants to meet their daily food requirements. Their income was in most cases not sufficient to meet expenditure on food (Ngomane, 2012).

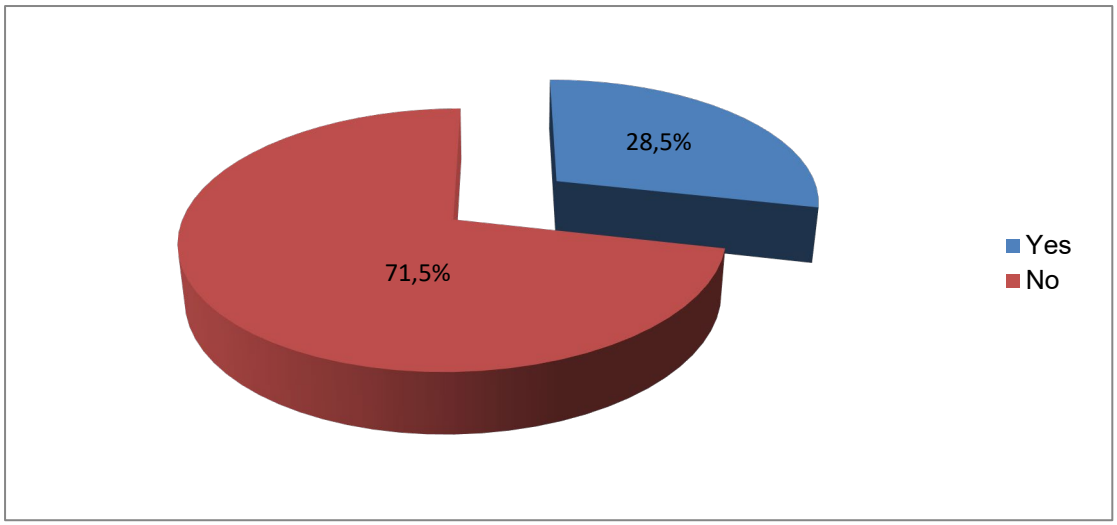

Figure 3.17 Employment in Mopani and Vhembe districts (n=200)

About 9.5% of farmers can access credit from commercial banks (Figure 3.18). Most commercial banks need security for loan approval and those who are casually employed or receiving social grants are left out. The respondents who were employed casually or in piece work were mainly involved in public work projects such as the Expanded Public Works Programme (EPWP) and other government projects in the area.

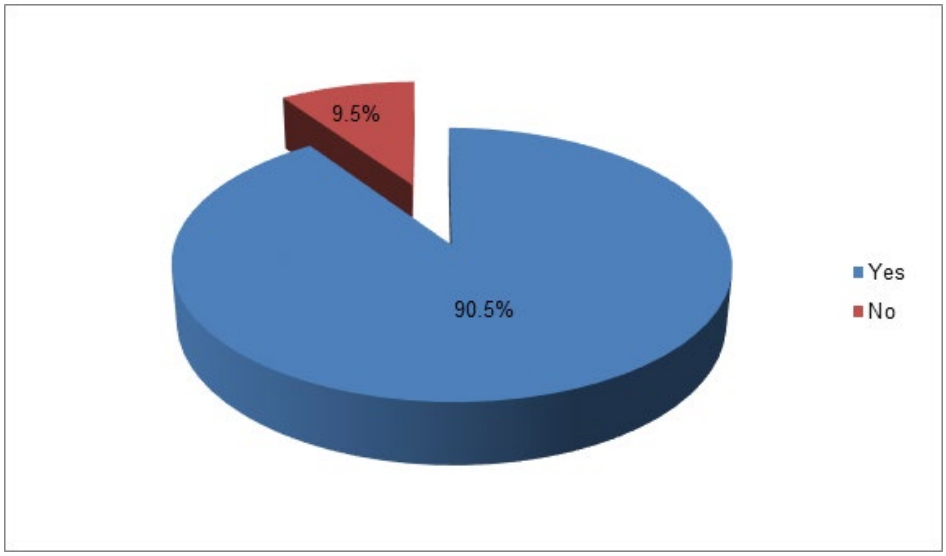

Figure 3.18 Access to credit in Mopani and Vhembe districts (n=200)

Only 27% of the respondents indicated that they were receiving a pension from their previous employment, while 48% relied on social grants from the government (Figure 3.19).

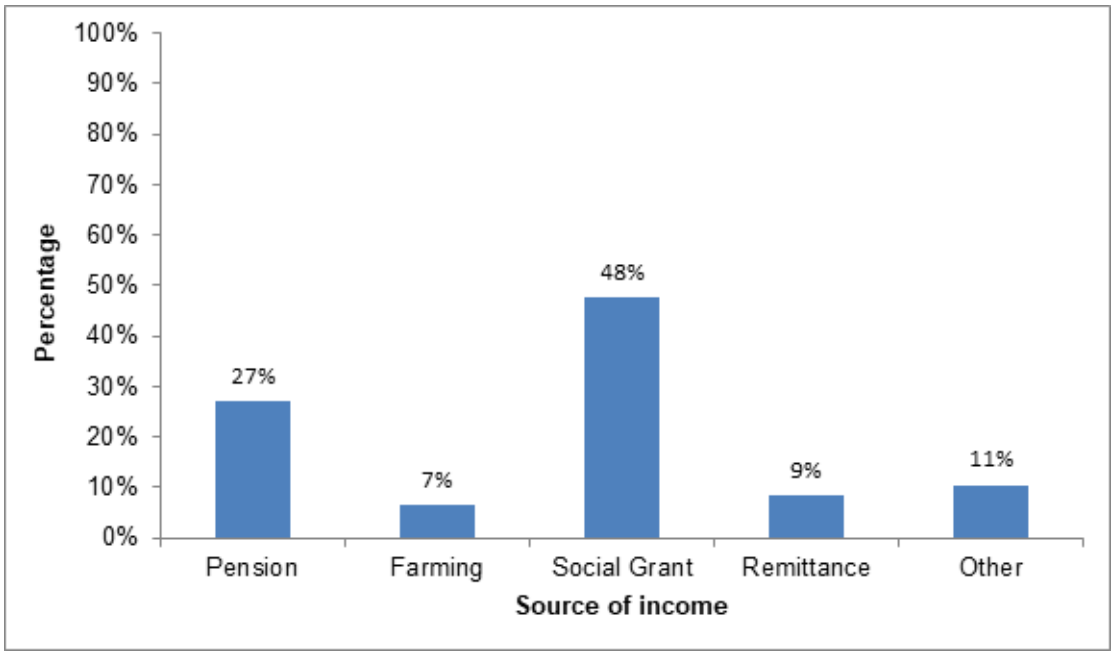

Figure 3.19 Sources of income of the respondents in Mopani and Vhembe districts (n=200)

Figure 3.20 indicates that 43.5% of respondents do not have bank accounts, while 31% do. This figure may correlate to some extent with the 48% who depend on social grants for their livelihood. Most farmers said that they did not accumulate enough money for it to be worth saving in a bank account.

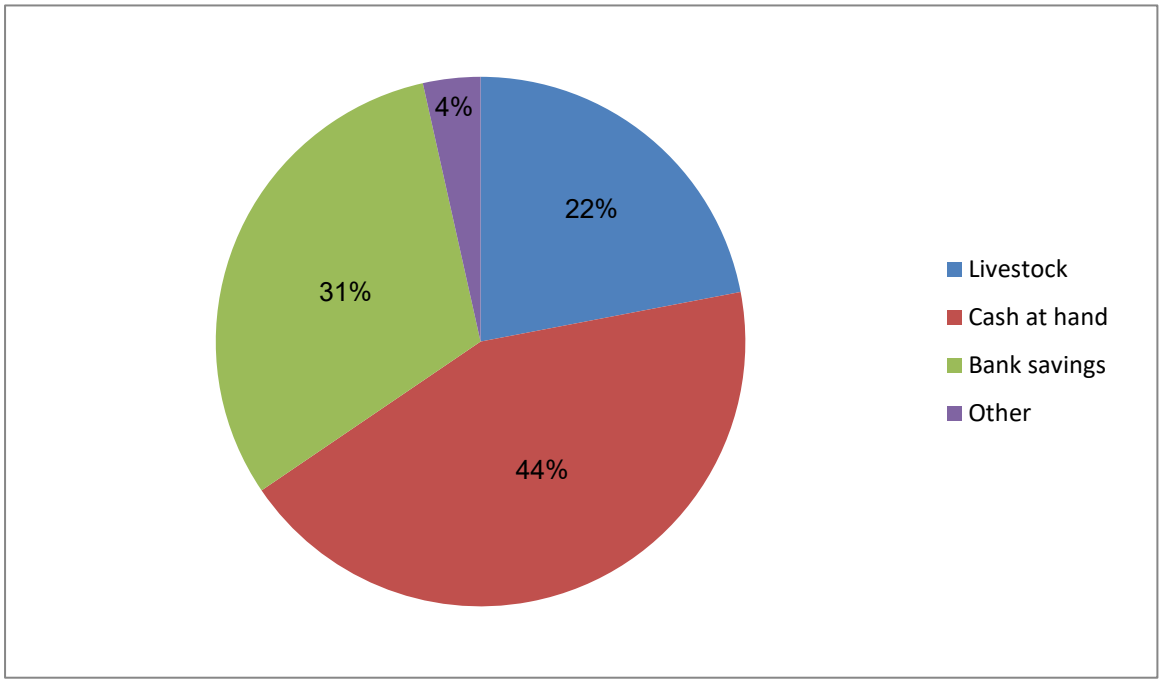

Figure 3.20 Saving money (Mopani and Vhembe districts, n=200)

3.5 Conclusions

Developing a smallholder farmer typology to identify livelihood strategies made sense of the diversity among smallholder farmers in Limpopo. A Sustainable Livelihoods approach enabled allowed the researchers to collect demographic and asset data about gender, level of education, land, water and financial sources, markets and social functions (such as group dynamics). Initial indications were that most smallholder farmers in the Vhembe and Mopani districts are elderly (56-75 years) and female (more than 60%). Since South Africa is keen to foster youth participation in agriculture, it must be established why this age group is not involved in farming. Farms in the surveyed districts were generally small, with only 20% of farmers reporting access to more than 4 ha of land. What are the implications of such small areas of cultivation for food production? There is a need to follow up on the issue of land to ascertain whether farmers experience a shortage of land or whether what they have access to is adequate for their needs. Even though 48% of smallholder farmers declared government grants as their main source of income, they still participated in farming activities. From a welfare perspective, one may infer that smallholder farmers who depended on social grants are probably the most vulnerable in terms of food security, ownership of assets and access to credit. The results also indicated that those with more education and those working for salaries were at a distinct advantage concerning living standards and asset attainment.

4 SMALLHOLDER FARMING IN THE OVERBERG AND WEST COAST DISTRICTS, WESTERN CAPE

Ncube, B., Fanadzo, M., Carelsen, C.P.R., and Pili, O.
Also part of a PhD thesis by Fanadzo, M and Masters theses by Carelsen, C.P.R., and Pili, O.

4.1 Introduction

Defining and characterising smallholder farmers in the Western Cape is a daunting task. There have been several attempts, including those of the Department of Agriculture, Forestry and Fisheries (DAFF) and the Western Cape Department of Agriculture (WC-DoA), making use of variables such as the size of the plots, source of labour, the purpose of production and scale of farming. Definitions of smallholder farmers were considered in Chapter One when it became clear that characterising smallholder farmers is a complex task. The failure to understand smallholder farmers has resulted in inefficient support systems for farmers vulnerable to shocks such as the current drought in the Western Cape. It is, therefore, necessary to reconsider which variables might serve to define and classify smallholder farmers in the province. Sustainable Livelihoods Analysis is one approach that can be used to determine these variables. SLA is a tool that can improve one's understanding of livelihoods, particularly those of the poor (DFID, 1999), and how different people live their lives in different places and environments. A livelihoods analysis was conducted to determine the assets possessed by smallholder farmers in the West Coast and Overberg districts in the Western Cape, and their general livelihood strategies. This section gives a preliminary description of smallholder farmers' livelihoods in the two districts. The findings will eventually be used to determine certain classes of smallholder farmers and with reference to these explore possible strategies that can be adopted by farmers to cope during drought periods.

The literature indicates that smallholder farmers in the Western Cape are, in the first instance, characterised by high levels of poverty. Land size, management, capital, labour, age, gender and education are among the other variables that have been used to characterise them. It is common cause that smallholder farmers' land, in the Western Cape and in South Africa as a whole, is too small to enable them to graduate to the next level of farming known as commercial farming (Kirsten 1998; Marais 2012; Pienaar 2013). Western Cape smallholder farmers also struggle to access credit from financial institutions because of their lack of collateral. They are also characterised by low levels of education (Tshuma 2014). The study, therefore, sought to establish if these characteristics hold for the selected areas and to identify the coping strategies that farmers in these areas have developed over the years.

4.2 Data Collection and Analysis

Site selection

The Overberg and West Coast districts in the Western Cape were selected as study sites for the livelihoods analysis. The selection was based on the extent to which the districts were experiencing drought, the type of farming (dry-land farming) and the logistics in terms of time and other resources. A meeting was held with the Chief Director for the WC-DoA on 31 October 2017 to introduce the project, seek buy-in from the department and confirm the sites. The department is one of the key participating stakeholders in the project. During the meeting, it was indicated by the Chief Director that the impact of the drought on the two selected districts was not the same. The Overberg district had not yet been declared a drought disaster area, while the West Coast had. It was agreed that the differences provided an opportunity to compare the two sites. The Department expressed great interest in the project and requested a regular update as the project progressed.

A follow-up meeting with the Overberg District Manager was also held on 9 November 2017 at WC-DoA Bredasdorp Office. A letter was requested to authorise the commencement of data collection and the participation of farmers, and this was provided. The West Coast District is divided into two sub-districts, namely, the West Coast North and South. Constraints of time have allowed only one town in one municipality in the West Coast South to be studied thus far.

Overberg District

The Overberg District is situated at the southernmost tip of Africa and is the second least-populated, non-metro district municipality in the Western Cape (Overberg District Municipality, 2016). According to the Western Cape Department of Social Development, Overberg's population was estimated to be 280 716 in 2017 (Overberg District Municipality, 2016). The district makes up only 9% of the geographical area of the Western Cape (www.localgovernment.co.za). It is made up of four municipalities, namely Theewaterskloof, Swellendam, Overstrand and Cape Agulhas (www.localgovernment.co.za). Theewaterskloof Local Municipality has its headquarters in Caledon, Overstrand Local Municipality in Hermanus, Cape Agulhas Municipality in Bredasdorp, and Swellendam Local Municipality in Swellendam.

The inland side of the Overberg hosts a beautiful landscape of small grain fields, with yellow canola and wheat plantations attracting tourists during the winter rainfall season (Overberg District Municipality, 2016). Theewaterskloof Municipality can be categorised as a rural area with open spaces and farming activities (Theewaterskloof Municipality, 2012). The Theewaterskloof dam situated at Villiersdorp provides water to the local farmers, drinking water to surrounding towns and is also a main supplier of water to the City of Cape Town (Overberg District Municipality, 2016). Agricultural activities in Theewaterskloof include wheat production, stock farming and fruit production (Overberg District Municipality, 2012). Villiersdorp, Grabouw, Botrivier and Caledon are towns in the Theewaterskloof area that have

no access to land for smallholder farming. Grabouw and Villiersdorp are surrounded by many fruit farms and employ surrounding communities (Overberg District Municipality, 2016).

Swellendam Municipality is a small grain production area that produces grain products for SOIL, an oil company in Swellendam, and its agricultural activities include wheat production, stock farming and fishing on a small scale (Overberg District Municipality, 2016). The Bredasdorp area hosts the Cape Agulhas Municipality, and local communities are involved in fishing and other coastal activities including tourism to create livelihoods (Overberg District Municipality, 2016). Agriculture in Cape Agulhas includes fruit, wheat, barley, youngberry, livestock, dairy farming, grapes for export and winemaking. Other sectors are retail and manufacturing, mining and quarrying. Swellendam is also known as a tourist destination.

Figure 4.1 shows the distribution of towns in the four municipalities of the Overberg District.

Figure 4.1 Map showing the four Overberg District Municipalities and towns (adapted from Local Government, Western Cape, 2016)

West Coast District – North and South

The West Coast is located north of the City of Cape Town. It comprises five municipalities, namely Swartland, Bergrivier, Matzikamma, Cederberg and Saldanha Bay (West Coast District Municipality, 2015). The district is known primarily for producing wheat, canola, rooibos tea, fruit, grapes and wine, and export-ready vegetables (West Coast District Municipality, 2015). Animal products contribute 45.3% of the agricultural income and include poultry, fresh milk and dairy products, beef, mutton, lamb and pork (West Coast District Municipality, 2015).

Figure 4.2 Map showing the five West-Coast District Municipalities and towns (adapted from Local Government, Western Cape, 2016)

A semi-structured questionnaire was designed to collect data on the Overberg and West Coast smallholder farmer assets and general livelihoods using the DFIF Sustainable Livelihoods Framework. The questionnaire contained questions about the five main types of livelihood asset, the physical, human, financial, social and natural. A consent letter attached to the questionnaire was signed by all the farmers who participated in the data collection. Each questionnaire had an identification section for recording the names of the respondent and farm, district and town, date, and commencement and termination time of the interview.

Sample selection

The field data collection targeted smallholder farmers who are practising dry-land farming in the Overberg and West Coast Districts. Table 4.1 shows the current number of smallholder farmers in the Western Cape in comparison to commercial farmers.

Table 4.1 Statistics of Western Cape farmers (Source: Western Cape Government, 2017)

District	Commercial	Smallholder
Cape Winelands	1431	121
Central Karoo	221	35
City of Cape Town	186	26
Eden	1206	122
Overberg	870	97
West Coast	1700	148
Total	**5615**	**549**

Data collection in the Overberg took place during the week of 4-9 December 2017, while in the West Coast it was the week of 7-13 January 2018. A total of 36 and 42 farmers were interviewed in the Overberg and West Coast districts, respectively. Data collection is a continuous process and it is anticipated that more farmers will be interviewed as the research proceeds. There are also key farmer-participants who were identified but were not available for the interviews during this period of data collection, but who may yet be useful in social network mapping and evaluation.

One-to-one interviews were conducted with farmers in their homes or fields. The WC-DoA assisted with arranging the interviews and were very helpful and supportive during the entire process. Some of the extension officers dedicated their whole day to the team, helping with locating and making appointments with the farmers.

After the interviews, data was captured on spreadsheets and later summarised into graphs using Excel. Smallholder farmer assets were analysed according to the five categories. The main goal was to determine the assets possessed by the smallholder farmers and how they translated these into strategies to secure their livelihoods. The completed questionnaires were numbered and these numbers were used in capturing and analysing the data so as not to include the names of the respondents.

4.3 Characteristics of the smallholder farmers in Overberg and West Coast Districts

This section summarises the results of the Overberg and West Coast interviews.

4.3.1 Type of Farming

When the respondents were asked for some brief background, including how they had become farmers, most of them said they had been born and bred in the district. All the respondents in the Overberg and West Coast indicated that they considered themselves farmers. In the Overberg, one respondent indicated that he practised farming as a hobby, while some others considered themselves part-time farmers. Figure 4.3 portrays the farmers' responses to the question about farming as an occupation.

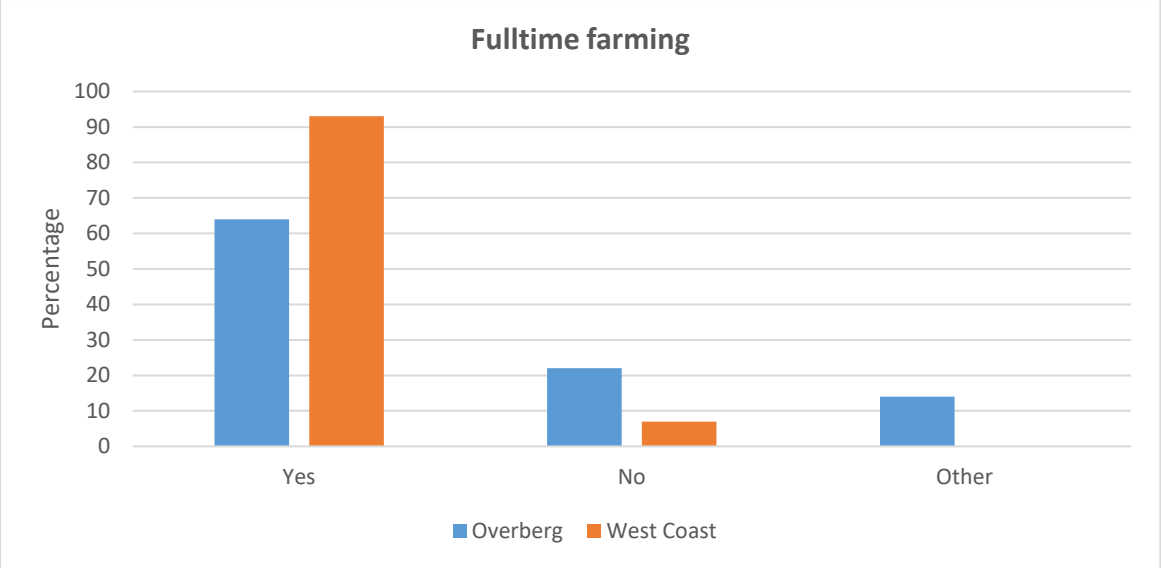

Figure 4.3: Smallholder Farming in the Overberg and West Coast

Among West Coast respondents, 93% declared themselves fulltime smallholder farmers, while in the Overberg this figure was 64%. Seven per cent of Overberg respondents were not sure whether they should be described as smallholder farmers or not.

Some of those who indicated that they were not smallholder farmers disagreed with the categorisation. Others said that while they were categorised as such, they felt that they had developed into commercial farmers, or were somewhere in between, no longer smallholders by limited by various factors from further development. Respondents who viewed themselves as semi-commercial cited limited resources as one of the major obstacles to fully becoming commercial. All the respondents in the Overberg and West Coast indicated that they regarded their farms as businesses. Most of the farmers had started farming as children, the oldest farmer having been involved in farming in the Overberg since 1973.

Smallholder farmers in both districts practised mixed farming (Figure 4.4). In the Overberg, cattle production is dominant (31%), followed by sheep production (25%), while vegetable production is the dominant practice in the West Coast district, followed by sheep.

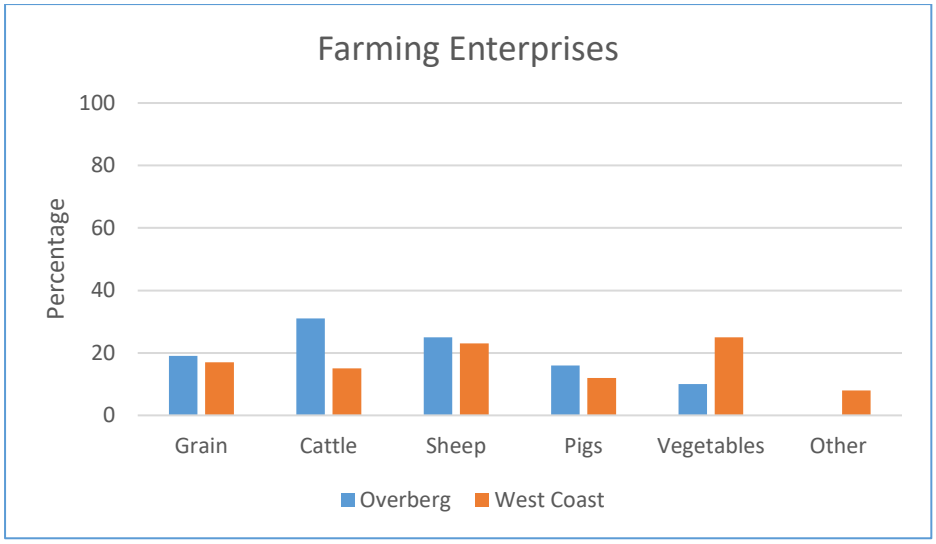

Figure 4.4: Varieties of farming enterprise in the Overberg and West Coast districts

4.3.2 Human assets

Age distribution, family and labour

The West Coast had a slightly higher percentage (55%) of respondents in the elderly age group compared to the Overberg with 52%, while the Overberg had the highest percentage (36%) of respondents in the middle age category (Figure 4.5). In both districts, 12% of the respondents fell into the youth age category.

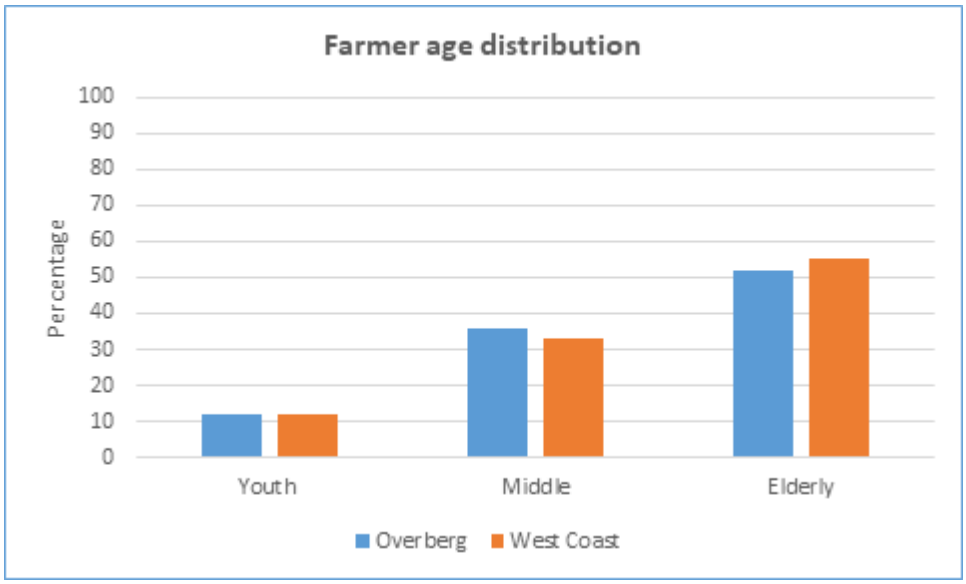

Figure 4.5: Farmer age distribution in Overberg and West Coast

The percentage of female respondents (8%) was lower in the Overberg than in the West Coast (24%), their male counterparts amounting to 92% and 76%, respectively.

In both districts, the number of family members involved in farming varied from household to household. In the West Coast, family members were involved in various activities in the

farming business, including administration and production. In both areas, more than 70% of the farmers hired casual labour.

The number of casual labourers that were hired varied in both districts from respondent to respondent, depending on the amount and type of work that needed to be done. Some farmers hired a fixed number of workers, while others had varying numbers per hire. Nevertheless, in both districts, the category of 2-4 labourers was in the majority, while the category of 5-6 labourers scored the lowest percentage. In the West Coast, 24% of the respondents indicated that they hired permanent workers, while in the Overberg, this figure was 44%.

Level of education of household head

Figure 4.6 shows the education levels attained by smallholder farmers in the Overberg and West Coast.

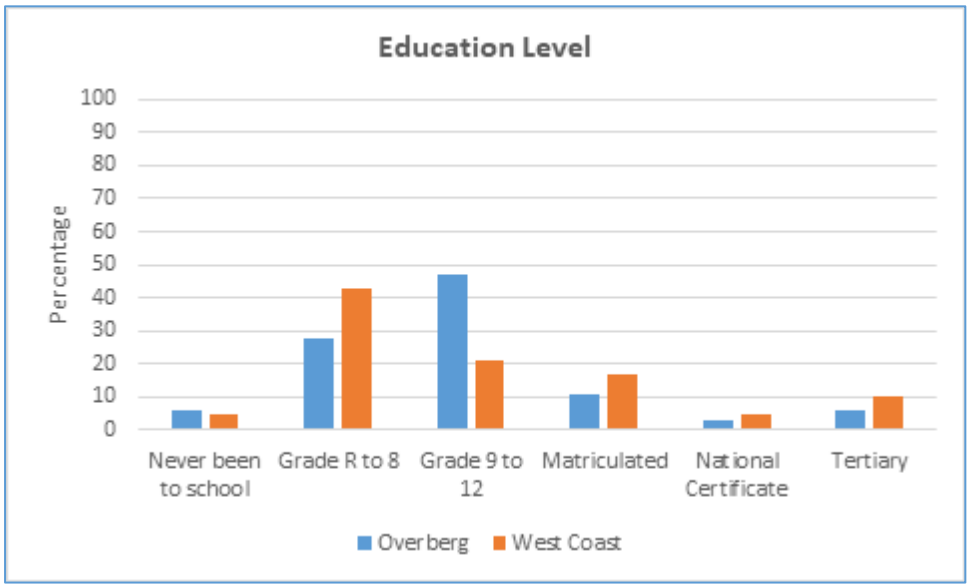

Figure 4.6 Smallholder farmer education levels of interviewed farmers in the Overberg and West Coast districts.

In the Overberg district, 47% of the household heads that responded to this question were in the Grade 9 to 12 category, though only 3% of the respondents had National Certificates. In the West Coast, the majority of the respondents (43%) were in the Grade R to Grade 8 category of highest education level reached, while 5% of the respondents had National Certificates.

Farm-related training and type

Respondents in the Overberg and West Coast received various farm-related training from a variety of organisations. In the Overberg, 42% of respondents had received farm-related training, while in the West Coast district this figure was 68%. The WC-DoA had been training farmers in many areas of farming including general farm management, for example, record-keeping, tractor driving and maintenance, firefighting and production in the area of their specialisation. About 20% of the farmers in both districts attended farming-related events

including information sessions, demonstration days, training courses and workshops. In the Overberg, 2% of the respondents had not attended any such event for various reasons, including a lack of time and interest.

Respondents in both districts indicated that they needed skills development and training in various areas of farming enterprise, including administration, finance and book-keeping, tractor maintenance and repair, and farm management in general. About 55% of the respondents in the West Coast district reported having received training in other non-farm related skills, such as mechanics, mining, bookkeeping, police and education.

4.3.3 Economic Assets

Employment

Most respondents described themselves as self-employed: 83% in the Overberg and 74% in the West Coast. Figure 4.7 displays the distribution of employment in the two districts.

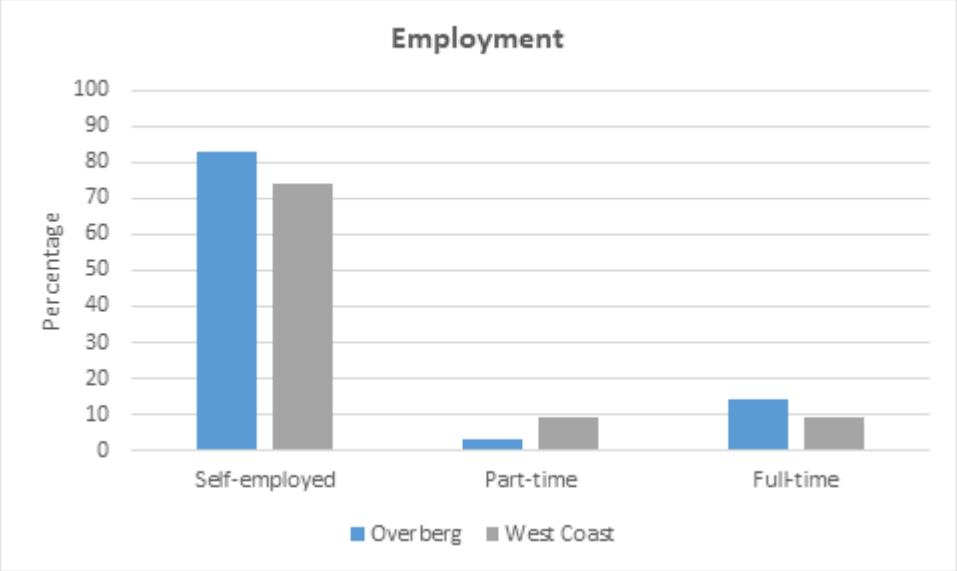

Figure 4.7: Smallholder farmer employment in the Overberg and West Coast districts

Sources of income

Farming was the dominant source of income in the Overberg and West Coast (49% and 43%, respectively), followed by remittances in the West Coast (21%) and pension (16%) in the Overberg. Other sources of income were declared by 1% of respondents in the West Coast and 4% in the Overberg. Remittances came mainly from children.

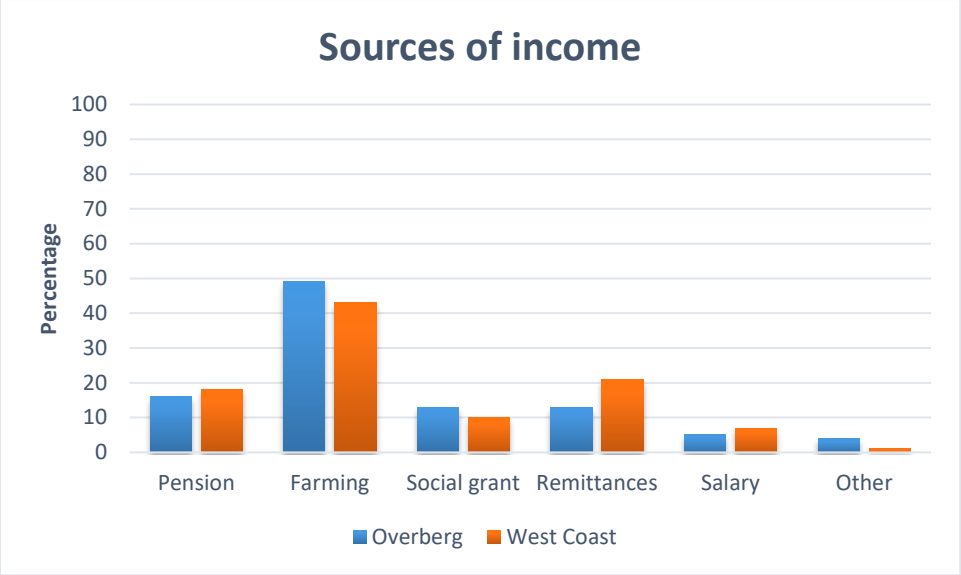

Figure 4.8 Income sources among smallholder farmers in Overberg and West Coast districts

Remittance sources

In both districts, respondents indicated that they received remittances from their sons or daughters or both. In the Overberg, 56% and 44% of the respondents received remittances from their sons and daughters, respectively, while in the West Coast 43% and 57% received remittances from their sons and daughters, respectively.

Ways of saving money

Most of the farmers in the Overberg and West Coast saved their money in livestock (39% and 42%) and commercial banks (43% and 40%, respectively)

Markets

In the Overberg, the majority of the respondents indicated that they had access to markets through BKB for wool, SA Breweries for grain, local abattoirs for livestock, and the Overberg Agri and SOIL factory. Community members and neighbours were also their markets. Respondents in the West Coast cited the local community, abattoirs, Syngenta, Tiger Brands and other markets for their produce.

The distances from respondents' farms to their markets varied from 1km to 300km in the Overberg, and from 0km to 400km in the West Coast. Transport used depending on where the markets were and the arrangements between producer and consumer. In the Overberg, most respondents reported that they had off-take agreements with their markets and that transport was provided at R12/km. Some respondents used their private transport. Transport costs in the West Coast for those with the local market or who had buyers who collected the produce was nil. However, some paid transport costs of up to R3600. Respondents mentioned word of mouth, off-take agreements, auctions, email, social media and the telephone as among ways in which they marketed their produce. Challenges faced during transportation of the produce to

the markets included poor roads, mode of transport, cost and distance, especially in the West Coast region.

4.3.4 Natural assets

Land ownership

Land available to the respondents ranged from 0.5 ha to 2075.5 ha in the Overberg and 50 m^2 to 6088 ha in the West Coast. Most of the farmers who had large pieces of land indicated they were not using all the land or were still clearing parts of it. Land ownership varied among households. Figure 4.9 presents the types of land ownership found in the two districts.

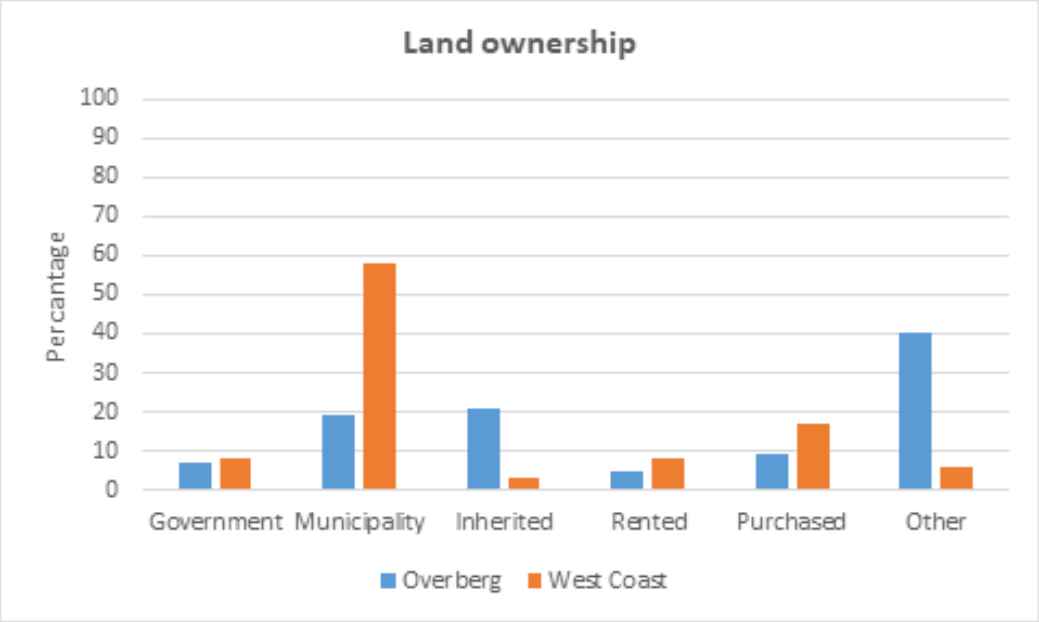

Figure 4.9 Land ownership/access among smallholder farmers in the Overberg and West Coast districts

About 58% of the respondents owned land through municipality leases in the Overberg, while in the West Coast this figure was 19%. Those who had inherited land in the Overberg amounted 3%, a lot less than in the West Coast (21%). As many as 78% of respondents in the Overberg district indicated that their land was not large enough for profitable use, compared to 64% in the West Coast.

About 81% of Overberg respondents had sought more land while 43% had done so in the West Coast.

Water sources

In the West Coast and Overberg, 31% and 45% of the respondents, respectively, indicated that a dam was the main source of water for agricultural and domestic use. Figure 4.10 shows the different types of water source accessed by smallholder farmers in the two districts.

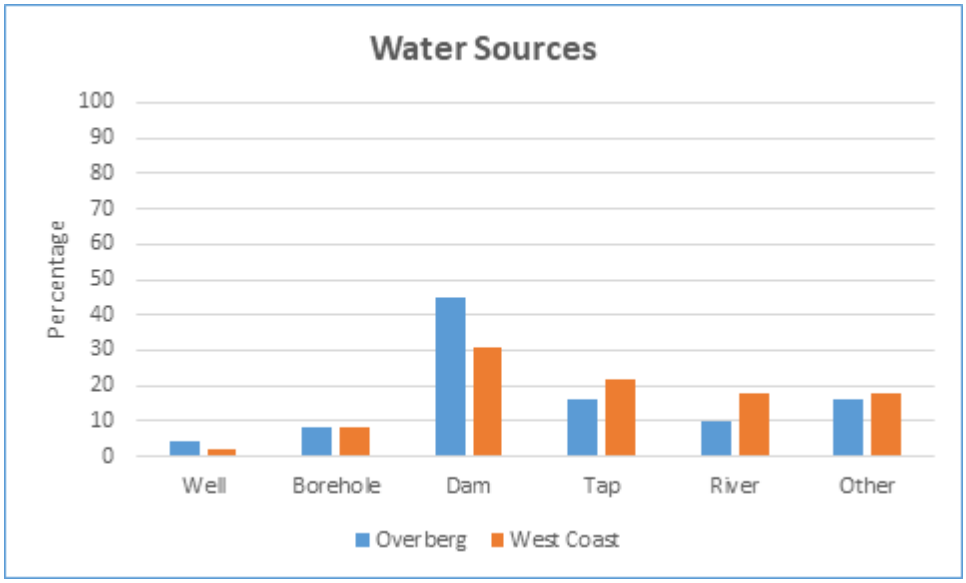

Figure 4.10: Water sources of the interviewed farmers in the Overberg and West Coast

Water authorisation

About 40% of respondents in the West Coast district had water rights while in the Overberg the 34% of smallholder farmers accessed water by municipal authorisation. The water pump or pipeline was the main infrastructure used to transport water from the source to the respondents' farms in the Overberg, while a canal system and/or pipeline constituted the main infrastructure for water transportation in the West Coast.

4.3.5 Physical assets

Shelter

In both the Overberg and West Coast districts, 14% of the respondents did not own houses, while others owned buildings in addition to their houses (76% in the West Coast and 53% in Overberg, respectively). The buildings owned included animal housing, storage facilities, guest houses and labourers' houses.

Energy Sources

Electricity was the main source of energy (53% and 40% for respondents in the West Coast and Overberg, respectively), followed by gas in the West Coast (22%) and wood in the Overberg (29%). A few respondents (7% in the Overberg and 6% in the West Coast) used solar energy.

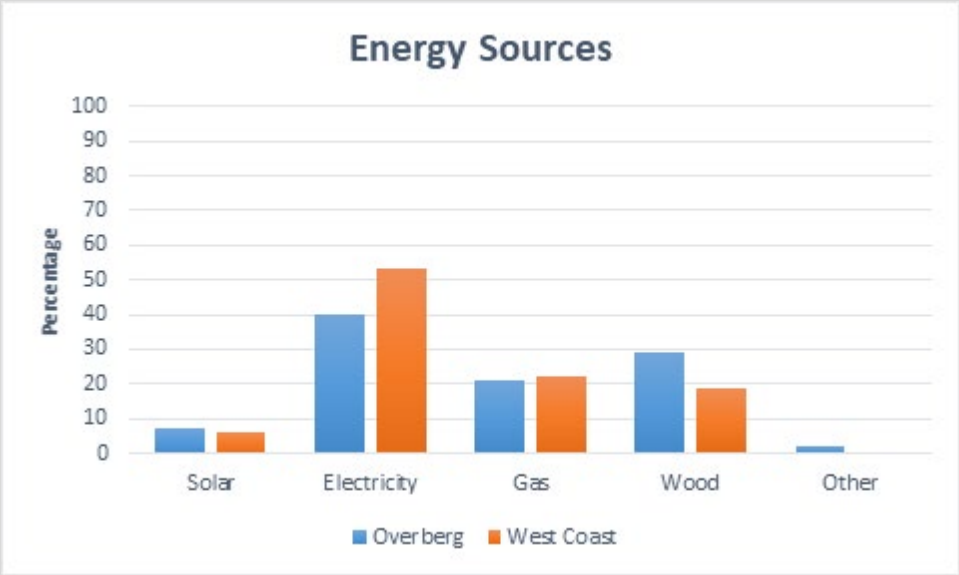

Figure 4.11 Energy sources used by smallholder farmers in Overberg and the West Coast

Communication

The most common mode of communication in the Overberg and West Coast was the cell phone (38% and 39%, respectively), followed by postal services (27% and 35%, respectively). The least common communication modes were the fax and two-way phone. The majority of the respondents indicated that the communication modes available to them were relevant to their needs.

4.3.6 Social assets

There was a 5% difference between farmer group membership in the two areas studied (Figure 4.12, below).

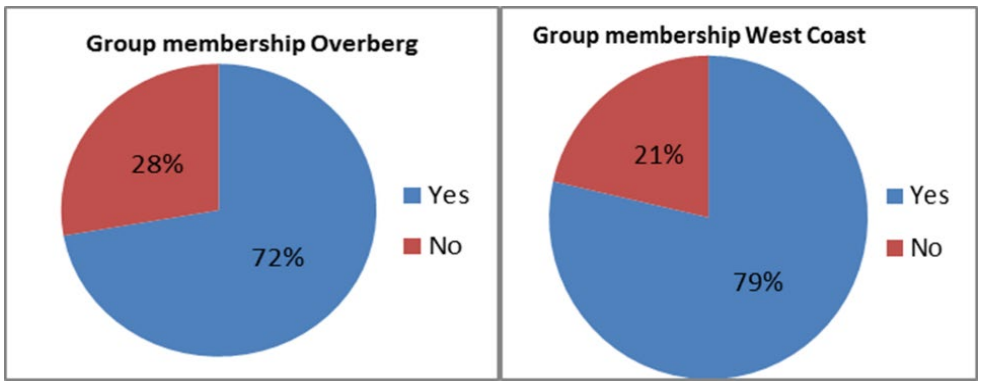

Figure 4.12 Group membership among smallholder farmers in the Overberg and West Coast districts

Although group membership was higher in the West Coast (79%), the requirement that members pay fees was there was lower (53%) than in the Overberg (73%). Most groups held meetings once a month in Overberg (56%) and the West Coast (31%).

Respondents in both districts indicated that they discussed various farm-related issues in their meetings, including farming methods, water, conflict resolution, challenges, future plans and climate change. Only 3% and 4% of the respondents in the Overberg and West Coast, respectively, did not attend group meetings. More than 80% of respondents felt that the meetings were useful and functioned well, though 15% disagreed.

4.4 Emerging Trends in Smallholder Farmer Livelihoods in the Overberg and West Coast Districts

DAFF (2012) attempted to define smallholder farming by focusing on the characteristics of smallholder producers, characterising smallholder farming as when the bulk of the labour comes from the family within the household, including female-headed households. Various stakeholders or partners in development still find it difficult to streamline their support services to the desired target groups because there is no clear demarcation (Pienaar, 2013; Tshoni, 2015). Preliminary results of the smallholder farmer livelihood strategies analysis in this study confirmed their heterogeneity. Their possession of human, natural, physical, social, and financial assets differed, with the result that they adopted different strategies for sustaining a livelihood.

Analysis of farmers in the two districts showed that respondents were mostly middle-aged to elderly, generally educated and predominantly male. It was encouraging to discover that there were, however, several women in the West Coast working together on projects. In the Overberg, the women involved in farming were excelling, with two of them winning awards. The first received a Ministerial Special Award for the Youth 2014 DAFF and Smallholder Runner-up for 2014 DAFF, among others. The second female farmer received a different award at the national level. In terms of race, the majority of smallholder farmers in the West Coast and Overberg are coloureds. It is not clear whether or not race is an important variable in categorising smallholder farmers, although certain contrastive generalisations might be made between smallholder farmers in the Western Cape and those in Limpopo, who are predominantly black (Tshuma, 2014; Nwafor, 2015).

Smallholders are small-scale farmers who use farm produce for home consumption to some degree and use family labour within the farming operation to some degree, but for whom farming contributes a highly variable amount of cash income via the marketing of farm produce (Cousins, 2010). This definition was confirmed in the Overberg and West Coast to a reasonable extent. The findings show that in the two districts, families worked together in their farming businesses, with children joining their parents in farming activities during the weekends and on holidays. Some of the children have joined their parents on the farm full-time, preparing to take over the business when the parents pass away or can no longer work. Family members were involved in production activities, administration and management of the farming business and other farm-related responsibilities. In some households, children were studying agriculture formally to be able to assist in managing the business. A farmer in the Overberg was working

together with his wife, with the wife being hands-on while the husband ran another business elsewhere. They worked as a team. In the West Coast, another farmer had just started taking responsibility for financial management and administration and was working together with his father and his wife, the father being involved in farm-related activities that he was able to manage at his advanced age. In addition to family labour, smallholder farmers in the Overberg and West Coast also hired casual and permanent labour, according to the work available and their capacity. They endeavoured to create jobs for others despite their limited resources. Some simply could not hire casual or permanent labour.

Smallholder farmers in the two districts are reasonably educated and are receiving further training from the WC-DoA in farming skills, including record-keeping, tractor driving and maintenance, firefighting and production in the area of their specialisation. Some have received training from Kaap Agri Academy, Overberg Agri, Grain SA, Elsenburg, and Stellenbosch University. However, the majority indicated that they needed skills development in various areas of farming enterprise, such as the introduction of tunnel farming. In the West Coast, farmers had much non-farming experience and expertise, including in mechanics, construction, mining and bookkeeping.

The findings revealed that farming is the major source of income for smallholder farmers in the West Coast and Overberg. However, some farmers were also employed on a full-time or part-time basis. This scenario is consistent with the understanding of the South African Department of Agriculture (2013), which notes that farming is not always the sole or even main source of income for smallholder farmers, but that diverse non-farm sources of income exist to sustain the family. Most of the respondents in the Overberg and West Coast farm on a cash basis and save money in commercial banks or by buying livestock.

There were extensive differences in the size of land farmed by the respondents in both the West Coast and Overberg, although the majority owned small or very small plots. It became apparent that most of the smallholder farmers in the West Coast and Overberg are restricted in terms of land, and that this is a major obstacle to their progressing to commercial farming (among others). This is also the reason why they are categorised as smallholders, although most of them were not comfortable with the term because they were already producing on what they regarded as a medium scale. The matter remains complex, however, since other respondents maintained that they did not desire to become commercial. Some of the latter were too old and comfortable where they were, while others wanted to produce more intensively on the little piece of land that they had. This implies that support programmes should be tailor-made according to the needs of the farmers, including those addressing the extent of land. Some farmers had been proactive, securing additional land from commercial farmers, private owners, churches and municipalities.

The National Department of Agriculture regards smallholders as having the potential to expand their farming operations and to become commercial farmers but needing access to

comprehensive support (South African Department of Agriculture, 2013). It is also argued that working such tiny plots, farmers cannot be blamed for not committing resources and time to farming (Machethe et al., 2004). Rather, the common tendency is for the farmer to embark on a variety of livelihood strategies to make ends meet, with the small plots being kept as a form of 'security' (Machethe et al., 2004). Those that are fully utilised are mostly owned by pensioners who are too old for other livelihood activities (Machete et al., 2004).

The main source of water for West Coast smallholder farmers was the dam at Clanwilliam. They accessed their water through water rights, while in the Overberg access to dam water was by municipal authorisation. Water was transported from the Clanwilliam dam by canal and/or pipelines (drip or flood irrigation). Certain contentious issues were identified during data collection around rights to water, the distribution and management of water and other water-related political issues. Some farmers manipulated the water infrastructure and diverted water into their farms, resulting in other farmers in the same area not having water. Figure 4.13 (below) shows a dry canal just alongside a farmer's house, while on the other side of the town, the canal was filled with water flowing into other farms.

Figure 4.13: Empty canal in Ebenhaeser, West Coast

It appears that there may be a situation of miscommunication or misunderstanding between smallholder farmers in the West Coast and the organisations involved in water distribution and management. The services seem not to be reaching all those deserving of them, which is resulting in frustration and even desperation among farmers in the district. The situation could

be the same in the Overberg, although it seems that respondents in this district have devised ways of transporting water from the source to their farms, including water tanks and buckets ferried on the bakkies. Figure 4.14 shows a farmer offloading buckets of water from a bakkie, transported from a relative's soil dam some 30km away.

Figure 4.14: A farmer transporting water for his cattle from a relative's farm in the Overberg

Most of the smallholder farmers in the Overberg and West Coast had standing agreements with private organisations for which they produced. In the Overberg, these included the BKB for wool, SAB for grain, local abattoirs for livestock, Overberg Agri and the SOIL factory in the

Overberg. The same scenario existed in the West Coast, where respondents identified the abattoirs, Syngenta, Tiger Brands and others as their markets. Some of the market arrangements were challenging for the respondents: certain buyers did not pay promptly, and if farmers did not supply on time or according to the terms of the agreement they accrued penalty interest, while some even had their contracts terminated. It was revealed that sometimes farmers ended up sourcing produce from other farmers to preserve their market contracts. This implies that market accessibility for smallholder farmers in the Overberg and West Coast remains to some extent a challenge. Smallholder farmers lack a voice and the power to influence decisions in their favour, although they are growing good quality produce. In the Overberg, one farmer found no market for his produce. Most of it was past harvest time at the time of collecting data for this report but still in the ground.

Figure 4.15 Carrots flowering due to the lack of a market in Lemonshoek, Overberg

Distance from markets and transport costs differed in the Overberg and West Coast districts. For some respondents, transporting their produce to the market was a challenge, while for the majority the local community was their market and they did not require any transport. Some paid very little or nothing, while others paid significant amounts. Those who had off-take agreements had to pay transport costs but did not worry about finding the transport themselves. Respondents used various ways of marketing their produce, including word of mouth, off-take agreements, auctions, email, social media and the telephone. Some did not need to do any marketing for their produce because they had a niche market for it. Poor roads, finding a suitable mode of transport, transport costs and distance, were cited as among the challenges faced by farmers who had to transport their produce to market. Lahiff and Cousins (2005) argue that in order effectively to develop the smallholder sector, there is a need for the upgrading of

roads and bridges in rural areas, the construction of marketplaces and storage and processing facilities such as mills and abattoirs, and support for local providers of agricultural services. Additionally, the government will need to reshape markets to achieve wider changes in the market environment in which small producers are often marginalised (DAFF, 2012). This requires state intervention, including the provision of a combination of incentives and regulations for the commercial sector, particularly the large companies that dominate agricultural value chains (DAFF, 2012).

Most respondents in both districts owned houses, and many owned additional buildings that served to support their livelihood. Amongst those who did not own houses were the farmers who had land leased from the government or municipality. They could not invest anything by building on land that did not belong to them. This was an emotionally raw spot for some farmers because short-term leases had deprived them of security during their tenure. One farmer in the Overberg expressed frustration with his short-term government lease, not least because he had invested a lot of money in renovating the government house for it to be habitable. The storage facility on the farm was in a dilapidated state, but he could not invest further due to the absence of security. Insecure land tenure deters farmers from making long-term development investments in their land (Bembridge, 2000).

Figure 4.16: A dilapidated storage facility on a farmer's government-leased land in Barrydale, Overberg

Electricity and gas were the main sources of energy in the West Coast district, while smallholder farmers in the Overberg principally used electricity and wood. Respondents remarked that electricity was becoming expensive and that some of them had received huge

bills from Eskom that they could not pay. Solar power was not widely used in either district, but there were plans by some of the respondents to start using it as a source of energy.

Respondents in both districts indicated that their main modes of communication were the cell phone and the postal service. A small percentage of the respondents used fax, two-way mobile radio and a land-line phone. Email was quite widely used among the respondents in both districts. It seems smallholder farmers are increasingly embracing aspects of technology, especially as a younger generation slowly penetrates the sector.

Group membership investigation was an interesting exercise. It was revealed that the majority of the respondents belonged to one or more farmers' groups in their communities, although a small number did not. Their reasons for not belonging to a group included a lack of time and interest and the feeling that they had enough experience and did not need any group input. Farmers who belonged attended group meetings frequently and paid membership fees. The meetings focused on various aspects of farming, including water, conflict resolution, challenges, future plans, climate change, job creation and land issues. Although the majority of farmers expressed the view that their groups were functioning well, others complained about the frequency of group meetings, high membership fees, groups not having the interests of members at heart, and poor leadership. This implies that there were underlying political issues and that some were perhaps benefitting at the expense of others. It may also imply that some members remained in the group(s) for fear of victimisation. Institutional support would help these groups to become dynamic farmers' unions and cooperatives (Lahiff and Cousins, 2005).

It can be concluded that the effective defining and categorising of smallholder farmers in the Overberg and West Coast districts of the Western Cape requires an understanding of their heterogeneous nature. The results of the livelihoods point to the fact that various factors need to be taken into consideration when defining smallholder farmers and providing them with support for development. One-size-fits-all definitions do not work in the two districts. In South Africa, "small-scale" is often equated with the backward, non-productive, non-commercial, subsistence agriculture that is found in parts of the former homeland areas, and generally associated with black farmers (Tshuma, 2014; Nwafor, 2015). This definition is already inconsistent with what was discovered in the West Coast and Overberg. It is therefore mandatory for a livelihoods analysis to be conducted whenever there are interventions to be made for smallholder farmers, to inform them and ensure their effectiveness.

Smallholder farmers in the West Coast and Overberg had different natural, physical, social, financial and human livelihood assets, and they employed different livelihood strategies. In the Overberg, the majority of farmers were involved in non-farm activities, including private businesses and full-time or part-time work. The percentage of respondents involved in non-farm-related activities was higher than that of those who were involved in farm-related activities only. This was explained by the fact that many of the respondents were still able-bodied and could find work to do to supplement their income. The situation is different in the

West Coast, where the percentage of the respondents who were involved in non-farm-related activities was lower than that of those involved in farm activities. Similarly, several the respondents in the West Coast had other sources of income besides farming, from pensions, social grants, remittances, salary and business income.

Livelihoods analysis in the West Coast and Overberg in the Western Cape confirmed that smallholder farmers are a heterogeneous group. The research was conducted when the Western Cape was in the midst of a drought, which had impacted heavily on the livelihoods of smallholder farmers in the Overberg and West Coast. The Sustainable Livelihoods Framework recommends the analysis of organisations involved in enhancing the livelihoods of people, to determine the implications of their involvement and their relationship with the people with whom they are involved. The livelihoods analysis interviews included a few questions on defining drought, and how the drought had affected farmers. This was to enable researchers to determine the perceptions of the smallholder farmers concerning drought and to identify key informants and other participants for further interviews regarding coping and adapting strategies for agricultural water use during drought. The smallholder farmers interviewed were also asked about the organisations that were working with them to enhance and sustain their livelihood strategies during the current drought. This was to enable the researchers to determine the organisations to be included in the next phase of the research.

4.5 Contrasts in Smallholder Farmer Characteristics in Limpopo and Western Cape

There were both similarities and differences between the smallholder farmers in the surveyed areas in Limpopo and the Western Cape. In both Limpopo and the Western Cape, it was mostly the elderly who were involved in farming. Only 6% of the youth were involved in farming in Limpopo, while in the Western Cape the percentage was double, but still only about 12%. There was a stark contrast in the gender profile of the farmers. In Limpopo, about 61% of the farmers were female, while in the Western Cape more than 90% of the farmers were male.

Education levels were also different. While about 6% of respondents in the Western Cape had never been to school, in the Limpopo this figure was as high as 32%. In both provinces, a preponderance of farmers had attained primary level education (40% in Limpopo, 28% and 43% in Overberg and West Coast, respectively). About 10% of the farmers had attained tertiary education qualifications in both areas.

There was a huge disparity in the size of land farmed between the two areas. About 80% of the farmers were using less than 4 ha of land in Limpopo, while in the Western Cape land sizes varied from 50 m^2 to 6 000 ha in the West Coast district and 0.5 ha to 2 000ha in the Overberg district. In the Western Cape, most of the farmed land was leased from the municipality. There is a need further to probe the dynamics of land access and ownership in both provinces. Although the pieces of farmland were small in Limpopo, the farmers at least owned the land.

In the Western Cape, there was a huge contrast in land ownership between the Overberg and West Coast districts.

It was interesting to note that in both provinces farmer group dynamics played a very important role. In both provinces, about 70% of the smallholder farmers belonged to a farming group. The groups met quite regularly (once a week, or once a month) in both provinces and the farmers said they derived benefit from their membership.

The Western Cape was in the middle of a devastating drought. Despite this, the farmers were still obtaining their water from dams (45% in the Overberg District and 31% in the West Coast). Farmers in the Limpopo Province also obtained their farming water from rain (i.e. surface water sources). Boreholes also played an important role in the provision of potable water (22%).

There were some interesting trends in the study of financial capital. About 50% of the farmers in Limpopo depended on social grants as their main source of income, while 49% and 43% of the farmers in the Western Cape districts were derived their main income from farming. Only 7% of the farmers in the Limpopo depended on farm income. These results showed a huge disparity concerning the reasons for farming. Unfortunately, not much could be concluded about the reasons for the differences. Were they related to land, farming knowledge, access to transport for produce, or even the culture of the community? About 62% of the farmers in the Limpopo had no access to transport and depended on public transport. In the Western Cape, many farmers had contracts with commodity companies who took their produce to the markets. It is necessary further to explore this issue.

There was a marked difference in the energy sources used by the farmers. In the Limpopo, 85% of the farmers used electricity while in the Western Cape this figure was 40% for Overberg and 53% for the West Coast. In the Western Cape farmers also relied a lot on gas and wood.

4.6 Conclusions

The different assets and general livelihoods of the smallholder farmers in the Limpopo and Western Cape identified in this study were used to further explore farmer characteristics. It was observed that although all the respondents possessed almost all types of assets, they were not at the same level or in the same proportion. There were huge disparities between Limpopo and the Western Cape in some cases. It follows that the strategies that farmers employ to make a living are not the same. The challenges faced and the opportunities that are available to the smallholder farmers in the two provinces differ considerably.

5 COPING AND ADAPTATION STRATEGIES FOR AGRICULTURAL WATER USE ADOPTED BY SMALLHOLDER FARMERS DURING DROUGHT PERIODS

Ncube, B.; Pili, O., Fanadzo, M. and Shikwambana, S., Carelsen, C.P.R.
This work is presented in detail in a Masters Thesis by Pili, O., 2020.

5.1 Introduction

Water is important to the livelihoods of all people, perhaps particularly the rural poor who are primarily engaged in agriculture (Namara et al., 2010). During the apartheid era in South Africa, access to agricultural water was highly skewed because of policies that favoured a minority of the population (Van Koppen, et al., 2011; Förstera et al., 2017). The laws and acts that were established during the apartheid era left behind difficult problems regarding access to land and water that are not easy to solve. The exclusion of black farmers from owning land involved their exclusion from water access since land ownership was linked to access to water (Madigele, 2017b). The South African post-apartheid government introduced policies and a legislative framework, including the National Water Act (NWA, 1998), as tools to redress the inequalities in water allocation initiated by the apartheid government.

The new water policy framework of the post-apartheid government aimed to equalise access to water through formal collaborative institutional tools at the local level, involving Water User Associations (WUAs) (Förstera et al., 2017). The policy was implemented to enable smallholder farmers to have access to productive water (Barrett et al., 2017). While WUAs were established to create markets for agricultural water, problems are arising from liability, lack of professional knowledge and the representation of farmers' interests (Barrett et al., 2017). Even though water is so important for agricultural productivity, in SA smallholder farmers are faced with continuing inequalities in access to water.

Sections 61 and 62 of the Water Act (1998) provide for the promotion of access to irrigated agriculture and sustainable irrigation development, including grants for the acquisition of water entitlements for irrigation and grants for training the Management Committees of WUAs. Under the same sections of the National Water Act, it is stipulated that poor farmer irrigation needs will be supported financially (Madigele, 2017b). According to the Water Allocation Reform (WAR) Strategy (2008), by 2014 previously disadvantaged individuals should have had access to 30% of all the water, while women should have access to 50% of that water by the year 2024. The water reforms also recommended that blacks should eventually have access to 60% of the water. The WAR programme proposed to achieve equitable water access through supporting resource-poor and emerging farmers financially, implementing compulsory licensing to promote equitable water allocation within catchments, and giving historically disadvantaged groups priority in licensing processes (Madigele, 2017b).

Despite well-developed policy and legislative frameworks for the transformation of water allocation, little has been achieved since the National Water Act was promulgated in 1998. This is particularly true in the agricultural sector, where 95% of the water remains in the hands of white commercial farmers (DWS, 2018). Even though the New Water Framework aimed to redress past inequalities through the law, policy and collaborative water governance, these goals seem to appear to have been expressed on paper and never implemented. It is argued that existing agential capabilities at all levels of South African water governance are in practice not fit for the successful implementation of the policies (Förster et al., 2017). Conflicts and struggles continue to plague smallholder farmers, with access to agricultural water being one of the key issues (Ncube, 2018). The process of resolving the water allocation issue is seemingly taking forever, with unforeseeable complications hampering the implementation of policies. The highest percentage of allocated water is still in the hands of and benefitting only previously advantaged individuals. Equalising past disparities of water access through participatory and discursive means within WUAs has not happened (Förstera et al., 2017).

SA is also facing a water scarcity crisis driven by a massive backlog in water infrastructure maintenance and investment, recurrent droughts driven by climatic variation, glaring inequities in access to water, and deteriorating water quality. The crisis is already having significant impacts on economic growth and on the wellbeing of everyone in the country, which will worsen if not addressed (DWS, 2018a). The agricultural sector is the largest user of freshwater, with irrigation abstractions representing about 60% of total water use (DWS, 2018b). Water scarcity is multi-dimensional because different groups of people are affected at different levels, with the poor and powerless being more exposed (Denby 2013). There should, therefore, be a basic shift in focus from a narrative of physical water scarcity to one of the rights, access, entitlements, resource allocation and governance.

5.2 Data Collection

The research aimed to survey coping and adaptation strategies for agricultural water use adopted by smallholder farmers during drought periods in selected districts in the Limpopo and Western Cape provinces. Surveys were conducted in Limpopo and the Western Cape from December 2017 to January 2018 period, in combination with data collection for the report on smallholder farmer characteristics and livelihood strategies in the two provinces. The surveys in Limpopo covered 200 farmers. In the Western Cape, partly because of the spatial distribution of the farmers the project covered a total of 100 farmers in the West Coast and Overberg districts. In the Western Cape, additional data was collected during 11 follow-up focus group discussions carried out over two weeks in May 2018. Table 5.1 indicates the areas where focus group discussions took place in the two districts.

Table 5.1 Sites for focus group discussions in the Overberg and West Coast districts

Overberg	Barrydale Swellendam Elim Bredasdorp Napier Barrydale
West Coast	Vredendal Lamberts Bay Graafwater Goedverwaght Hopefield Ebenhaeser

A list of guiding questions for focus group discussions was compiled after analysing the gaps from the survey data. Appendix 1 contains a list of guiding questions. Focus group discussions were conducted in English with translation into Afrikaans and Xhosa when required. Figure 5.1 shows a focus group session in Vredendal in the north of the West Coast district.

Figure 5.1 Focus group discussion session in Vredendal, West Coast District

At the end of each focus group discussion a network mapping exercise was conducted to get a deeper understanding of the organisations that had supported farmers during the drought period. This data was collected in preparation for the *Report on the role of organisations on livelihoods, drought coping and adaptation strategies for smallholder farmers in the Western Cape.*

5.3 Defining Agricultural Water use

Valipour (2015) defines agricultural water as water withdrawn for irrigation, livestock and aquaculture purposes. It includes water from primary renewable and secondary freshwater resources, as well as water from over-abstraction of renewable groundwater or withdrawal of fossil groundwater, direct use of agricultural drainage water and treated wastewater, and purified water. This water plays an essential role in food production and helps to mitigate poverty by producing an important source of income in many countries. According to the Centre for Disease Control and Prevention (CDC) (2016), agricultural water comes from a variety of sources, and even municipal water systems can be used for agricultural purposes. Typical sources of agricultural water include surface water, rivers and streams, irrigation ditches, open canals, impounded water such as ponds, reservoirs and lakes, and groundwater from wells and rain. The total surface water available in South Africa averages about 49 200 million m^3 per year, of which about 4 800 million m^3 per year originates from Lesotho (DWS, 2014). A portion of this runoff, known as the Ecological Reserve, needs to remain in the river to maintain the natural environment along the watercourse. There are six major water use sectors, namely, irrigation, urban use, rural use, mining and bulk industrial, power generation, and afforestation. The combined total water requirement for all user sectors for the year 2000 was 13 280 million m^3/a (DWS, 2014). Agricultural irrigation represents approximately 60% of the total water requirement, followed by urban usage at 25%, the remaining 15% being shared by the other four sectors (DWS, 2014).

The agricultural sector as the leading user of water does not necessarily use the water to maximum advantage. As a result, agricultural water is gradually becoming scarce and inappropriate use continues to pose risks to limited water resources (Boutwell, 2015). The water faces severe competition from non-agricultural users and is challenged by less efficient water use enforcers. Farmers are therefore enjoined to implement practices and techniques that enhance the sustainable use of water in agriculture (Pereira, 2005). Since the agriculture sector is far ahead in demand for water, innovation for both management and conservation is required. Agriculture has been obliged to cope with the increasing demand for food with less water as a result of sharing it with other sectors (Hamdan et al., 2006).

As the most important resource for life, water has been a central issue on the international agenda for several decades. Nowadays, many areas of the world are affected by water scarcity (Mancosu et al., 2015). There is increasing consensus in the international water, scientific and development communities that water scarcity will increase dramatically in many parts of the world in the next 20 to 30 years. Climate change is threatening to exacerbate water scarcity with a predicted reduction in water resources (Knox et al., 2012). Awareness of climate change over the past decade has focused its broad attention on water as a key resource under threat. Increasing water scarcity will have effects on agriculture, as nations with scarce water resources continue to deplete them (Pegram and Baleta, 2014). As water resources are increasingly developed and utilised, catchment quantity and quality stress tend to increase

(Pegram and Baleta, 2014). Globally water is becoming increasingly scarce, with droughts intensifying the crisis of insufficiency (Pereira et al., 2002; Pereira, 2005). It is not only that a shortage of rainfall is limiting the quantity of water resources available, but also that the quality of water is increasingly degraded, making the water unavailable for many requirements (Pereira, 2005).

In SA, water is a national asset and the Minister of Water Affairs is the protector and national manager of water resources. SA is recognised globally for its progressive water legislation and the complexities of its water resources management. Sufficient water resources have been developed to ensure that all water requirements can reasonably be met without compromising the socio-economic development of the country (NWRS, 2004). South Africa's water resources management consists of catchment management functions, river systems management, water storage, water abstraction and return-flow management. Since water is a scarce resource, it is of critical importance that water resources be managed in an integrated way. Section 2 of the Water Act states that the nation's water resources must be protected, used, developed, conserved, managed and controlled, taking into account the basic human needs of present and future generations; equitable access to water; social and economic development; the public interest; the growing demand for water; ecosystems and biological diversity, and international obligations (Pienaar and Van der Schyff, 2007).

SA is mostly semi-arid: its water resources are scarce (NWRS, 2004) and unevenly distributed across the country. Climate varies from desert and semi-desert in the west to sub-humid along the eastern coastal area. The country receives an average rainfall of about 450-500 mm per year (mm/a), well below the world's average of about 860 mm/a. About 98 per cent of available water resources have already been allocated (Nomquphu et al., 2007; Daniel et al., 2010). The country experiences extreme weather conditions such as droughts and unpredictable rainfall. It is estimated that the water supply will remain relatively constant. There are claims that SA has no more additional water and that all future economic development will be inhibited by this fact, which few appear to have grasped. The country has no further dilution capacity when it comes to absorbing effluents in its water bodies. South Africa is ranked as the 30th driest country in the world and is a highly water-stressed country, with extreme climate and rainfall fluctuations.

About 70% of South Africa's gross domestic product is supported by water from the Limpopo, Inkomati, Pongola and Orange Rivers, which collectively drain two-thirds of the land area (DWS, 2014). Judicious joint management of these rivers with the relevant neighbouring countries is therefore of paramount importance to South Africa. Although the national government is the public trustee of the nation's water resources and the ministry concerned is ultimately responsible for implementing water legislation, the management of water resources takes place on a regional level in 19 Water Management Areas (WMAs) that cover the entire country (DWS, 2014).

South Africa's water is drawn from a variety of sources. Typically, 77% is surface water, 9% is groundwater and 14% is drawn from the reuse of return flows (Green Cape, 2017). Groundwater constitutes about 97% of all fresh water on Earth. Although groundwater is not abundant in South Africa because of its mostly hard rock geology, it is easily accessible throughout the country and is a vital source of supply to many users. Groundwater is extensively used for rural domestic purposes, stock watering, water supply to villages and smaller towns as well as irrigation in localised areas. It, therefore, constitutes a primary source of water over much of SA. Groundwater refill is primarily from rainfall, which drains into the soil and replenishes over time, but also occurs through leaching from other water bodies (NWRS, 2004). It is part of the natural hydrological cycle and is therefore not seen as an additional or separate water resource. The DWS monitors groundwater levels and trends. More than 60% of the boreholes monitored in the Western Cape are showing a decline since January 2015 (Drought Fact Sheet, 2017). The most critically affected areas and towns include Beaufort West, City of Cape Town, Cape Winelands, and especially the Boland area, the West Coast and adjacent areas to Saldanha, and further north, the areas around Lamberts Bay and Bitterfontein. South Africa faces water resource challenges of increasing water scarcity and competition for water due to population growth, economic growth, climate change and deteriorating water quality. The country needs to improve its water productivity and reduce the non-beneficial use of water. This is particularly important in the irrigated agriculture and forestry sectors of South Africa, to which approximately two-thirds of the surface water resources of the country have been allocated (CSIR, 2010). During droughts, increased competition for water resources from agricultural use and urban use increases the likelihood of the reallocation of water away from farming. Highly intensive irrigation agriculture is affected, as witnessed in the recent drought in the Western Cape (Western Cape Government Agriculture, 2017). Agriculture is therefore forced to find new approaches to cope with water scarcity and implement sustainable water use practices.

South African water resources are still not being managed sustainably and the country remains water stressed. According to Global Policy Forum, the term 'water stress' is used to describe conditions in which the amount of water available for access for each person in a country is less than 1500 cubic metres per annum. The current water supply of the country is harshly constrained by inadequate aquifers, irregular rainfall patterns, and low levels of rainfall. The condition of water stress is expected to become even worse by 2030 (Madigele, 2017b). There are water-poor people in the country. Inequalities in water provision affect trust between water users today and prolong social exclusion and feelings of shame (Goldin, 2010). Over the years water resource development and management in SA have continuously evolved to meet the needs of a growing population and a vibrant economy. Taking into consideration limitations imposed by nature, these developments have largely been made possible by recognising water as a national asset, which licences its transfer from where it is available to where the greatest overall benefits for the nation can be achieved.

The National Water Act (NWA) No. 38 of 1998 recognises water as a scarce resource belonging to the people and aims to protect, use, develop, conserve, manage, and control water resources as a whole. It addresses equity, efficiency, and sustainability in the management of water resources, unlike the previous riparian rights system (Abunnour et al., 2016). As per Section 4(1), under schedule 1 of the Act, it is stipulated that everyone is entitled to water for reasonable household purposes from any source to which such a person has lawful access. Irrigation is the most important water user with 60% of water withdrawn, while livestock and nature conservation use 2.5%. Water is mostly used for irrigation in SA: about 80 to 90% of high-value crops such as potatoes, vegetables, grapes, fruits and tobacco are irrigated, and between 25 to 73% of industrial crops, such as sugarcane and cotton, depending on the crops and years (FOA, 2016; Baloyi, 2010). Farmers use drip irrigation for wine grapes and table grapes and micro-irrigation for citrus. The irrigation demand for water is essentially inelastic (Nieuwoudt and Backeberg, 2011).

Animal production systems are also a significant component of agricultural water use (Newton et al., 2003). Many animal production facilities, such as dairies, poultry houses, processing plants and related operations use water continuously throughout the year. These production systems are therefore directly affected by the continuing drought and limited availability of water. Water use by animals comprises the water actually consumed by the animals plus the water used in management, and in the case of aquaculture, water used essentially to house the animals (Newton et al., 2003). While significant amounts of water are used in animal production and food processing, water availability limits animal production mostly through the production of fodder crops and forage (Morison et al., 2008). The integration of livestock, fed on crop residues or grazing rangelands, typically results in higher water productivity in a farming system than in similar systems without livestock. Competition for water between different uses and users is also increasing (Descheemaeker et al., 2010).

5.4 Agricultural Water Use in the Limpopo Province

Water storage is mainly in three sources; rivers, dams, and groundwater – all of which are subject to impacts from over-abstraction. The demand for water in Limpopo has increased drastically over the last decade alone, placing pressure on available resources. For example, the average monthly discharge of the Limpopo River over time indicates that approximately 25% more water is being utilised from the catchment than in 1952 (DWS, 2015).

Limited surface runoff is generated in the Limpopo water management area, mainly because of low rainfall. Runoff is highly seasonal and variable, an exception being the Waterberg area which is relatively well-watered with good base flows. Most of the surface runoff in the Limpopo water management area is contributed by the Mokolo and Mogalakwena Rivers, which both originate in the Waterberg and drain much of the Waterberg area (DWAF, 2003). The Nylsvley in the south-east of the water management area is South Africa's largest ephemeral floodplain. It has Ramsar status as a Wetland of International Importance and has

also been identified by Birdlife South Africa as an import bird area. No natural lakes are found in the water management area. The mainland use impacts are associated with commercial forests in the Soutpansberg and infestations of invasive alien vegetation, mainly in the Mogalakwena River catchment (DWAF, 2003).

The surface water resources which naturally occur in the water management area have been highly developed and the water is fully utilised. The main storage dams are:

- Mokolo Dam on the Mokolo River (Matlabas/Mokolo sub-area), which provides water for irrigation as well as to the Matimba Power Station and Lephalale
- Doorndraai Dam on the Sterk River and Glen Alpine Dam on the Mogalakwena River (Mogalakwena sub-area), both constructed mainly for irrigation purposes
- Nzhelele Dam and Mutshedzi Dam on the Nzhelele River, and Luphephe Dam on the Nwanedzi River (Nzhelele/Nwanedzi sub-area), which supply water to villages as well as for irrigation (DWAF, 2003).

There are no major dams in the catchments of the Lephalale and Sand Rivers. Many farm dams have been constructed throughout the water management area. Water is also transferred into the water management area to augment the local resources, the largest transfers being from the Luvuvhu and Letaba water management area, as well as from the Olifants water management area to Polokwane. Smaller but equally important transfers are from the Luvuvhu and Letaba water management area to Louis Trichardt and from the Crocodile (West) and Marico water management area to Modimolle. There are no transfers of water between catchments within the water management area (DWS, 2015).

Several options for the possible further development of surface resources have been investigated. Of these, raising the existing Glen Alpine and Mutshedzi dam walls is regarded as the most feasible. Construction of the proposed Groenvley Dam on the Sterk River (downstream of Doorndraai Dam) was found to be very costly for the small yield to be gained. Due to unfavourable topography and geology, there are no sites suitable for the construction of major dams in the Sand River catchment, whilst it is unlikely that the construction of a major dam on the Lephalala River will be environmentally acceptable. A joint study with Botswana on the development of the Upper Limpopo River also showed that the building of a large dam on the Upper Limpopo will be very expensive and uneconomical (DEA, 2013).

Groundwater utilisation is of major importance in the Limpopo water management area and constitutes the only dependable source of water for many users in the area. A large proportion of the rural domestic requirements are supplied from groundwater, including most of the rural settlements and villages in the Sand and Mogalakwena sub-areas. Some of the larger centres, such as Polokwane, Mokopane and Makhado, receive part of their water from local wellfields. Groundwater is also widely used for stock watering, whilst large quantities are abstracted for

irrigation, mainly in the vicinity of the Limpopo River and the upper Sand River catchment (DEA, 2015).

In total, nearly 40% of the yield from local water resources in the water management area is from groundwater, with recent work indicating that it could be more. A substantial part of the recharge of groundwater is through infiltration from sandy riverbeds. In some cases, such as along the Limpopo and Sand Rivers, where direct connectivity between the surface water and groundwater exists, recharge can also be induced through pumping near the rivers. Direct artificial recharge of groundwater is practised in the upper reaches of the Sand River catchment, where treated effluent from Polokwane is infiltrated into the aquifer. Localised over-exploitation of groundwater is also experienced in parts of the water management area (DWS, 2015).

The quality of groundwater in the water management area is generally good. The water with high mineral content, however, occurs in localised areas near the Limpopo River and the vicinity of Steilloop in the Mogalakwena catchment. No pollution of groundwater has been recorded. The abstraction of groundwater in much of the water management area is regarded as approximately in balance with the long-term sustainable yield from this source. Yet there may be sufficient underdeveloped potential to render additional abstraction from groundwater the most feasible option in certain cases for augmenting the water supply. Potential impacts on surface flows and groundwater levels over the long term will need to be taken into consideration (Basson and Rossow, 2003).

The State of Dams Monitoring Programme indicates that between October 2014 and October 2015 the volume of water stored in dams in Limpopo decreased by 13% (DWS, 2015). Specifically, the storage of water in the Limpopo and Luvuvhu and Letaba WMAs has decreased by approximately 20%, and by 11% in the Olifants and Crocodile and Marico WMAs (DWS, 2015). This data shows the impacts of a drought or extended dry season and suggested that under future drought conditions the available water supply in Luvuvhu and Letaba WMA will be the most vulnerable.

Estimates indicated that an estimated 2 020 million m^3/annum of utilisable groundwater exploitation potential was available to the Limpopo province based on the WMAs located within the Province. This constituted 19.5% of the country's renewable and available groundwater (DWA, 2010). Throughout all the Limpopo WMAs, the dominant use of groundwater was irrigation, with rural and municipal (domestic) use being secondary (DWA, 2010). In 2014 the Limpopo region reported that, overall, 67% of groundwater levels monitored were higher than they were in the same period in the previous year, and in comparison to historical levels, the groundwater levels were well above the level for concern, despite the steadily increasing demand for water (DWS, 2014). It may, therefore, be concluded that the quantity of available and renewable groundwater in the Province was not a constraint, although the quantity surface water could be.

In the natural state, the quality of surface water in the Limpopo water management area is good, particularly in the Waterberg area. Yet water pollution is still an issue of concern in the WMA. Some bacteriological pollution of surface streams occurs as a result of wash-off from rural villages and dense settlements with insufficient sanitation infrastructure. Limpopo is home to some key growth nodes in the country, but the province faces significant challenges to its resources. For instance, the National State of Water Resources indicated that nationally the risks to health from consumption of contaminated drinking water were highest in Limpopo (DWS, 2014).

Water quality in the province is also threatened by both point-source and diffuse pollution. Point sources include mining, domestic and industrial effluents, whereas non-point sources include agriculture and stormwater runoff. The National State of Water Resources (NSWR) (DWS 2014) declared that the major water quality problems facing the country are:

- Eutrophication
- Faecal pollution
- Salinization.

Agricultural runoff, rich in nutrients, and water pollution from acid mine drainage significantly increase salinity in surface watercourses. Acid mine drainage is of particular concern in Limpopo because of huge coal deposits in the province. Elevated salinity poses a hazard for the environment including biota. It can also destroy the structure of soils and affected soils may reduce crop yields. Exposure to high salinity frequently results in depletion of biotic reservoirs by reducing the fecundity of aquatic organisms. The Electrical Conductivity (EC) of surface water points monitored by the Department of Environmental Affairs indicates that all WMAs in Limpopo showed ideal or good water quality conditions, with the highest salinity occurring at monitoring points in the Crocodile and Marico WMA (DWS, 2014).

5.5 Agricultural Water Use in the Western Cape Province

The Western Cape (WC) is characterised by great variability in the abundance of water resources. Where water is available, it is mostly already fully utilised, primarily for irrigation and there is little opportunity for further development of the resource, such as through the construction of new dams. Both surface and groundwater resources are exploited, with the rate of exploitation being unsustainable in some places. Nevertheless, the demand for water from the agricultural sector continues to grow (Midgley et al., 2005). Irrigation to support agriculture is the major user of water (GreenCape, 2017).

Farming activities in the Overberg District in the WC include vegetables, fruit, maize and livestock. The largest water use is for wine grapes, table grapes, olives and plums. Cereal crop production is not feasible in most areas because of insufficient water. Swartland and the eastern part of the Southern Cape produced below to far below normal crop yields in the 2017 season (WCDOA, 2017). Livestock also depends on water for drinking and, because of poor rainfall, the veld condition was negatively affected in most parts of the WC province (WCDOA, 2017).

Water resources in the WC region are already fully committed if the specified allocations to the ecological reserve are honoured in practice. In some places a water allocation deficit is already present, meaning that demand is being met out of the ecological reserve, or from groundwater reserves beyond the natural recharge rate (Midgley et al., 2005).

In sum, the WC is experiencing significant water stress. There may be potential for the abstraction of significant quantities of groundwater from the Table Mountain Group aquifers, which also underlie parts of the Olifants, Breede and Gouritz WMAs (Midgley et al., 2005).

5.6 Coping and Adaptation Strategies for Agricultural Water Use during Drought: Limpopo

Coping mechanisms are the actions and activities that take place within existing structures, such as production systems, and are the responses of an individual, group or society to challenging situations (Olaleye, 2010). The Intergovernmental Panel on Climate Change report (Field et al., 2012) defines coping as the use of available skills, resources, and opportunities to address, manage, and overcome adverse conditions, to achieve basic functioning in the short to medium term. According to Opiyo et al. (2015), coping involves a temporary adjustment in response to change or to mitigate shocks and stresses on livelihoods. In livestock production, coping is a short-term response to feed and fodder shortages (Jordaan et al., 2013).

Crop water use

Farmers' options for coping during the drought in Limpopo are limited by the shortage or absence of capital assets, which makes it necessary for them carefully to select coping strategies for crop management that account for capacity constraints and help them adapt to drought. This section outlines some of the strategies that smallholder farmers use to cope and adapt to drought in rainfed cropping systems in the three surveyed areas (Greater Giyani, Greater Tzaneen and Thulamela) of the Limpopo province. The socio-economic characteristics of the respondents that were surveyed for the Deliverable 2 report are shown in Table 5.2, below.

Table 5.2 Socio-economic characteristics of the farmers in each area

Variables	Characteristics	Mopani (Greater Giyani) %	Mopani (Greater Tzaneen) %	Vhembe (Thulamela) %
Farming	Grain Production	29	72	56
	Cattle Production	4	3	4
	Mixed farming	67	25	40
Age (years)	18-35	13	0	8
	36-55	33	17	24
	Over 56	53	83	68
Household size	1-4	17	31	36
	5-7	35	40	24
	Over 7	48	29	32
Education	Never be to school	28	33	36
	Grade R to 12	55	56	56
	Post matric	17	11	8
Farm Related Courses	Yes	25	36	36
	No	76	63	64
Farm Events	None	33	61	48
	Information session	52	32	44
	Training	15	7	8
Source of income	Pension	33	22	28
	Farming	12	3	4
	Social grant	29	60	52
	Other	25	15	16
Credit providers	Yes	8	11	8
	No	92	89	92
Hectares	Less 1 ha	8	48	40
	1-1.9 ha	8	23	4
	2-2.9 ha	35	15	32
	3-3.9 ha	15	5	0
	Above 4 ha	35	9	24
Agriculture water	Borehole	23	19	28
	Dam	16	1	12
	River	11	5	4
	Rain	51	75	56
Plan for Drought	Yes	35	14	16
	No	65	86	84

Figure 5.2 shows the percentages per district of farmers using crop diversification to cope with drought. About 24% of the farmers in Thulamela Municipality use crop diversification as a method to mitigate the impact of drought, while only 12% of farmers in Greater Giyani employ this practice. Crop diversification refers to growing more than one crop on the same field during the season. The level of crop diversification depends largely on the geo-climatic and/or socio-economic conditions and technological development in an area. It is generally considered that the higher the level of agricultural technology, the less will be the degree of diversification. Rich farmers prefer to specialise in the agricultural enterprises while poor and subsistence

farmers are generally more interested in the diversification of crops. The practice of crop diversification enables smallholder farmers to achieve several production and conservation objectives simultaneously.

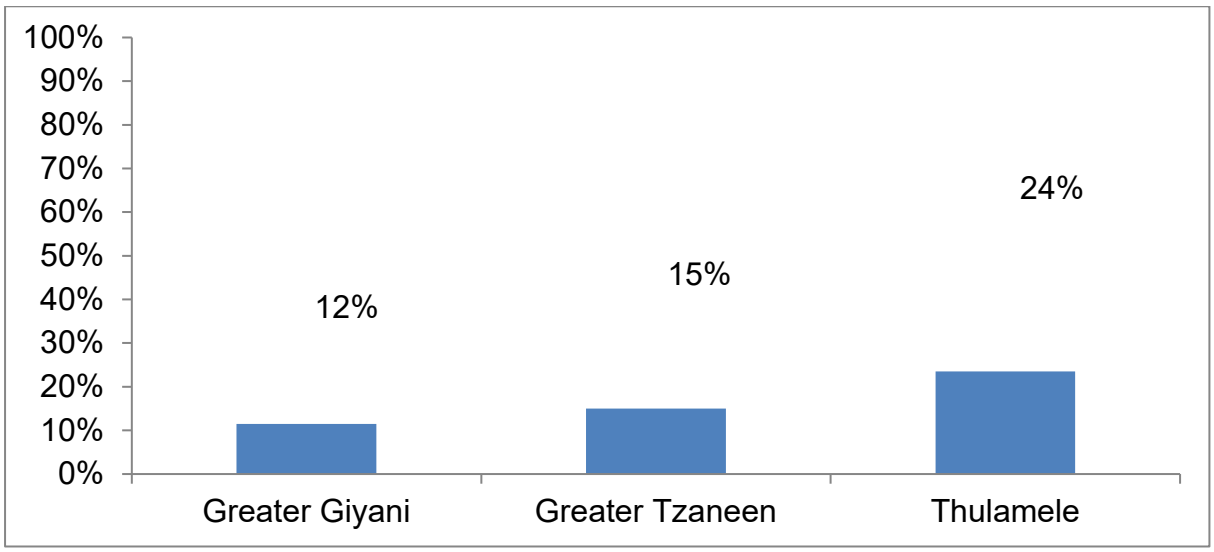

Figure 5.2: Use of crop diversification as a strategy to cope with drought (n=200)

Figure 5.3 shows the percentages of smallholder farmers changing planting dates as a mechanism to cope with drought. Only 16% of farmers throughout these district municipalities change their planting dates to cope with drought. Given farmers' capacity constraints and the high variability of the onset of the rainy season in both Mopani and Vhembe Districts, strategies to enable more accurate estimation of the onset of the growing season for planting crops would be extremely valuable for crop management.

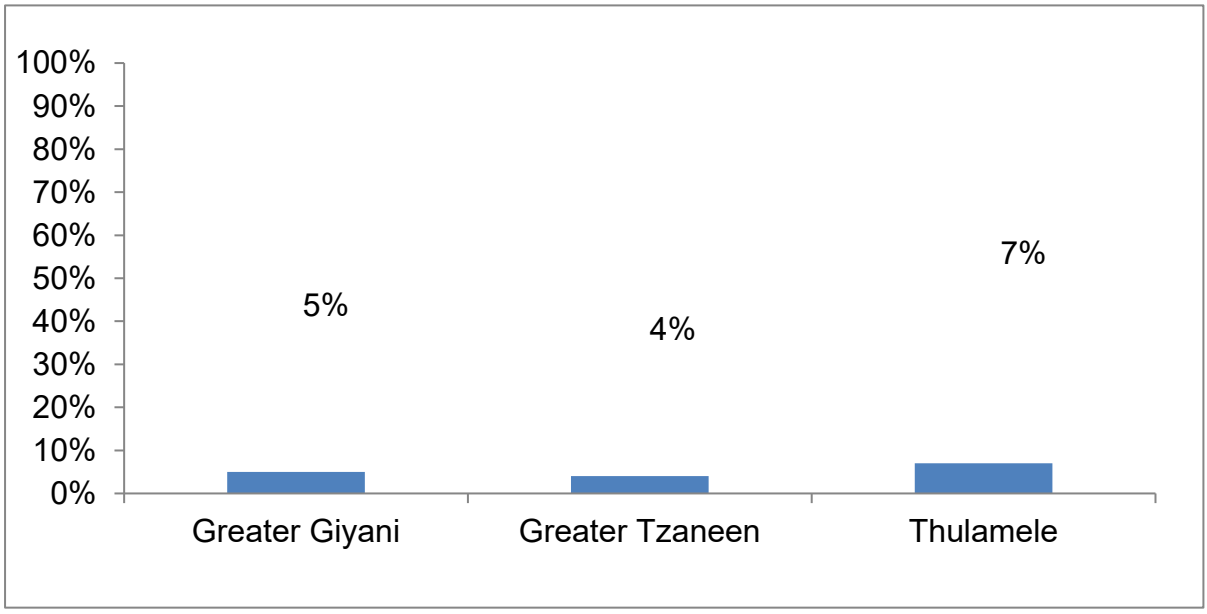

Figure 5.3: Changing of planting dates to cope with drought (n=200)

Figure 5.4 shows the percentages of the smallholder farmers surveyed who are growing drought-tolerant plants to cope with drought. Drought-tolerant plants have built-in features to minimise water loss and maximise water uptake. This is one of the commonly used coping strategies in Limpopo Province.

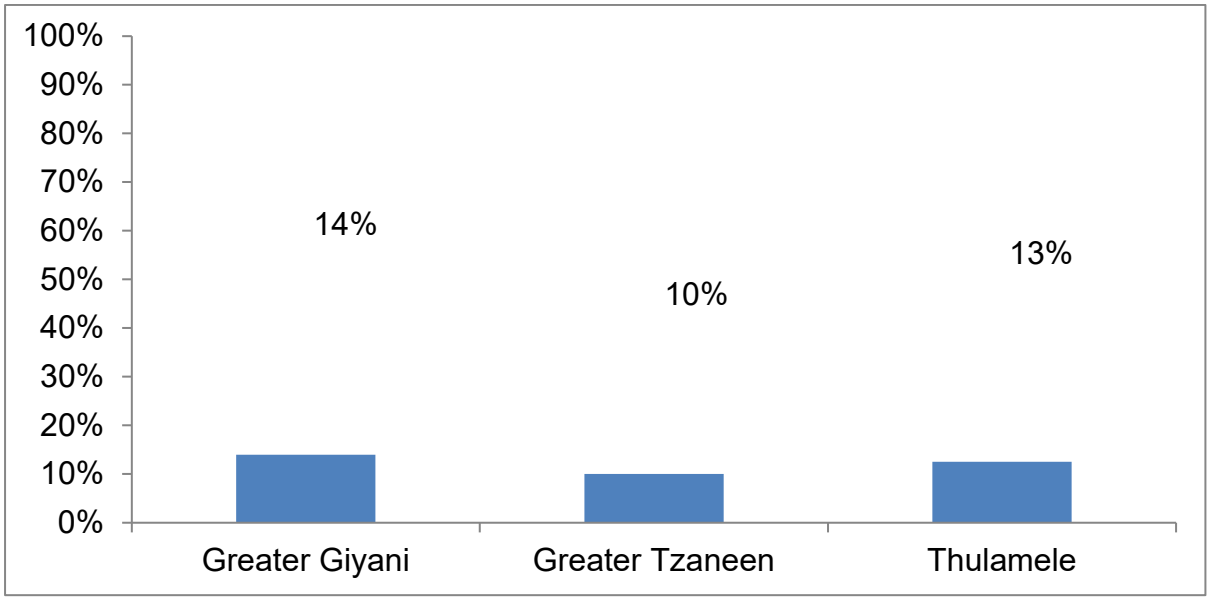

Figure 5.4: Use of drought-tolerant plants to cope with drought (n=200)

Figure 5.5, below, portrays the percentages of respondents using cultivating early maturing plants to cope with drought. This is the most widely used strategy in all three municipalities to cope with drought.

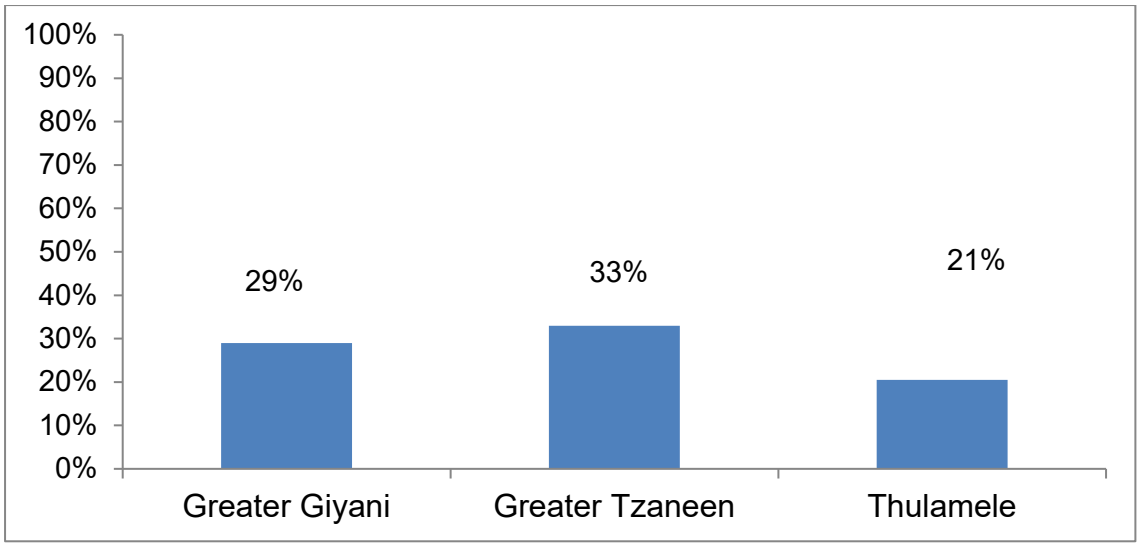

Figure 5.5: Use of early maturing plants to cope with drought (n=200)

Livestock water use

During and after a drought, cash-strapped households sell off remaining livestock, driving down prices, making it even harder to cope with the disaster and re-inscribing the cycle of poverty. There are several strategies that farmers can implement to reduce drought impacts on livestock. This section outlines some of the strategies that smallholder farmers in Limpopo use to cope with drought in their livestock farming system.

Figure 5.6 shows the percentage of respondents using groundwater sources as a strategy to cope with drought. Boreholes are frequently appropriate for mitigating extreme droughts, but they do not always make the most efficient use of limited resources because of the chances of pump breakdown and salt-water intrusion through over-use (Moss, 2004). Groundwater surveys and the appropriate siting of boreholes are necessary for achieving maximum impact.

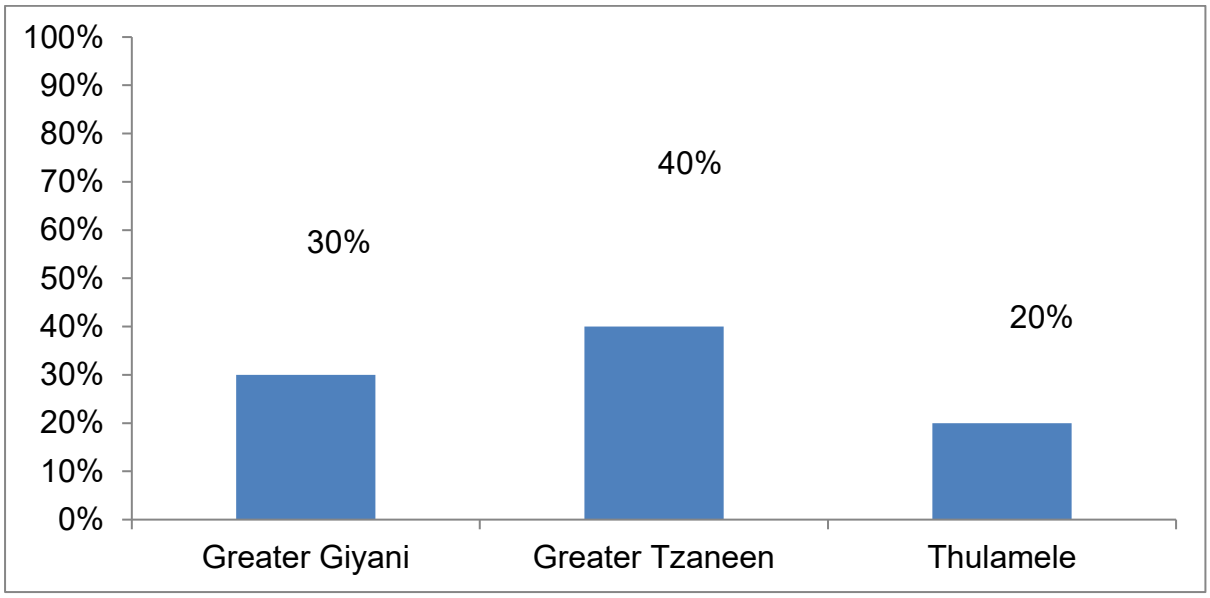

Figure 5.6: Use of groundwater for livestock during drought (n=200)

Figure 5.7 shows the percentages of respondents who reduce stock to cope during drought. Reduced forage production due to drought necessitates reducing stocking rates. Another option is providing supplemental feeds to replace forage lost because of a lack of water for irrigation. In situations like these farmers are usually left with no choice but to reduce livestock numbers. Reducing stocking rates is usually accomplished by culling and selling yearlings.

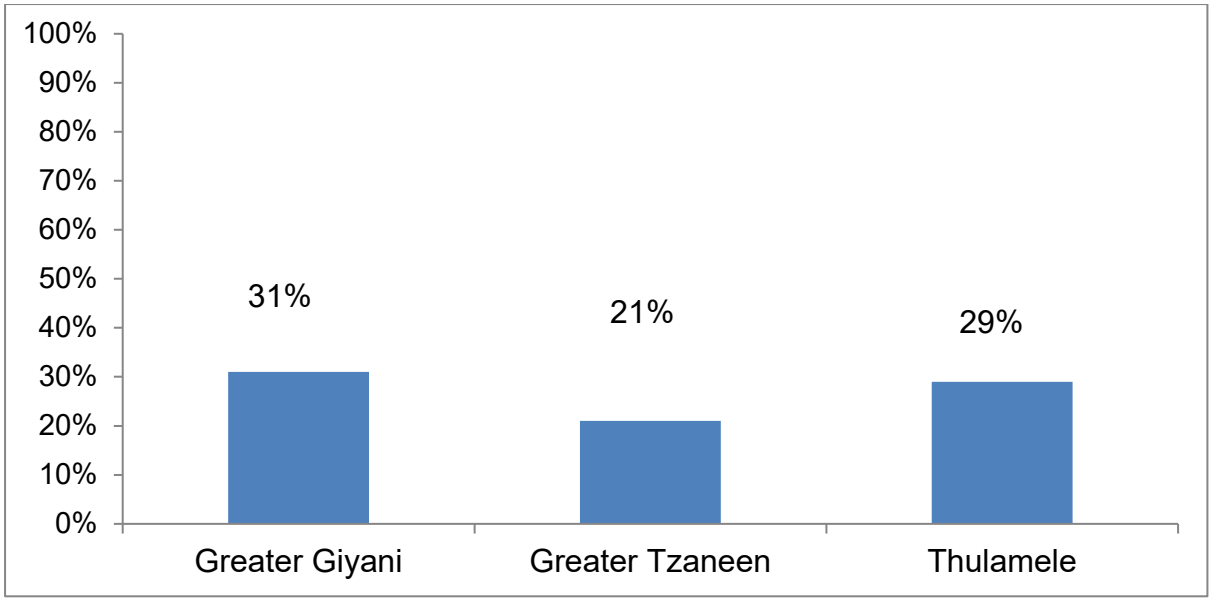

Figure 5.7 Reduction of stocking rates during drought (n=200)

Figure 5.8 presents the percentages of respondents changing to drought-tolerant breeds to cope during drought. This coping strategy is not favoured by the majority of smallholder farmers in Limpopo.

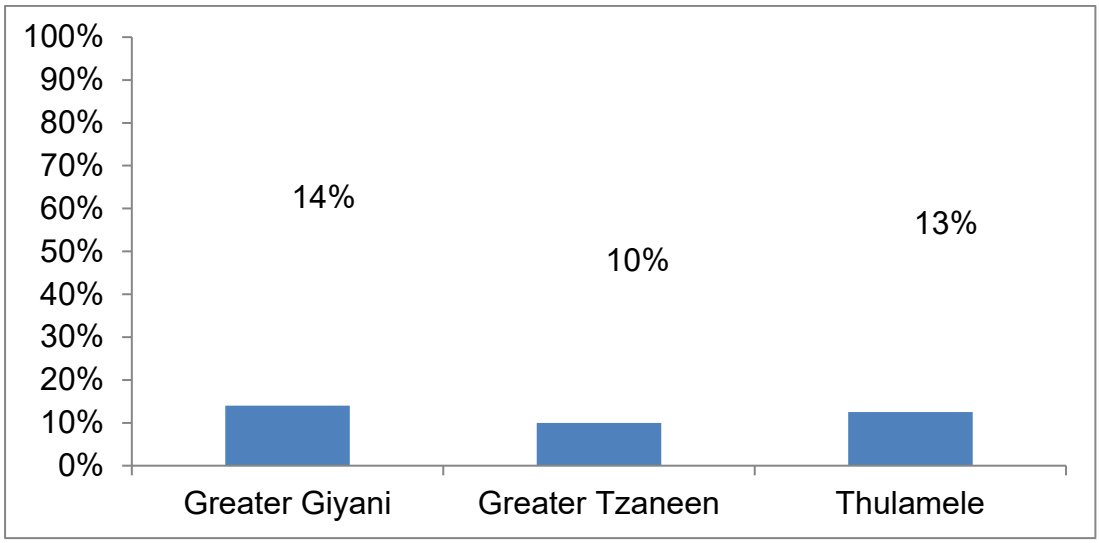

Figure 5.8: Changing to drought-tolerant breeds to cope with drought (n=200)

Limpopo has already launched Conservation Agriculture projects under the SoilCare and LandCare programmes. The Department of Agriculture, Forestry and Fisheries released a Climate Change Sector Plan for Agriculture, which identified four key performance areas: institutional arrangements, vulnerability assessments, mitigation and adaptation, and response and recovery. Information management and communication, public awareness, education and training, and funding arrangements – human, natural, social, physical and financial capital – have been identified as important enablers for the Plan. Table 5.3 lists the various strategies that smallholder farmers in Limpopo implement to reduce the impact of drought.

Table 5.3 Adaptation strategies adopted by farmers in Limpopo (n=200)

Adaptive Strategy	**Greater Giyani**	**Greater Tzaneen**	**Thulamela**
Water storage	✓	x	✓
Conservation techniques	x	✓	x
Crop diversification	✓	✓	✓
Switch to more resilient crops	✓	✓	✓
Construction of small dykes to protect agricultural blocks	x	x	✓
Introduce soil, water and nutrient conservation practices	x	x	✓
Improved land management such as erosion control	✓	x	✓

Although most farmers in Thulamela are elderly and less educated, they adapt better to drought. This is probably due to the large number of research projects and extension services in the district. Rainwater harvesting is a significant drought mitigation strategy among smallholder farmers in the province. Captured rainfall can be stored either in containers as drinking water or in the soil for plant production. This runoff water is often available at the household level, an important factor in the enhancement of water security. A farmer living in a dry region in a developing country cannot direct government policy and single-handedly launch a large regional water infrastructure project to supply piped irrigation water to his home. The rain falling on his land is the only water resource available to him.

Normally, a significant proportion of tropical rain is lost as runoff, potentially causing erosion. The building of bunds parallel to elevation contour lines, following the topography, can capture much of this runoff rainwater, which will then infiltrate into the soil. Thus more crops can be grown even in a drought year. There are various possible systems for rainwater harvesting, for both crop farming and pasture enhancement. Field rainwater harvesting is an excellent example of enhanced water use efficiency (Baloyi, 2010).

Mulch is any type of material that is spread or laid over the surface of the soil as a covering. It functions to retain moisture in the soil, suppresses weeds, keeps the soil cool and makes the garden bed look more attractive. Organic mulches also help improve soil fertility as they decompose. Mulching with organic materials may not be feasible on a large scale, but can be highly effective for smaller plantings.

Zero tillage is an aspect of controlled traffic farming. It involves the use of a no or minimal disturbance disc with diverse rotations, resulting in continuous soil cover through retaining the entire residue on the soil surface (Ellis, 1993). This method reduces the water requirement and is good for early planting. Crop rotation is the alternation of subsistence, cash and green manure/cover crops with different characteristics, cultivated on the same field during successive years, and following a previously established sequence. Crop rotation mitigates the

build-up of pathogens and pests that often occurs when one species is continuously cropped and can also improve soil structure and fertility. There are several benefits to using crop rotation, including improved nutrient cycling, soil tilth, and weed control, all important factors for the survival of crops during drought. Several farmers have adopted these strategies in Limpopo.

Infrastructure maintenance is one way in which communities have conserved water during drought, although this remains a challenge in many areas, especially those with small irrigation schemes. A review by Van Averbeke et al. (2011) found that poor performance in smallholder irrigation schemes was associated with a range of factors that included poor maintenance of infrastructure and equipment. However, in recent years DAFF has transferred infrastructure ownership to communities and their local authorities to promote self-sufficiency and responsibility for maintenance. Extension officers have trained operators in maintaining and operating the infrastructure for effective water use in many irrigation schemes, including the ones in Limpopo. The department has also invested in community awareness regarding water scarcity, the potential pollution of water, water use efficiency, possible reuse of water, water storage, etc.

Coping strategies

In Limpopo, 80% of the farmers practise agriculture on a subsistence basis. While maize production comprises the main component in smallholder farming, over 50% of farming units in the province practice animal husbandry. Livestock ownership is the wealth of the farmers. Table 5.4, below, lists the strategies that smallholder farmers in Limpopo implement to reduce the impact of drought on livestock farming.

Table 5.4 Adaptation strategies (n=200)

Adaptive Strategy	**Greater Giyani**	**Greater Tzaneen**	**Thulamela**
Rainwater harvesting	x	✓	✓
Water storage	x	x	✓
Switch to more resilient livestock	✓	✓	✓
Building more dams and reservoirs	✓	x	✓

Farmers in Greater Tzaneen and Thulamela have adopted rainwater harvesting as a long-term strategy for providing water for livestock. In Thulamela a lot of farmers have installed water storage structures, particularly tanks. More dams and reservoirs have been constructed in Greater Giyani and Thulamela, but indifferent water management means that they do not necessarily fillup. Most farmers in all the three districts had switched to more drought-resilient livestock breeds.

5.7 Coping and Adaptation Strategies for Agricultural Water Use during Drought: Western Cape

This section presents the project's findings on the coping strategies for agricultural water use adopted by smallholder farmers in the Overberg and West Coast districts of the Western Cape during the recent drought. The same smallholder farmers who were interviewed individually during the livelihoods surveys were invited to the focus group discussions. In the Overberg 52 participated and the sample was drawn from Barrydale, Suurbraak and Swellendam (combined), Napier and Bredasdorp (combined) and Genadendal. In the West Coast, 49 farmers participated in the focus groups discussions. The sample was drawn from Ebenhaeser and Vredendal (combined), Lamberts Bay, Graafwater, Goedverwaght, Hopefield and Darling.

Water sources, authorisation, infrastructure and challenges

Questions asked during the discussions sought to understand water sources, water infrastructure, drought impacts, coping and adapting strategies adopted by farmers, and challenges associated with agricultural water use faced by smallholder farmers in coping and adapting to drought. Responses to these questions are presented Tables 5.5 to 5.8, below, according to area and district.

Table 5.5 Overberg District water sources, authorisation, infrastructure and challenges

Area	▪ Background	Water Sources/Authorisation	Water Infrastructure	Challenges
Barrydale	Farmers in Barrydale practise livestock and mixed farming.	▪ Land is rented from Swellendam Municipality. An additional 2000ha of communal grazing veld is available for the animals. ▪ The main water sources available to the farmers are earth dams and a river. ▪ One of the farmers has access to municipal overflow water.	Pipelines	The water supply is unreliable, especially during drought periods when the dam does not receive inflow.
Swellendam/ Suurbraak	Animal production is the main enterprise in these two areas (mostly cattle and pigs).	▪ Land is rented from the Swellendam Municipality for a period of nine years and 11 months. The Municipality had to stop the water supply due to non-payment of water bills by the smallholder farmers. Other farmers only have access to rainwater for agricultural purposes. ▪ The main water supply is from the Swellendam Municipality reservoir and earth dams for the animals.	A pipeline has been installed from the reservoir to the farmer's plots (pig houses).	Water is expensive for smallholder farmers, resulting in non-payment of bills.
Napier/ Bredasdorp	The main commodities are small grain, livestock and mixed farming	▪ Land is rented from the Cape Agulhas Municipality for a period of nine years and 11 months. Some farmers have commonage land and the others have bought land. ▪ The main water source is rainfall for the grain, with borehole water and springs as a backup supply. ▪ Some farmers have water rights.	Water is stored in earth dams and water tanks.	
Elim		▪ Land is rented from the Moravian Church and from private owners. ▪ The main water source is a dam, springs "Elim is rich with water, located in the wetlands, we are blessed with a lot of water springs".	A main pipeline has been installed to transport water to the garden plots. Water is stored in water tanks.	Infrastructure is growing old.
Genadendal	Farmers are involved in livestock; vegetable; vineyards and mixed production	▪ Land is communally owned in Genadendal and is administered by the Transformation Committee. ▪ The smallholder farmers at Genadendal received legal permission to cultivate the land but no formal lease agreement was issued to them. The farmers access water for the irrigation of crops and for livestock from the river, borehole and dam. There is also municipal water.	A canal system supplies water from the mountain.	Canals are not appropriately maintained.

Table 5.6 West Coast water sources, authorisation, infrastructure and challenges

Area	Background	Water Sources/Authorisation	Water Infrastructure	Challenges
Ebenhaeser	Most of the farmers practise mixed farming and vegetable farming.	▪ Water is from the municipality and is linked to communal land ownership. ▪ Individual authorisations (water rights). ▪ Farmers pay R49/month for water.	▪ Farmers receive water through a canal system. ▪ No storage facilities.	▪ Infrastructure for water is broken and not adequate. Farmers upstream do not get enough water: the pressure is low, and the canal is narrower there. ▪ No capacity to build storage facilities.
Lamberts Bay	Farmers practise mixed farming and vegetable production.	▪ Water is obtained from the municipality and is free of charge. ▪ Land is leased for nine years eleven months.	▪ Water pipelines for transporting water. ▪ Tanks used as storage facilities.	▪ The pressure of the water is very low, cannot fill the tanks. ▪ Pipeline is exposed to animal-trotting and heat, now in a bad state.
Goedverwacht	Farmers are involved in mixed farming, vegetable and livestock production.	▪ Land is owned by the church. ▪ Leasing is for nine years eleven months. No payment is made, only taxes and rates. ▪ Dam, river, wells and fountains are the main sources of water. ▪ The water rights are held by the church. ▪ Farmers take turns to access the water.	Pipeline	▪ No contracts for land which is linked to the water authorisations. ▪ Lack of contracts has resulted in poor management of water because some people access more than stipulated in their schedule. ▪ Water infrastructure not in a good working condition, farmers up-stream access water more than others. ▪ The pipe is broken and needs to be fixed.
Hopefield	Darling farmers practise livestock farming. Some have poultry and others have horses.	▪ Farmers are farming on their own land ▪ The rain and boreholes are the main sources of water ▪ No water rights	They store water in water tanks and use buckets for water harvesting.	Water is a challenge in Hopefield. Groundwater is salty and not suitable for crop irrigation and domestic purposes.
Darling	Farmers in Darling are involved livestock, mixed farming and vegetable production.	▪ Farmers are relying on the borehole for water. ▪ They fetch water with small containers to their plots.	▪ They store in water tanks	▪ Municipal water was cut off, resulting in farmers investing money to revamp the borehole drilled by the Department of Water and Sanitation years ago. ▪ They bought a generator to supply electricity to the borehole pump in order to pump water from the borehole to the tanks.
Graafwater		Municipal water used for livestock consumption.	A pipeline is used to transport water to the plots.	

5.8 Drought, Impacts, Coping Strategies for Agricultural Water

Table 5.7 Drought impacts and coping strategies for agricultural water for crop and livestock in the Overberg District

Area	▪ Understanding of drought/ impacts	Coping strategies for crops	▪ Coping strategies for livestock
Barrydale	▪ Farmers understand drought as minimum rainfall where dams are empty with no grazing for livestock. Farmers say drought is when livestock die due to insufficient feeds and crops dry up. One farmer said that "drought takes away everything from you, even your future". ▪ Impacts of drought include reduced harvest, loss of livestock and income: "I lost around R130 000, equivalent to more than 100 sheep"; "I lost almost 50% of my livestock," two farmers said. The soil dams emptied, and the rivers ran dry. ▪ No water was available for the livestock and farmers had to transport municipal water for the livestock. This intervention becomes too expensive for farmers, because they have to pay for the water. ▪ Feeds prices increase. ▪ Farmers were forced to buy feeds to sustain their livestock, as they could not plant their own feeds. ▪ Debt: farmers are faced with big bills for water: one farmer reported, "The water bill is R2684.50".	Drip irrigation. No till conservation farming.	▪ Grazed livestock in the veld ▪ Sold some livestock to reduce numbers ▪ Transported water to the farm (hire transport to fetch water from the dam) ▪ Bought feeds for livestock ▪ Moved livestock to other people ▪ Veld got dams and irrigation dam ▪ Built and installed lots of water tanks and dams to harvest rainwater. ▪ Cleared aliens in dam water courses
Swellendam/ Suurbraak	▪ Farmers in the two areas understand that drought is when "there is no water and that means there is no life since farming depends on water, we cannot plant, and livestock need water". ▪ Drought is a "period of water scarcity and without enough rain, where there is no grazing for livestock"; "it is painful, you put more and get less". ▪ Impacts include no plantation of anything. ▪ Loss of livestock due to scarcity of grazing. ▪ Not all farmers were impacted by drought. ▪ Loss of income – "have to transport water from the river; buy water and transport water at R20/1000L". ▪ Water availability restricted, farmers had to buy a lot of medicine for sick livestock; pensioners had to use pension money to buy livestock feeds since there was no grazing for cattle, grain prices increased for pigs. ▪ Had to drive long distances to farms to buy livestock feeds. Livestock died, especially cattle. Those farmers who were not impacted reported that the drought almost hit them, but the rain came in time.	Installed boreholes for extra water for the nursery.	▪ Transported water for livestock ▪ Made own feeds Lucerne bales ▪ Bought affordable feeds for livestock from SOIL and SSK ▪ Controlled the grazing capacity by restricting animals to smaller camps ▪ Bought water from the municipality ▪ Bought livestock feeds from Co-op. ▪ Bought remaining canola, oats and barley from Co-op
Napier/ Bredasdorp	▪ Drought is understood as terrible condition for farming, since there is no rain and no grazing for livestock. ▪ Drought is a "period without water, dams are empty. The growing of plants and livestock is a struggle since it is very hot". ▪ Dams are empty. ▪ Financially, had to buy feeds for livestock. ▪ "There is low production of grain and no feeds for livestock; have to buy from the mentor". ▪ Impacts include plants taking too long to grow, so that when the harvest time came the crops were not ready to be harvested; livestock dying and selling prices drop. ▪ Had to use expensive water (scheme water) to maintain the livestock.	▪ The farm uses borehole water for small areas. ▪ The land was left fallow.	▪ Bought feeds for livestock ▪ Used borehole water saved for livestock ▪ Transported water from the river ▪ Bought medicine ▪ Bought scheme water ▪ Sold livestock ▪ Saved money for any emergency
Elim	▪ Drought is when there is no rain, groundwater and no water from the rivers and dams and is associated with global warming. "It is when certain expected %age of rain is not available, or it rains less". ▪ Impacts include no production of olives and the veld dried up; feeds for livestock did not grow and the seeds during the year 2017 did not germinate. ▪ There is no feed for livestock; farmers have to purchase straw bales and Lucerne. Livestock and crops are dying, and it causes loss in income. ▪ The reservoir is now dry for the first time in years	Small areas cultivated using shade netting.	▪ Sell livestock ▪ Collect grazing and canola residue from Co-op. ▪ Purchase less straw ▪ Buy feed for livestock ▪ Transporting water from Planted pastures
Genadendal	▪ Drought did not affect farmers much in Genadendal "we live in a gold mine; we have a lot of resources"; "we never suffered drought here in Genadendal". ▪ It is associated with climate change – "human impact is the biggest problem" ▪ Alien clearing to create jobs, no consulting with the community, it affected the environment, rivers no longer flow smoothly	▪ Transported municipal water using solar pump. ▪ Cut the size of cultivated land. ▪ Rainwater harvesting and filled the dams	▪ Selling of cattle ▪ Buying feeds ▪ Using old borehole water ▪ Buying feeds for livestock ▪ Transporting water to the livestock ▪ Using borehole water

Table 5.8 Drought, impacts, coping strategies for agricultural water for crop and livestock in the West Coast District

Area	Understanding of Drought/ Impacts	Coping Strategies For Crop	Coping Strategies for Livestock
Ebenhaeser	▪ Drought is commonly understood as follows: "Lack of sufficient water", "Veld is dry", "You cannot farm", "No irrigation water available". ▪ Drought is associated with lack of water and feeds for livestock and plants. ▪ Lucerne fields dried up due to lack of rain. Lucerne production decreased by 60%. ▪ Quality of livestock was compromised, e.g. "Livestock died, goats were too weak to give birth, and sheep are still struggling". Farmers needed to dose them regularly. ▪ Contracts with markets (Off-Tech agreements) were lost because of lack of harvest: "Our seeds contract was cancelled"; "I could not plant anything due to water scarcity, I used to plant tomatoes every year for Tiger Brands". ▪ "Vineyards did not grow".	▪ Scaling down on or zero production ▪ Use of less water	▪ Sold livestock at lower prices ▪ Transporting water to the animals ▪ Reduction of stock by selling ▪ Grazing of animals on grasses
Lamberts Bay	Drought is understood as a period of bad rainfall, where the land is dry, and plants do not grow.	▪ Use water sparingly	▪ Have to use savings to buy feeds for livestock ▪ Plant potatoes to feed livestock
Goedverwacht	Drought is understood as a period with no feeds for livestock and no water for plants. Farmers declared that "it is a sad story for a farmer for water is life, so no water no life to plants, livestock and people". Crops, livestock, good market and income were lost.	▪ Irrigate with sprinklers	▪ Asked commercial farmer for grazing land ▪ Transported water to the farm ▪ Do not have a lot of debt ▪ Sold livestock ▪ Collected feeds from Silos
Hopefield	▪ The farmers from the Hopefield area have access to different types of land ownership arrangements; hence, they have different types of water use arrangements. Some participants who belong to a group received access to land through the old LRAD system. This group of farmers have access to 2000ha of land. The land is equipped with two boreholes that supply water to the livestock animals for stock water purposes. The boreholes are equipped with electrical pumps and pipeline systems that transport water to the animals. ▪ Farmers in Hopefield understand drought as a climate change whereby rain is very scarce and makes life difficult for crops, human beings and livestock. They also defined it as a killer in the farming business and the main culprit of farm losses. ▪ The low rainfall patterns over the past few years resulted in crop failures; production declined; farmers lost a number of sheep because they could not grow feeds without water; feeds prices increased.	▪ Stopped crop production	▪ Bought feeds ▪ Utilised water from borehole to different camps ▪ Transported water to livestock ▪ Developed small camps to control grazing
Darling	▪ Farmers understand drought as a struggle with water and poverty because they cannot plant anything; no rain, livestock have no feed. ▪ Farmers consider drought a big challenge bringing loss to their livelihoods, as they have to pay a lot of money to the municipality for water. ▪ Farmers lost their livestock (pigs, goats and sheep). Sheep died when giving birth due to hunger. Farmers were affected financially; they made less money than in raining seasons, had to spend more money on buying feeds. Farmers had a very low yield on grain for three years.	▪ Transported water for vegetables ▪ Collected money to repair borehole and buy a pump	▪ Took some goats to the Eastern Cape ▪ Bought feeds ▪ Stored feeds for livestock ▪ Used borehole water ▪ Transported water to the farm ▪ Used water pump ▪ Used water tanks for stock water
Graafwater	▪ Farmers understand drought as the absence of rain for a long period of time: "like now it's been 4 years without rain"; "drought means water needs to be saved". ▪ The main production systems employed by these farmers is mixed production.	▪ Bought water ▪ Installed grey water system	▪ Fetched water from the tank to the farm ▪ Sold some livestock ▪ Transported water to the livestock ▪ Used water from the boreholes for livestock ▪ Lowered the livestock numbers ▪ Controlled feeds ▪ Planted extra feeds (spinach and radish)

5.9 Adaptation Strategies for Agricultural Water Use During Drought in the Western Cape

Adaptation strategies differ from coping mechanisms in that they are more permanent and need to be initiated prior to droughts. Strategies affect livelihoods and lifestyles, and can involve change of livestock type, change in grazing practices, farm level diversification, economic diversification, insurance, building of fodder banks, permanent reduction of grazing capacity, water reticulation, planting of drought-resistant crops, and budgeting and financial planning for droughts (Jordaan 2013). The Intergovernmental Panel on Climate Change report (Field et al., 2012) defines 'adaptation' as the ability of people, organisations and systems, using available skills, resources, and opportunities, to address, manage, and overcome adverse conditions. Adaptation therefore involves longer-term shifts in livelihood strategies, and adaptation strategies differ from household to household and region to region, according to the presence or absence of support systems that can increase the resilience of affected individuals (Opiyo et al., 2015). For example, moving livestock to areas with secure water and pasture resources is seen as an effective adaptation strategy against droughts (Opiyo et al., 2015). Table 5.9 shows the adaptation strategies adopted by smallholder farmers in the selected areas of the Overberg district.

Table 5.9 Adaptation strategies for agricultural water use in the Overberg district

Area	**Adaptation strategies (Crop/Livestock/Mixed farming)**
Barrydale	No strategy adopted
Swellendam/Suurbraak	No strategy adopted. "You grow from bad to worse, it's like apartheid, we are in a bad state"
Napier/Bredasdorp	Drilled boreholes
Elim	Some farmers are planning for aquaculture
Genadendal	Not impacted by drought: "we never suffered drought here in Genadendal", "The grace of God is upon us".

Farmers in Overberg have adopted few strategies to prepare for future droughts. Farmers in Swellendam, Barrydale and Suurbraak felt they were helpless, probably because of not owning the land they were farming. In Napier and Bredasdorp farmers drilled boreholes for long-term water supply. While farmers in Genadendal and Elim agreed that they had not been affected by drought, in Genadendal there were serious water governance issues that caused conflict even during the focus group discussions.

Table 5.10, below, presents the adaptation strategies adopted by smallholder farmers in the West Coast District.

Table 5.10 Adaptation strategies for agricultural water use in the West Coast district

Area	Adaptation strategies (Crop/Livestock/Mixed farming)
Ebenhaeser/Vredendal	No strategy: "There is nothing we can do, we are poor", "the land is too small, we can't do anything".
Lamberts Bay	▪ "We want to organise ourselves with the municipality to get sewerage water to water the plants" ▪ "I want to give up on goats and farm with pigs because they feed on anything" ▪ "How can we prepare for drought without water?" ▪ Proposal to drill a borehole or re-open the ones that are closed
Goedverwaght	Plans to change from bigger to smaller livestock production
Hopefield	"We don't have the muscle, we need help with the pivot centre so we can irrigate our crops, it is over a million to do it."
Darling	No strategy – "we are in the process of involving the African Farmers Association of South Africa (AFASA) to help us to own land by giving us information and guidance".

The situation in the West Coast was almost one of desperation. Most farmers felt they were helpless in planning for drought as long as they did not own the land or have access to water.

5.10 Emerging Trends for Coping and Adaptation Strategies for Agricultural Water Use

Limpopo

The coping and adaptive capacity of smallholder farmers is described in terms of the human, physical, social, natural and financial capital that they possess. Smallholders can convert their capital from one form to another depending on their needs during periods of drought. Farmers with little capital are more vulnerable to the impacts of climate change such as drought (Eriksen and Silva, 2008). Such farmers often need significant external assistance to cope with drought. During the survey farmers also identified certain barriers to coping and adaptation, including a lack of information, lack of government support, and lack of education and skills.

The education level and age group of farmers appears to have had a direct influence on their use of drought-tolerant plants as a coping strategy. Greater Giyani Municipality had more post-matric respondents than the Greater Tzaneen Municipality. People who are educated understood research better and could easily be persuaded to experiment with drought-tolerant plants. In the Greater Tzaneen Municipality, 83 respondents were over 56 years old, compared to 11 respondents in the Greater Giyani Municipality. Young people could more easily be persuaded to use drought-tolerant plants than old people. Yet smallholder farmers in Thulamela Municipality who were old and did not have secondary education nevertheless used drought-tolerant crops as a mechanism to cope to drought. This is indicative that effective farmer education and demonstrations can convince farmers to make significant changes in a system, even one to which they have become used for decades, or even generations.

Although planting time is a crucial management strategy in Limpopo, information on planting appropriate planting dates is often not available. This can be explained in part by the fact that farmers use indigenous knowledge entailing non-climatic reasons for sowing. For instance, although farmers are aware of the risk associated with early planting, some farmers plant crops without any rainfall events. To support farmers with scientifically sound information on planting dates, attempts have been made to estimate and communicate these.

Coping strategies are remedial actions undertaken by those whose livelihoods are threatened. They involve managing resources both during drought and in normal times to withstand the risk and effects of drought. Irrigation, farm diversification and drought-resisting coping capacities and strategies were identified based on the literature, expert opinion, observations, level of ease of measurement and their importance. It was found that 37% of the farmers used drought-resistant crops or animal breeds, 51% practised farm diversification, 16% changed planting dates, and 83% planted early maturing crops. Farmers found it easier to farm with early-maturing crops than changing planting dates as a coping strategy. Figure 5.1 also indicates that only 51% of farmers employ diversification in their farming activities, which leaves the remainder more vulnerable to drought.

Smallholder farmers sell their excess animals and non-farming assets to buy feed for their livestock. Some plant oats to make silage and lucerne for grazing which can be used in dry periods. The farmers were willing to change the type of livestock and crops farmed or reduce herd sizes. It was argued by extension officers that lucerne could be used for fodder banks, but farmers found it too expensive to produce. To manage drought effectively, diversifying livelihood strategies and income-generating options within and outside agriculture are required, especially through non-farm enterprises and employment opportunities. Off-farm income in the three municipalities should be explored during drought.

Western Cape

The study revealed that smallholder farmers in the West Coast and Overberg have access to various sources of water, including dams, taps, rivers, springs, wells and boreholes. The most common means of transporting water are pipelines, water tanks and canals. For the majority of farmers in the West Coast and Overberg, the availability of water and authorisation for its use largely depends on the nature of land ownership and contracts. Most of the farmers in the WC lease land from municipalities, private owners and churches. While some land is owned privately or communally, the majority of farmers are struggling with the long-term insecurity of contracts. Their leases are comparatively brief and not clear in their conditions, making it difficult for farmers to make any future decisions. These leases do not clarify the basis and conditions for water access. Farmers possess land but do not know where and how to access water. Yet water and land are not separable: the lack of the former disables the latter.

In Goedverwaght, some farmers had contracts that did not stipulate water access conditions, which resulted in others taking advantage of the situation. Land was rented from the Moravian church, and a process was underway to ensure that all farmers are provided with lease

agreements stipulating land and water conditions. This would assist the owner of the land to terminate or apply necessary measures in the event of a contract being breached. At the same time, without clear land contracts linked to access to water, smallholder farmers will continue to suffer and become increasingly vulnerable. In Elim, a concern was shared that the government has too many laws that hinder the progress of water authorisation for farmers. An example was given of people who left fishing because they did not succeed in obtaining a licence. As long as smallholders' land ownership issues are not addressed, they are effectively marginalised, and their future is compromised.

Those who are farming on communal land have water rights linked to their land ownership. Farmers take turns to draw water from various sources. However, they still face challenges, including conflicts and a lack of trust amongst themselves. Some farmers, especially those who are best located within the water infrastructure – for example, those who are upstream – benefit more than others from the available water. Several farmers complained that water does not reach them, because they are at the end of the flow, while others observed that the pressure of the water was very low by the time it reached them. In Hopefield, the water was reported to be salty and therefore not suitable for human and animal consumption. Water was also being diverted to individuals' farm, resulting in others having no access to the available water at all.

The above scenario reveals that in most of the areas, water was available, but its distribution was hampered by the (lack of) infrastructure. Some farmers complained that the infrastructure was poorly maintained and growing old. They pointed out that pipes were broken or were so dirty that water had stopped flowing and was leaking out along the way (Figure 6.1, below). Yet in the areas where farmers complained about this, for example in Genadendal, Ebenhaeser, Goedverwaght and Elim, they also conceded that it was their responsibility to maintain the infrastructure. This implies that some of the problems that farmers were complaining about were due to their neglect and needed to be more proactively attended to. However, the overall picture is that the government of SA has not yet addressed the inequalities that exist among its water users. Some benefit while others can only hope that one day they will be able to access water without impediment.

Figure 5.9: A broken pipe leaking while irrigating a vegetable garden in Lamberts Bay

The current drought has devastated some farmers' livelihoods. Farmers understand drought in basic terms as the unavailability of or a reduction in the normal amount of rainfall. Some of them connect this with climate change and global warming. They are unanimous in the opinion that water sources are drying up due to the current drought. Drought exacerbates the challenges posed by an already water-scarce environment. Most farmers who participated in the study were involved in dry-land farming. They indicated that water had increasingly become a problem, even for watering their livestock and small gardens. Some have now resolved to use expensive water from the municipalities, while others have resuscitated sources that were lying idle, including springs and wells.

The drought has become a very sensitive issue in the WC. Reports of victims of drought committing suicide and living in continuous depression were received. Initially, during the surveys, reports of suicide cases were only recorded in the West Coast. A key informant reported that in the Overberg there were now also cases of suicide due to the drought. The drought was becoming severe. Farmers described the drought as a killer, and each had a sad story to tell. Crime is now rife, and families are struggling. Yet while most were mourning their losses, others maintained that drought did not affect them. In the Overberg, Barrydale was the most affected by drought. The farmers in Barrydale were severely affected because their climate is the same as the Klein Karoo, although geographically the town is located in the Overberg. This was an oversight on the side of government drought relief efforts, and it has resulted in acute suffering for most of the farmers. The impacts of the current drought in Barrydale include loss of livestock and crop failure, reduced yields and loss of income, among others.

Farmers have adopted various coping strategies for agricultural water use in the crop, livestock and mixed farming. Strategies were consistent with those that have been reported in the literature (e.g. Ncube and Lagardien 2015; Ncube 2018), including scaling down or zero production in both livestock and crops, selling of stock at cheaper prices to avoid further loss, dosing, feeding animals with high-value nutrients, slaughtering, controlling grazing, and using water sparingly. These coping strategies were common to both the Overberg and the West Coast.

Transporting water from the source to the farm was a common strategy adopted by livestock producers. In some cases, water tanks and plastic containers were being carried on bakkies for long distances. This resulted in farmers having to pay fuel costs or hire transport from others. Inevitably, income was being lost. Farmers are also using their savings to buy feeds and medicines for their livestock.

5.11 Conclusions

Low-cost strategies such as stone bunds, micro-water harvesting and water harvesting were widely adopted by farmers. The high level of poverty in Limpopo led farmers to abandon some crop management technologies and approaches, even though they were proven to be efficient. Only those strategies which required few resources in terms of labour and money had a chance of being adopted by a large number of farmers.

Groundwater was an alternative to supplement crop water deficiency during dry periods. Groundwater can be used as a coping strategy for short-term and long-term transformative responses for Greater Tzaneen Municipality. Using groundwater for irrigation as a climate change adaptation strategy was clearly in the interest of all farmers whose livelihoods were dependent on agricultural production. Only 20% of respondents in Thulamela Municipality saw groundwater as a strategy to adapt to drought. This is because the Municipality has more surface water than Greater Tzaneen and Giyani municipalities. Although 30% of farmers in the Greater Giyani district nominated groundwater as an adaption strategy, the municipality did not have enough water for domestic use and agriculture. This further confirmed that capital assets are linked to adaptive capacity. Drilling new boreholes constitute the basis of conventional approaches to improving groundwater access to farmers.

Mixed crop-livestock systems enabled farmers to integrate different enterprises on the farm: livestock provided draft power to cultivate the land and manure to fertilise the soil, and crop residues occasionally fed livestock in some areas. Moreover, income from livestock may be used to buffer low crop yields in dry years (Herrero et al., 2010). The synergies between crop and livestock rearing offered many opportunities for sustainably increasing production, since they could raise productivity and resource use efficiency for farming households. This, in turn, could increase incomes and secure availability and access to food for farming households (Herrero et al., 2010).

Smallholder farmers in the Overberg and West Coast adopted very limited strategies to adapt to drought. Among the reasons for this were that the farmers regarded themselves as poor and not capacitated to do anything. Nevertheless, the strategies adopted included moving livestock to greener pastures, saving money and sourcing or planting extra feeds. Some farmers reported that they drilled boreholes and some were preparing to change their production types, for example from cattle production to goats or sheep that are more drought tolerant.

Farmers remarked that they were not prepared for drought when it occurred. They were caught unawares. They observed that they were in the middle of a drought, that there was no sign of it ending soon, and that they could do nothing about it. The farmers were adamant that the government should assist them to cope and adapt because they did not have the capacity. This showed that the farmers were not capacitated and did not recognise the power in their hands to address their challenges. Adaptation in these areas is nevertheless not just about changing the physical circumstances, but also reviewing the water governance systems.

Access to agricultural water varied across the sites in both the Limpopo and Western Cape provinces. There were however interesting trends in how farmers adapted during the drought in the two provinces. Farmers in Limpopo had access to surface water from dams, but this decreased during drought periods. From the survey results, more than 50% of farmers opted to use rainwater harvesting or groundwater via boreholes for essential requirements such as drinking water for livestock. There was mention of the use of stone bunds and in-field rainwater harvesting, but it was not clear how important these strategies were, and which farmers saw these strategies as important.

There was a clear distinction in access to water between the Overberg and West Coast districts. There were serious shortages of water in the West Coast and most farmers resorted to transporting water for livestock. Unfortunately, there are limited alternatives in the long term for these areas, except to increase the flow in the canal system or to introduce a working water rights system. The solutions seemed to lie in the main with the municipalities or the central government. A few areas had enough water, but the governance systems had broken down.

The only area that suffered serious water shortages in the Overberg District was Barrydale, where farmers already experience seasonal water shortages even in normal rainy seasons. The problem was mainly tied to the type of lands that the smallholder farmers used for farming. They could not apply for water use licences for temporarily leased municipal lands. Other areas in Overberg had enough water, but the infrastructure was old and farmer relations were not working in some instances.

6 DROUGHT MANAGEMENT PROGRAMMES IN THE WESTERN CAPE

M. Fanadzo and B. Ncube
Also part of a PhD thesis by M. Fanadzo.

6.1 Introduction

The final stage of field research in the Western Cape included an evaluation of drought relief programmes in the province, with a focus on the Overberg and West Coast Districts. The research in Limpopo continued beyond the project and the results will be reported through two MSc students registered at the University of Limpopo, one looking at cropping systems and the other at livestock systems.

The research aimed to conduct a process or implementation evaluation of the Drought Relief Scheme at CASIDRA. Process evaluation is the most frequent form of programme evaluation, entailing assessment of the fidelity and effectiveness of a programme's implementation (Rossi et al., 2004). It seeks to determine how well the services are being rendered to the recipients and if they are being delivered in a way consistent with the goals of the program; it assesses the organisation of the programme's activities, its use of resources and how well the programme is operating overall. Process evaluation can be used as a freestanding evaluation to yield quality assurance information, assessing the extent to which a programme is being implemented as intended and operating according to the standards established for it (ibid.).

Implementation evaluation, according to PDME (2011), examines the activities, outputs and outcomes, the use of resources and causal links. It builds on existing monitoring systems and is applied during programme operation to improve the efficiency and efficacy of operational processes. The same can also be used in conjunction with an impact assessment as part of a comprehensive evaluation. Programmes should be implemented as intended for them to improve or resolve the diagnosed problem or situation. Rossi et al. (2004) posit that poor management, compromised due to political interference or faulty programme design, may fail in such implementation.

A full process evaluation could not be carried out in respect of the CASIDRA programmes because of how the organisation is structured. CASIDRA is not part of the WCDoA but is described as an organisation that "renders project management service to Departments within the Western Cape Government (WCG), local authorities, businesses, non-governmental organisations (NGOs), community-based organisations (CBOs), academic institutions, other governmental agencies and international assistance institutions". The objectives of the evaluation were, therefore, to establish the role of CASIDRA in the implementation of the DRS, as understood by the organisation itself and the personnel involved within the programme. The assumption was that, as the appointed implementing agent, CASIDRA would

be able to explain the full process followed in the implementation of the DRS. There was need to ascertain the precise connections between CASIDRA and the WCDoA and the responsibilities of each entity in the drought management process.

The role played by private organisations is of paramount importance in the drought coping and adaptation strategies enhancement among smallholder farmers. Analysis of the role of organisations in livelihood maintenance and drought coping and adaptation in the West Coast and Overberg revealed that private organisations were playing a significant role, including during the recent drought in the province. Among organisations identified by smallholder farmers as helping them to mitigate the effects of the drought was Agri Western Cape. Other private organisations indicated that they did not have specific drought relief programmes in place to assist smallholder farmers but would attempt to introduce one when the opportunity arose for them. Some were assisting indirectly but in such a way that their support could be translated into strategies to help farmers cope and adapt during drought. Agri Western Cape was identified as one of the affiliates of the WCDoA that was involved in drought relief implementation. It, therefore, seemed necessary to understand how the organisation was functioning and the extent to which it was involved in drought relief.

6.2 Monitoring and Evaluation of Drought Programmes

Monitoring and evaluation of programmes are required by the National Monitoring and Evaluation Framework (NEPF) of 2011, in terms of which rolling three-year and annual national and provincial evaluation plans must be developed and approved by Cabinet and Provincial Executive Councils, identifying the minimum evaluations to be carried out by departments (DPME, 2011). NEPF stipulates that departments would be responsible for carrying out evaluations, with technical support and quality control for evaluations detailed in the national and provincial evaluation plans provided by the Department of Planning, Monitoring and Evaluation (DPME) and the Office of the Premier.

The DPME acknowledges the important role that can be played by external evaluators in producing findings that are independent and impartial for the improvement of the programme evaluated. However, it also argues that the duty of the external evaluator should not dilute the responsibilities of programme managers, who are required to take a leading role in developing terms of reference for evaluations, and in managing evaluation processes, although they are not ‘evaluators’ (Mandondo and Troskie, 2018). It is with this understanding that the external evaluation of government programmes has become a sensitive issue and is hardly ever undertaken by external evaluators.

The Western Cape Department of Agriculture (WCDoA) acknowledges that the Disaster Management Act (Act No. 57 of 2002) provides for an integrated and coordinated disaster management policy that focuses on preventing or reducing the risk of disasters, on mitigating the severity of disasters, on emergency preparedness, and rapid and effective response to

disasters and post-disaster recovery (WCDoA, 2016). The department has adopted the Drought Management Plan (DMP) of 2005 and has put in place certain structures to support its implementation, as stipulated by the Act. The Department is among the few such entities to make strides in establishing structures and implementing strategies to mitigate the effects of drought in the province. Elsewhere, according to the literature, the DMP of 2005 has seen slow and limited implementation, regardless of the number of droughts that have been experienced lately in South Africa. Where indeed attempts have been made to implement policy strategies, there has been notably poor coordination and limited or no evaluation to determine if the implementation was going according to plan and design. The DMP 2005 emphasises that monitoring, and evaluation must be effective (DAFF, 2005). The lack of or limited monitoring and implementation evaluation of the Drought Relief Scheme (DRS) has resulted in the inefficient and ineffective realisation of the strategies meant to improve the lives of beneficiaries.

Since 2015 the WCDoA is reported to have institutionalised evaluations through the inclusion of the Departmental Evaluation Plan (DEP) as an annual strategic objective performance indicator, and the number of evaluations completed is included as a province-specific indicator in its annual performance plan (Mandondo and Troskie, 2018). Contrary to the overall picture presented in the literature, the WCDoA has been hailed for its performance in monitoring and evaluating its programmes (Mandondo and Troskie, 2018). The institution was officially recognised as the best Department in South Africa in terms of institutionalising evaluations at a provincial level by the National Department of Planning, Monitoring and Evaluation (DPME), at the 6th Biennial South African Monitoring and Evaluation Association Conference held in Sandton, Johannesburg, from 23 to 27 October 2017.

Various organisations made an effort to assist smallholder farmers to cope and adapt during the recent drought experienced in the Western Cape. This was the case with both private and public organisations, although their approaches differed. The common goal was to keep smallholder farmers on their farms and enable them to continue farming after the drought ended.

An analysis of drought support systems for smallholder farmers in the Western Cape made it clear that there were many players. However, the Cape Agency for Sustainable Integrated Development in Rural Areas (CASIDRA) was the main player carrying out the function on behalf of the Western Cape Department of Agriculture. The final stage of drought research in the Western Cape, therefore, included an assessment of the main drought-associated programmes. The aim was to discern and assess the steps taken to implement and monitor the Drought Relief Scheme.

6.3 Role of the Western Cape Department of Agriculture

The WCDoA delivers a broad range of services including research and technology development to animal and crop producers, agricultural advice and guidance to the agricultural community and all users of natural resources, infrastructure provision, training (including higher and further education), conservation of natural resources, agricultural engineering services, analytical services in respect of plant pathology and water, soil and veterinary laboratories, veterinary health services, and coordination of rural development in 14 different nodes across the province (www.elsenburg.com, 2019). These services are delivered through seven programmes, as follows:

- Sustainable Resource Management
- Farmer Support and Development (FSD)
- Rural Development Co-ordination
- Research and Technology Development
- Agricultural Economics Services
- Structured Agricultural Education and Training
- Veterinary Services
- Rural Development.

The Sustainable Resource Management programme is aimed at providing sustainable resource management solutions and methodologies through agricultural engineering and Land Care services, a pro-active communication, facilitation and implementation of projects, as well as technology transfer to clients and partners. The Sustainable Resource Management programme is also responsible for the implementation and management of disaster aid schemes and for providing expert comment on applications for subdivision and/or rezoning of agricultural land. It is structured into four sub-programmes, namely Engineering Services, Land Care, Land Use Management and Disaster Risk Management.

Since this study focused on understanding the implementation of the Drought Relief Scheme to assist smallholder farmers, a brief look at the umbrella Farmer Support Development (FSD) programme is necessary. The FSD programme encompasses the broad development agenda of the Department of Agriculture and is designed and implemented predominantly to support smallholder farmers in the Western Cape (though it does not exclude the commercial sector) (www.elsenburg.com, 2019). The purpose of the FSD Programme is as follows:

- To ensure sustainable support mechanisms for new and established farmers (including land reform beneficiaries)
- To measure the impact of interventions as delivered by the programme
- To leverage investment from the private sector and commodity groupings
- To ensure quality and standards of service and advice to farmers
- To integrate our services with those of municipalities and other government departments with the implementation of food gardens for communities and households

- To facilitate skills development for qualifying farmers.

The FSD programme is structured into four directorates. Table 6.1 summarises the purpose of each of the directorates.

Table 6.1 Farmer support Development directorates and their purposes

Directorate	**Purpose**
Farmer Settlement and Development	To facilitate, co-ordinate and provide support to black smallholder farmers and commercial farmers through sustainable development within agrarian reform initiatives in the Province.
Extension and Advisory Services	To provide extension and advisory services to farmers. The directorate has employed the digital smartpen to assist in monitoring the quality of services rendered to farmers.
Food Security	To support, advise and coordinate the implementation of pillar one of the Integrated Food Security Strategy of South Africa (IFSS). The directorate contributes directly to the alleviation of food insecurity through the delivery of household and community gardens.
CASIDRA	To support the Department with project implementation and state farm management.

6.4 Role of the Cape Agency for Sustainable Integrated Development in Rural Areas (CASIDRA)

CASIDRA is a sub-programme of the FSD and acts as the implementing agent for the WCDoA projects. CASIDRA has been actively involved in Rural Development since 1989 in the Eastern, Western and Northern Cape Provinces. Activities have been consolidated in the Western Cape because of that province's ownership of the project (CASIDRA, 2018). CASIDRA's activities extend over the whole spectrum of rural and economic development, including agriculture, agro-industries, economic development, community development, rural tourism and infrastructure (CASIDRA, 2018). The organisation envisions itself as the catalyst for growth towards self-sustaining communities, maximising agricultural and economic development opportunities in rural communities through project management excellence. CASIDRA renders Project Management Services to departments within the Western Cape Government, local authorities, businesses, non-governmental organisations, community-based organisations, academic institutions, other governmental agencies and international assistance institutions. The organisation is funded by the Western Cape Government, although it recognises that closer private sector involvement will benefit not only development in rural areas but also the economic empowerment and tourism potential of the Western Cape as a whole.

CASIDRA has four programmes: Corporate Services, Agriculture and Land Reform, Rural Infrastructure Development and Poverty Alleviation, and Local Business and Economic

Development (CASIDRA, 2019). This study focused on the Rural Infrastructure Development and Poverty Alleviation Programme, which aims to provide a project management service for specific rural development projects and agricultural initiatives. The objective is to improve the standard of living of people in rural areas, by addressing the socio-economic needs of rural communities and creating employment. This is to be achieved through three sub-programmes, namely Infrastructure Development Services, Community and Household Food Security and other Project Management Services, including Training, Land Care, Disaster Management, Green Economy, Mechanisation and Alien Clearing. The specific sub-programme that was evaluated is Disaster Management, which addresses a whole range of climate and weather-related issues, including drought (CASIDRA, 2019).

6.5 Evaluation of the Drought Relief Scheme

The evaluation initially focused on understanding the processes that CASIDRA follows in implementing the drought plan of the WCDoA. The objectives of the evaluation were:

- To determine the activities of CASIDRA in the implementation of the drought relief scheme during the recent 2015-2018 drought
- To understand the relationship between CASIDRA and WCDoA
- To determine the perceptions of smallholder farmers towards the DRS as understood by CASIDRA and the extension officers
- To understand the role of a private organisation: Agri Western Cape.

6.5.1 Evaluation questions

This is a set of questions developed by the evaluator, evaluation sponsor and other stakeholders to define the issues the evaluation will investigate, stated in terms such that they can be answered using methods available to the evaluator and in a way useful to stakeholders (Rossi et al., 2004). These questions vary according to the nature of the programme issues they intend to address. They give a structure to the evaluation, guide in planning and assist in determining those interested in the evaluation process and use of findings (ibid). It has to be reiterated that the questions were generated by the evaluator only, in anticipation of engaging the staff involved in the programme at a later stage to finalise them. However, because comprehensive evaluation could not take place, some of these questions were not fully answered.

The evaluation intended to answer the following key questions:

- Who should the Drought Relief Scheme (DRS) serve?
- What services should the DRS provide?
- How can the DRS identify, recruit and sustain the intended participants?
- How should the DRS be organised?
- What resources are necessary to successfully implement the DRS?
- Does CASIDRA have the resources available and adequate for the scheme to be implemented as expected?
- Are the intended services of the DRS being delivered to their intended participants?

- Are the services of the DRS covering all the intended targets?
- Are all the participants satisfied with the DRS?
- What are the relationships between CASIDRA and WCDoA and the smallholder farmers?
- What challenges do CASIDRA and WCDoA experience in implementing the DRS?
- What are the possible ways of improving the implementation of the DRS in future?

6.5.2 Evaluation Process

A desktop review and mapping of CASIDRA and WCDoA organisational structures were carried out mainly through consultation of their websites and published documents. A meeting was then held at the CASIDRA offices in Paarl on 9 July 2019 to present the aims of the study and to obtain buy-in from the programme staff. The meeting was successful, and issues were clarified, culminating in the identification of the person who would participate in the study.

Face-to-face interviews were conducted with the officials directly involved with the DRS implementation. WCDoA extension officers were requested to complete a questionnaire to determine their role in implementing the DRS on behalf of WCDoA. Two extension officers, one each from Overberg and West Coast, eventually completed the questionnaire. Some smallholder farmers had either reported CASIDRA or WCDoA as the source of their drought support and specifically mentioned extension officers. It, therefore, made sense to include the extension officers in the study to determine the extent to which they engaged with the DRS implementation process and the nature of their relationship with the beneficiaries.

Data collection then focused on the extent to which CASIDRA was involved in the DRS implementation, and on challenges and suggestions for improving the programme's performance. A purely qualitative research process was employed as it allowed participants to express their views, moreover in ways that figures could not explain. The aim was to probe the perceptions of programme implementers on how the programme was going and its performance.

Interviews were also held with the Chief Executive Officer and Media Officer of Agri Western Cape to understand the work the organisation was involved in and its relationship with WCDoA.

6.6 Role of CASIDRA and the Western Cape Department of Agriculture

During interviews with the CASIDRA officials, it became apparent that CASIDRA was not responsible for implementing the whole DRS. It is, therefore, crucial to discuss the involvement of the WCDoA first, to provide the context in which CASIDRA is involved and the extent of that involvement.

As envisaged, Drought Implementation Plans (DIPs) are prepared before rolling out an intervention. Their development and coordination remain the responsibility of the WCDoA. A

DIP is a document that guides the activities of the scheme during implementation. An example of a DIP for 2018/2019 and 2019/2020 was identified and used as a point of departure to determine and discuss how the WCDoA designs, develops and implement DIPs for DRS in the province. This particular DIP contextualises the situation by acknowledging the fact that the Central Karoo, West Coast and Eden areas had recorded far below normal rainfall during the previous two to three years and that natural, planted pastures and fodder banks had long been exhausted. Furthermore, livestock was dying, and a lot more had had to be culled. It was reported that the province was supporting more than 2000 smallholder and commercial farmers with feed in the form of vouchers. It was estimated that the DRS would operate for an initial period of twelve months and that climatic conditions would determine whether the period needed to be extended. Key elements in the implementation plan included meetings, periods of funding, stakeholder involvement, reporting, risk analysis, cash flow projections, monitoring and evaluation, the capacity and preparedness of WCDoA, and summary activities. Table 6.2 highlights some of the elements of the DIP of 2018/2019 and 2019/2020, as an example of the many such plans that have been prepared by the department.

Table 6.2 Implementation plan 2018/19 and 2019/20 elements

Item	Description*
Meetings	Processing of the new applications and review of the old. Updates on beneficiaries.
Period of funding	12 months
Stakeholders	• WCDoA [District Managers [Land Care] • Project Coordinators [Disaster Risk Management] • Director [Sustainable Resource Management] • CASIDRA • Farmers • Suppliers
Risk analysis	The likelihood of risks and their anticipated impact was rated as low and contingency plans were put in place

*****_Some of the sensitive information is not reported here because no full evaluation took place, so the reporting was limited to general information_.

Among the stakeholders acknowledged to play a role in the DIP, from WCDoA, the FSD extension officials were invisible, yet they were involved reasonably in the process of implementation. DAFF (2005), in the DMP of 2005, highlights that the extension services for handling drought disasters must be well coordinated. The extension officers confirmed the role that they played by agreeing to take part in this exercise. Responding to the question: "What role did you play in the implementation of DRS?", the two officials spoke as follows:

> Resp-EO1: To provide administrative and technical support to drought-affected farmers in the Overberg district. Administrative support is in the form of completion

and collecting of documents (drought relief form, tax clearance certificate, lease agreements etc.). Technical support is in the form of calculating carrying capacity of the land, extension and advisory services, drought information sessions etc.

Resp-EO2: I was responsible for ensuring that the drought relief recipients were receiving their vouchers from the department, which allows them to access their animal feeds such as drought pellets, yellow maize, energy and protein licks among others through Piketberg Kaap Agri. However, the role was later played by the Land Care officials in the district office, and as an official from Farmer Support and Development, I had to only handle new applications and inquiries from clients regarding either application progress. However, whenever there were any inquiries, I had to send them to Land Care officials for further clarification.

The activities organised included information sessions and farmers' days, as ways of advising farmers of the available drought relief support. Officials also visited farms, assisting farmers to complete drought relief application forms, calculating carrying capacity, collecting supporting documents, tax clearance certificates and lease agreements, and submitting these to local Land Care officials. Considering that this is a role played by FSD extension officials to assist the Sustainable Resource Management directorate, the situation may necessitate a clear outline of roles and responsibilities to clarify accountability. As revealed by the statements quoted above made by extension officers who should be playing the same roles across the board, it is already clear that their duties are in conflict and working relations could be under strain. This might create an unhealthy working environment and relationships and undermine effective teamwork.

6.6.1 Selection of beneficiaries

The selection of beneficiaries of the DRS is the role of WCDoA through the Sustainable Resource Management Directorate. CASIDRA is not involved in identifying and selecting the recipients of DRS and has no influence. The organisation is only involved from the point when its representatives) attend meetings to receive applications approved by WCDoA. This is what the CASIDRA official had to say concerning his involvement in identifying participants for DRS:

Resp-CPM: So, we do that for them, they identify because they have got people in the field, what we call extension officers, and area managers the whole of Western Cape. So, those people then identify people that need assistance, they will fill in the correct documentation… it's been approved at Elsenburg, the money is with us, we then pay for that fodder. That is on the Drought Relief Scheme. They provide money for fodder for the animals and that's where we come in because they don't have a system to pay out the farmers, we've got that.

It would surely be more reasonable if CASIDRA, as an implementing agent, were involved in the recruitment of beneficiaries for the DRS. That this does not so suggest that the design of the DIP is somehow flawed, though there may well be plausible (if not obvious) reasons why things are the way they are. It is nevertheless inevitable that how the DIP is designed determines how the services of DRS are being delivered to its recipients and what effect. The only clear aspect of this process is that those who qualify according to the criteria set for DRS become participants. It is not clear whether or not potential participants are educated well before time regarding the requirements for DRS in the event of drought. Mthembu and Zwane (2017) found that the strict programme requirements for farmers excluded those who did not have proper records (for example, cattle dipping records or brand mark certificates).

6.7 Relationships

Relationship between WCDoA and CASIDRA

One of the objectives of this study was to determine how stakeholders are involved and connected, the different functions they perform and how these relationships influence their work. From the DIP in question, it appears that the WCDoA and CASIDRA are closely working together, although some officials from WCDoA are silent partners, as indicated earlier. The two extension officers from WCDoA reported that they were not in any way directly involved with CASIDRA during the DRS implementation.

> Resp-EO1: No involvement with CASIDRA.

> Resp-EO2: No involvement at all, I personally never got involved with any CASIDRA official during drought relief implementation.

The respondent at CASIDRA confirmed that FSD extension officials were not directly involved, although he worked closely with the Sustainable Resource Management Director.

6.7.1 Relationship between smallholder farmers and CASIDRA

As discussed under the recruitment section, the official at CASIDRA reported that there was no involvement between him and the beneficiaries. He acknowledged that there were WCDoA extension officers on the ground helping the farmers with the completion of the forms.

> Resp-CPM: That specific one, on the ground we are not involved.

6.7.2 *Relationship between WCDoA and smallholder farmers*

Extension officials from FSD confirmed that in terms of DRS implementation, they are only involved in offering extension services as they usually do. However, on behalf of Sustainable Resource Management, they assist participants in the DRS to complete application forms.

> Resp-EO2: When the implementation of the scheme initially started, I was much involved somehow in the administration. Thereafter, I was not involved as the responsibility was moved to the Land Care District Official without [my] being notified.
>
> Resp-EO1: Limited or in some instances no involvement in the Drought Relief Scheme. Continued with extension and advisory services.

6.7.3 *Relationship between FSD and Sustainable Resource Management personnel*

Both the extension officers reported that they were not sure what happens with the smallholder farmers concerning drought support after the completion of application forms. The forms are handed over to a Sustainable Resource Management official who then submits them to the authorities responsible for the approval of applications. The same official is then the last person to distribute vouchers to applicants who have qualified for support, who then present the vouchers at the supplier for feed. The extension officers receive no communication about the outcome for applicants whom they have helped with the forms.

> Resp-EO1: [I] assist one of the subprograms of Sustainable Resource Management called Land Care with completion of drought relief application forms and submit completed forms to the local Land Care office.
>
> Resp-EO2: My involvement with the Sustainable Resource Management was minimal as I only had to contact them for clarity of some issues that might have arisen during the implementation process. I would normally contact them for if one of the applicants wants to know something which I could not help with or address.

These sentiments suggest that there might be fine distinctions that need to be clarified in terms of the role of extension officers during DRS implementation. The extension officers seem to feel deprived of a responsibility that might not have been theirs in the first place. If extension officers should merely offer assistance during the implementation process, then it should be communicated to all parties to avoid misunderstandings and promote an open working environment. Extension officers are used to seeing farmers daily as they go about their business and have in most cases developed a considerable rapport with them, so it is understandable that they might feel excluded by not being fully involved in this particular process.

It might sound like duplication of tasks if both CASIDRA and extension officers were involved with beneficiaries of DRS during implementation. On the other hand, limited or no involvement with them might open a gap between the two stakeholders. The opinions or perceptions of beneficiaries could be directed to the wrong place. This emerged during the livelihoods, coping and adaptation strategies analysis of the same beneficiaries, when some could not distinguish between CASIDRA and WCDoA as the source of their support. Some voiced their frustration with the extension officer, yet whatever happens after the completion and submission of forms

is beyond the knowledge of the extension officer and his or her capacity to influence the outcome is almost nil.

While on this point, it is important to note that interventions that depend on other interventions to succeed present challenges to notions of accountability. Funnell and Rogers (2011) argue that those involved in the first stage are often adamant that it is not reasonable to hold implementers of the first stage accountable for the achievement of the outcomes since they do not control them. At the same time, if there is no success in moving from the first stage to the outcomes, continuing with the first stage of implementation has little point. This scenario appears to indicate that a programme should be developed and established by those intending to evaluate its impact. However, in the case of process evaluation, this point is not critical, unlike in the case of impact assessment.

6.8 Scope of Support

Participation by all smallholder farmers in the DRS is not guaranteed. Smallholder farmers are assisted only after their area has been declared a disaster area and if they qualify by meeting the requirements of the DRS, for example by avoiding overstocking and complying with the South African Revenue Authority. One of the extension officers reported that only nine smallholder farmers were assisted during the recent drought in the Barrydale area, an area drier than the others that qualified for declaration. This information could not be confirmed, because the intervention came way after the interviews with the farmers were conducted during the analysis of livelihoods and coping and adaptation strategies in the area. Another extension officer reported that they assisted twelve beneficiaries from the Bergrivier municipality, where he was responsible. A proper evaluation at the level of CASIDRA could, of course, establish the total number of recipients, because the reconciliation of vouchers and payments is done there. In interviews with CASIDRA personnel, the number kept changing, but the latest number provided was 3000 beneficiaries.

> Resp-CPM: What we make it easy for the farmer now … um, there is more than 2000 of them on the list, the last time I checked it was 3000….

Various reports from farmers during focus groups confirmed that some of them had indeed received support through DRS:

> FGD-Hope: The other thing is that also it costed us because we had to buy feed from other people 2015-16, 2017 we didn't buy we got support from the government because we got vouchers from the government to take care of ourselves.

> FGD-Goed: We got pellets only… but we no longer get them ….

> FGD-Eben: All of us got bales/pellets from the government.

During the focus group discussions with smallholder farmers, the research team gathered that the support came late when some of them had already lost their livestock. Some reported that the support remained constant regardless of their animal herds increasing. This implies a contradiction of programme requirements, suggesting that the beneficiaries may be lacking the basic information about what is expected of them as participants. There is a need for effective communication to prepare smallholder farmers for drought as a way of cushioning them from vulnerability and enhancing their adaptive capacities. If the farming community's role in the implementation of the DRS must be taken seriously for it to achieve its purpose, something should be done to educate farmers about the design and operation of the programme.

The existence of CASIDRA under the FSD and its involvement in implementing DRS through working directly with Sustainable Resource Management makes it difficult to understand the lines of reporting, communication and accountability. It appears that two directorates are competing to achieve one common goal, and questions such as the following may well arise: Does this reflect poor coordination of activities leading to poor implementation of plans? Could it be an oversight on the department's side or is it for a specific purpose? Are roles explicitly defined anywhere? Do the implementing personnel understand the DRS and how it should be implemented? These and many other questions remain unanswered. Given that buy-in was not sought from the Sustainable Resource Management directorate in the first place, some of these concerns and issues could not be clarified, and the views presented are partly those of the research team.

Following the discovery that the WCDoA had developed four evaluation plans since 2016, a search for some of the evaluation reports identifying findings relevant to the DRS was conducted. None of the evaluation plans showed that a DRS evaluation had been conducted or would be conducted soon, except the Smart-Agri programmed which was proposed for evaluation. It can be argued that it is too early to expect an evaluation of the DRS since the drought is just ending. It could, in any case, be a while before a DRS evaluation is conducted, considering how difficult it might prove to merge information from different stakeholders.

6.9 Challenges of Implementing the Drought Relief Scheme

One of the extension officers reported that he encountered farmers not being truthful in providing information during the completion of the application forms.

> Resp-EO2: Some farmers cheated the system by disclosing false information regarding the number of livestock they claimed they had and it, therefore, became controversial to investigate such cases in order to verify whether they have such animals. Whenever you come to verify the animals they'll either inform you that animals are already in the veld or some of the animals were somewhere else.

This is unfortunate, though perhaps to be expected. It might be pointing to a loophole in the verification system and process. There could be a need to tighten up the system so that there is continuous monitoring of herds regardless of whether there is a drought or not. Since extension officers work with farmers daily, there should be a way of collecting that and any other information potentially useful for future monitoring and evaluation purposes.

Other reports suggest that the support was not always channelled in the intended direction.

> Resp-EO2: There were such allegations that some beneficiaries were selling the drought relief feed to other farmers at a reasonably cheaper price.

The same concern was raised by the CASIDRA respondent:

> Resp-CPM: We don't have an agreement with the supplier of fodder, but we have got an agreement with the farmer to get fodder depending on the number of animals they have got, the current price R854/cow. So, maybe he has got 5 heads or 10 heads of cattle, but that the Department of Agriculture works out not us. They are supposed to go and count if a farmer said I got 10 heads of cattle, then whoever said he's got 10 and right in the beginning. When I analyzed I said to our CEO the risk is when we look at the social-economic side of the country these people in the rural areas don't have money they have got animals. If my two heads of cattle can bring in R1700 it's easy to defraud the department of R1700, these two heads of cattle can go to my son or cousin, so every time the department of Agriculture comes to count, they count the same ticket, but that is us, we don't take that risk, the department takes the risk. I mean if you look at the … I think R20 000 is the biggest amount per voucher, there is R1211 I don't know maybe that's a cow and a calf, but they work it out, we have got nothing to do with it… we just implement the business plan.

This revelation highlights the lack of accountability and responsibility on the side of the beneficiaries, while at the same times possibly manifesting weakness in the system. As indicated earlier, there is no further mandate placed on the farmer after they collect the vouchers for feed from the supplier. There might be limited, or no monitoring is done to determine the use of the support by beneficiaries and their sincerity in applying for such. The DRS Implementation Plan of 2018/2019 and 2019/2020 declared that there was a low likelihood of financial misconduct by beneficiaries and the contingency plan in place was that vouchers would be paid by CASIDRA. This is just one example to show that the verification process needs to be tightened up.

Needless to say, smallholder farmers are seen as lacking the capacity to cope and adapt to drought, due to their lack or limitation of resources. Organisations should, therefore, be committed to implementing programmes to enhance their coping and adaptive capacity and reduce their vulnerability. Failure to play this role exacerbates the situation and further exposes the farmers: for instance, as one of the extension officers reported, some resource-poor farmers

were struggling to collect their feed on time due to lack of transport. These reports suggest that there is a gap in the services provided. It is not clear whether the provision of transport is possible in such cases, but if not, the beneficiary should understand that they bear the responsibility of personally sourcing transport. This could be a manifestation of the 'dependency on the government to provide everything' syndrome when the beneficiary recognises no responsibility to do anything for him/herself. There is, therefore, a need to exercise caution when reporting or reaching conclusions on the findings of programme implementation.

Extension officers were asked if in their opinion they had assisted smallholder farmers to their satisfaction. Both respondents opted for "Maybe" as their response, and explained their answer as follows:

> Resp-EO2: I would like to see more farmers being helped but unfortunately at some stage, they could not get help as they failed to submit required documents although they had livestock. Some of the farmers could not get help based on the fact that they were keeping more animals than what is required (over-stocking) and thus affect natural resources such as veld condition (over-grazing). Such farmers were not willing to comply or reduce the number of their livestock so that they could benefit from the scheme.

Two issues emerge that of farmers' reluctance to respond to advice, and that of the limitation of resources, which are both beyond the extension officers' control. It is, of course, possible that those who decided to keep their herds intact might have found other ways of mitigating the effects of drought, while those who were genuinely in need but could not qualify were further affected and joined the ranks of those who simply could not survive the drought.

The other respondent felt that although he was not sure if the purpose of the DRS was achieved, he could not account for the result because it was partly beyond his control.

> Resp-EO1: I am not directly involved in the drought relief programme. However, I am responsible for extension and advisory services, especially providing information to farmers concerning drought management.

This is yet another weak point in the DRS implementation that needs to be fixed.

In terms of human resources, although not reported by officials, the fact that Sustainable Resource Management was assisted by the extension officers could reflect the inability of the District Manager (Land Care) to visit all participants in the DRS and perform all the administrative work. It was acknowledged that Land Care projects are time-consuming due to the intensive extension required to plan and execute projects with previously disadvantaged communities, and that having enough personnel to render agricultural extension services to

new farmers was a pressing issue. Furthermore, the expertise of the extension officer (who in this case is only indirectly involved) in performing drought management work may be limited or compromised. A study conducted by Wentink and Van Niekerk (2017) on the implementation of the Disaster Management Act with a focus on the capacity of personnel found that 73% of respondents felt that not enough staff were working in municipality disaster management centres to deliver an adequate service.

Financially speaking, one of the extension officers reiterated that there was no specific budget for drought management, thus provinces needed to use whatever was available from Land Care funds before reaching out to the National Treasury. This also limits the scope of whom the DRS can assist during droughts.

A suggestion was made to improve the system through which assistance is rolled out to its beneficiaries, and the need for transparency and accountability was emphasised.

> Resp-EO2: Compliance of some regulations should be applied across all levels of farmers and should not be selective or imposed only to black farmers which are already in the government database. Animal verification was mostly enforced on smallholder farmers and less attention was given to commercial farmers, officials could hardly tell where those commercial farmers are farming or situated.

The need for monitoring and evaluation was reiterated. However, it has been established that the WCDoA is responsible for drought response and relief. What remains is whether or not the monitoring and evaluation are robust enough to address the issues emerging from this report. The limitation of this study stems from the difficulties encountered in accessing information to determine what exactly has been done, resulting in it not being conclusive in some respects. However, throughout the efforts to understand the implementation of the DRS, the absence or limited awareness of the expected outcome of the DRS was evident, which implies a lack of concern about whether interventions are being designed in such a way as to achieve a clear and measurable outcome. On the same note, the official from CASIDRA acknowledged that the organisation could not be the judge and the prosecutor: there was a need to erect a monitoring and evaluation system to ensure the achievement of desirable outcomes. The respondent further acknowledged that government departments are typically concerned about outputs rather than outcomes. This is what the respondent had to say about outputs vs. outcomes when asked: “who should be responsible for outcomes”?

> Resp-CPM: Good question… CASIDRA is not responsible to do the monitoring and evaluation of the project. So, we must only look at the outputs, we must assist that farmer with X, Y and Z. We give out 20 tractors for a year to farmers, now one guy from mechanisation went around the provinces and saw 80% of the tractors are parked. The farmer uses a battery to fill out his tank, you see, there was an output, there was no outcome. But CASIDRA when I put in a proposal, let CASIDRA put in

> monitoring and evaluation and go see what is happening out there. We have spent millions if not billions on farmers to capacitate or to assist them. Where are those farmers now? Yeah, they are still there but what is their status? If their status is still the same as five years ago, then we have achieved nothing. Absolutely nothing.

One of the extension officers added his voice on monitoring and evaluation:

> Resp-EO1… monitoring of relief support and continuous feedback to the government with regard to drought relief.

It remains a sad story that large sums of money have been invested in projects meant to change the lives of the needy but have yielded limited results. The CASIDRA official was concerned about his organisation's lack of identity and the limited impact they were making on the livelihoods of smallholder farmers involved in the programmes they implemented. He emphasised the fact that their terms of reference limited them literally to spending money on behalf of the WCDoA, which was worrying because there was a lot of potential in the organisation.

6.10 **Role of Agri Western Cape**

Agri Western Cape envisions its core purpose as the preservation and promotion of healthy local agriculture and food supply chains, capable of serving the society's immediate and long-term needs. The CEO has summarised the goal of the organisation as follows:

> We are a member-based organisation and at this stage we got commercial farmers affiliated with farmer unions and farmer unions affiliated with Agri Western Cape and Agri Western Cape affiliated with Agri SA. Okay, so that's agriculture organised stuff…We also have commodity organisations that are affiliated with us, yeah so I think we cover a large part of the agricultural sector in our province… just a background of how the structure looks like…I think you can shoot those questions… Well, if I can give you our broad goal and purpose is to influence policy… yeah, we represent commercial farmers and whenever we see it necessary to influence, to interact with policymakers and make and getting involved in policy decisions um that's our main focus and also relief…in terms of drought, we also have a drought relief fund that we assist our members with… and then via the commodity organisations, we also support emerging farmers in terms of training. We don't have capacity ourselves but we just have a small complement of staff, like I said the commodity organisations that are affiliated with us, for example, the Hortgro and Vinpro we support what they are doing for emerging farmers so yeah, that's our goal. We would like to see a vibrant commercial industry and we would like to see more emerging commercial farmers, of course, we see it comes in stages where are smaller and you become a commercial farmer. I think we need food production for food

> security for our country so we need more producers so yeah we support it, although we don't have the capacity to get involved in project specifics via our affiliated members we do support wherever we can…

As it envisages its role, the organisation represents farmers in meetings that make critical decisions concerning their farming activities, in an attempt to influence policy in favour of the farmers.

> Resp-AWC: We have got a very good relationship with them and we support what they do and they support what we do…we are supported because I think we try to influence or to contribute policy decisions … I mean that requires a good relationship or understanding between the two of us… Like I said we represent a lot of farmers and at this stage, I can say we have got a very good relationship we are working… We sit in a lot of committees that they have and attend the critical… the crucial meetings that they have and yeah we have a very good relationship with them, as we see them as important stakeholders in the whole agriculture sector and I trust that they see us in that way as well….

Agri Western Cape has its drought programmes implemented by the organisation itself through the 19 district representatives in all five district municipalities in the province. Respondent AWC1 had this to say about the programme:

> We have got our own program for drought where we get donations and we assist our members with transport or buying of fodder. We have got 19 district representatives so we get feedback from them, they lodge an inquiry and we say this area we can assist. We also ask other areas if they have feed and then we pay for the transport if it is not free and then they themselves decide in their area which area is critical because they distribute to their members there in terms of what actually is on the ground. So, we don't get involved there because for me to sit in this office and say X needs this… it's a bit difficult, so we ask our representatives there to distribute….

The drought support is only for the organisation's members.

> Unfortunately, it's for our members, but the department one is for all farmers. Because it is Agri Western Cape Fund, so yeah it was a decision on our board meeting who do you support first because we are a member organisation, so if we don't have members there is no existence.

Respondent AWC1 observed that there was no need to differentiate smallholder farmers from commercial ones because there were connotations of segregation and patronisation attaching to the term. The approach to assisting beneficiaries during drought was therefore not an issue of categories, as all members of the organisation automatically qualified for support. This

principle applied to all the activities of the organisation: all members were treated equally and received the same information once they were added to the database. The number of members assisted through the drought programme could be around 3800 (estimated number of members affiliated with different farmer unions across the province).

Regarding Agri Western Cape's involvement in DRS implementation:

> Where we are involved in the WCDoA – DRS, we assist the department with identification of critical areas because we have got structures in the whole province, so we can get feedback so on the committees we are involved we say this is our critical areas, does it match yours? Then they table it, the map of the province so we know where the critical areas are, so we give input from that side. But the application, the verification and the evaluation and the approval lies with the department.

In terms of influencing drought policy, Respondent AWC1 was of the view that because of the good relationship they had with WCDoA, they were able to sit and talk openly, and that the department was keenly aware of the drought. The role that the organisation was playing now was to simply emphasise the issue and support the department with information and advice.

6.11 Conclusions

The WCDoA and CASIDRA are fulfilling their mandates of implementing the DRS in the province to assist smallholder farmers with fodder for livestock during drought. The Department is performing its task of coordinating the efforts of all stakeholders as outlined in the Provincial Drought Management Plan of 2016 and the examples of the Drought Implementation Plans of 2017/18 and 2019/20. Evaluations have also been conducted by the department since 2015, as stipulated by the NDME. However, it remains a major challenge to determine the extent to which the DRS is being implemented at the provincial level. What has become evident is that CASIDRA is only involved in the administration of the funding on behalf of the WCDoA. CASIDRA is not directly involved with smallholder farmers, nor with the extension officers, but liaises with the management staff at the WCDoA. CASIDRA is also directly involved with the suppliers of animal feeds, for example, Kaap Agri and Cape Feeds. Apparently, CASIDRA's sphere of operation is limited and stops well short of being able to exert influence for change on farmers.

The nature of connections among those involved in the implementation of the DRS as stipulated by the DIPs of 2018/2019 and 2019/2020 is generally worrying. There seems to be a lack of cohesion in communication and the delegation and execution of duties. Although this conclusion is admittedly based on the testimony of the few individuals who were interviewed, the situation evoked could account for how services are being rendered to the beneficiaries and could raise many concerns regarding accountability on the part of those involved in the implementation process.

Reflecting on the question of recruitment, the process seems to be haphazard and exclusive of those who do not meet certain requirements, though some of the reasons for this are beyond the farmers' control. There is a need to cushion smallholder farmers through proper planning and investment in programmes that empower them for future support interventions.

Challenges experienced during implementation of the DRS include misappropriation of support by beneficiaries, inadequate capacity in terms of human resources, and a lack of coordination and communication among stakeholders at the level of CASIDRA, WCDoA directorates and the farmers themselves.

Agri Western Cape is involved in DRS implementation through the WCDoA and is offering support in terms of information and technical advice. The organisation has a drought fund which is meant specifically for its members to enable them to keep their activities running. Generally, Agri Western Cape supports the government departments in leveraging their efforts through lobbying and other forms of policy influence. The two main organisations working closely with Agri Western Cape are Hortgro and Vinpro. The major challenge identified by the organisation is lack of capacity, which is the reason for its limited direct involvement with its clients (smallholder and commercial farmers).

It can therefore be concluded that the DRS still faces implementation challenges, even in the Western Cape where some of the structures were established. There is a need for more work to be done on strengthening the process to be followed when implementing the DRS, and this should be followed by systematic data collection for ongoing monitoring to facilitate future evaluations.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Smallholder Farmer Characteristics

Smallholder farmers are not a homogeneous group, and any policies and strategies should begin by recognising this fact. There are various categories of smallholder farmers requiring different support approaches. Technological and institutional packages should be tailored to the characteristics and livelihoods of the smallholder farmers involved. It is also necessary to recognise that farming areas in the former homelands do not have the same agricultural potential as newly resettled areas. Diverse strategies will, therefore, need to be developed to ensure that different smallholder farming areas receive relevant assistance.

There were huge differences between the assets and general livelihoods of the smallholder farmers in Limpopo and the Western Cape. Although the respondents owned almost all the varieties of assets, they were not at the same level. Considerable disparities were starting at the demographic level that served to confirm that strategies for support could not be the same.

7.2 Agricultural Water Use

Access to agricultural water varied across the sites in both the Limpopo and Western Cape provinces. There were serious shortages of water in the West Coast in the Western Cape. In both provinces, farmers resorted to transporting water for livestock. In Barrydale in the Overberg district, farmers were already experiencing seasonal water shortages even in normal rainy seasons. Smallholder farmers were leasing municipal land that had no water rights and were unable to apply for water use licences for temporarily leased lands. Groundwater from boreholes was a coping strategy for short-term and long-term transformative responses in both provinces. There were limited alternative water sources in the long term in both areas, except to increase canal systems or working water rights systems. The solutions lay mainly with the municipalities of the central government. In the few areas that had enough water, the water governance systems had broken down. In Overberg, there were areas with enough water, but the infrastructure was old and relations among farmers were in some instances less than cordial.

7.3 Drought Support to Smallholder Farmers

The last phase of the research sought to determine the role of organisations in supporting livelihoods and fostering drought coping and adaptation strategies for smallholder farmers in the Western Cape, including the effectiveness of extension services. It was found that drought relief schemes in South Africa continue to be based on money spent on supporting farmers to cope and adapt to drought and the number of clients assisted. The national government continues to be reactive rather than proactive: this was confirmed in both the Overberg and the West Coast by farmers who reported having received animal feed or grants to purchase feeds and medications, but too little and too late, often after they had already lost livestock.

At the provincial level, smallholder farmers were assisted largely by the Western Cape Department of Agriculture through the Cape Agency for Sustainable Integrated Development in Rural Areas (CASIDRA). During focus group discussions farmers reported that the value of vouchers for animal feed was fixed, although prices tended to climb during drought due to high demand. Farmers eventually turned to their savings to be able to continue. Most smallholder farmers seemed to have been caught unawares by the drought, showing a lack of proper early warning systems. Farmers who received information reported that it was about climate change and that they could not interpret the information to mean that drought would occur soon.

Some extension officers were of the view that the Overberg had not been affected by drought although several smallholder farmers reported being impacted by drought, especially in Barrydale. However, it was not just the extension officers' perception: the Overberg had not been declared a drought disaster area, which made it difficult for officials to acknowledge and implement relevant activities. Private organisations did not provide direct drought assistance to smallholder farmers during the drought period, though some farmers benefitted from programmes sponsored by private organisations through other structures. Commercial farmers and mentors assisted some smallholder farmers in their areas.

Some government departments supported smallholder farmers in the Western Cape. Organisations such as the Western Cape Department of Agriculture (WCDoA), Department of Human Settlements, Water and Sanitation (DWS), the Department of Agriculture, Forestry and Fisheries (DAFF), Department of Rural Development and Land Reform (DRDLR). DWS advised farmers to save and manage water better to achieve desired outcomes. Water restrictions were, however, imposed, resulting in farmers not being able to access water for agricultural purposes. The Breede-Gouritz Catchment Management Agency (BGCMA) also had specific programmes set up to support smallholder farmers.

Due to the commodity approach of Western Cape agriculture, there were numbers of private organisations supporting farming. Private organisations also supported smallholder farmers with information on drought mitigation, funding, facilitation of access to resources and lobbying. Several organisations pointed out that no interventions were focusing specifically on drought relief for smallholder farmers.

WCDoA and CASIDRA were fulfilling their mandates of implementing the Drought Relief Scheme (DRS) in the province to assist smallholder farmers with fodder for livestock during drought. WCDoA coordinated the efforts of all stakeholders as outlined in the Provincial Drought Management Plan of 2016, and the Drought Implementation Plans of 2017/18 and 2019/20. Evaluations had also been conducted since 2015 by the department. However, it proved difficult to determine the extent to which the DRS was being implemented at the provincial level. What was evident was that CASIDRA was only involved in the administration of the funding for the WCDoA. CASIDRA was not directly involved with the smallholder farmers nor with the extension officers. The organisation was in contact with the management

staff at the WCDoA and with the suppliers of animal feeds, for example, Kaap Agri and Cape Feeds. Apparently, CASIDRA's sphere of operation is limited and stops well short of being able to exert influence for change on farmers. The nature of connections among those involved in the implementation of the DRS as stipulated by the DIPs of 2018/2019 and 2019/2020 is generally limited. There seems to be a lack of cohesion in communication and the delegation and execution of duties, though this conclusion is admittedly based on the testimony of the few individuals who were interviewed.

Reflecting on the question of recruitment, the process seems to be haphazard and exclusive of those who do not meet certain requirements, though some of the reasons for this are beyond the farmers' control. There is a need to cushion smallholder farmers through proper planning and investment in programmes that empower them for future support interventions.

Challenges experienced during implementation of the DRS include misappropriation of support by beneficiaries, inadequate capacity in terms of human resources, and a lack of coordination and communication among stakeholders at the level of CASIDRA, WCDoA directorates and the farmers themselves.

Agri Western Cape is involved in DRS implementation through the WCDoA and is offering support in terms of information and technical advice. The organisation has a drought fund which is meant specifically for its members to enable them to keep their activities running. Generally, Agri Western Cape supports the government departments in leveraging their efforts through lobbying and other forms of policy influence. The two main organisations working closely with Agri Western Cape are Hortgro and Vinpro. The major challenge identified by the organisation is lack of capacity, which is the reason for its limited direct involvement with its clients (smallholder and commercial farmers).

7.4 Recommendations and Future Research

There is a need for a review of the classification of smallholder farmers. The current classifications do not recognise farmer livelihoods and the huge diversity in the farmers in different parts of South Africa. The disparities between the Western Cape and Limpopo Provinces prove this in the four districts that were studied. As a result of these differences, a lot of farmers are probably being left out of farming programmes.

The livelihood strategies of smallholder farming communities in the study locations will have to be strengthened, to preserve food and secure livelihoods. Adaptation can come in the form of planting more drought-tolerant crops, the use of higher-potential or more drought-tolerant livestock genotypes and species and moving livestock to more productive pastures. Support for crop-livestock farmers should be appropriate to the smallholding and multi-purpose production systems and facilitate the development of local market-oriented subsistence production. This could gradually shift to building up smallholder farmers' commercial production capacity

based on the intensification of current production systems. Inclusion of integrated systems of livestock and dual-purpose crops could help buffer smallholders from climate-related crop yield losses while supporting a fledging livestock sector. Training in pasture management, disease control and crop-livestock husbandry, and schemes to access inputs and markets that overcome the disadvantages of smallholder farming communities could also be promoted. Crop production, livestock rearing, and other land-based livelihood activities are an important source of employment, food and income for many smallholder farmers.

Land sizes in the surveyed districts were generally small, with only 20% of farmers having access to more than 4ha of land. The implications in terms of food production of such small plots need to be investigated, to determine if the farmers face land shortages and whether what they have access to is adequate for their needs. Tenure was also an issue, especially in the Western Cape. Farmers were on short-term leases that disqualified them from access to financial credit and water rights.

Appropriate policies also have the potential to increase benefits in light of the changing climate. The study found limited numbers of young people in agriculture. Farmers felt this needed to be addressed at the level of the school curriculum, to generate interest in farming at an early age. However, it is also important to realise that agriculture on its own will not solve the problems of rural poverty. Where appropriate, other non-farming, low-risk activities could be promoted to support local livelihoods.

Smallholder farmer drought support systems were being implemented in the Western Cape. However, there was a lack of coordination among the government departments, especially national government departments. The Western Cape government sought access to farmers through CASIDRA, but there were clear indications that the system could be better coordinated and managed. Private organisations played a crucial role in supporting some farmers. Such relationships with farmers need to be built upon. Drought support systems need to be coordinated and consolidated.

Drought response was found to be largely reactive at the national level. The implementation of a coherent drought plan remains a challenge. Farmers are critical of the current process of declaring disaster areas. In previous studies, farmers have called for a provincially based system of declaration and providing support to farmers. The current systems are set up in such a way that by the time a district is declared most farmers would have lost livestock.

A separate study has been carried out to assess the effectiveness of extension services. There is need for government to strengthen extension services across the country, and to equip extensions officers to be able to address new challenges such as climate change. This is particularly crucial for early warning systems since most farmers were unaware of the impending drought. Previous studies have shown that when farmers could combine scientific

and indigenous knowledge, they were better able to cope with droughts. It is worth returning to this subject area.

8 LIST OF REFERENCES

Abunnour, M.A., Hashim, N.B. and Jaafar, M.B. 2016. Agricultural water demand, water quality and crop suitability in Souk-Alkhamis Al-Khums, Libya. IOP Conf. Ser. *Earth Environ. Sci*, 37:(012045).

Action-dialogue: opportunities, constraints and innovative approaches in small-scale agriculture in South Africa. (2014). *Goedgedacht*:6-8, August 2014.

Adeniran, A.I. and Aristide, D.K. 2020. *ICT and food security in Africa*. Cambridge: Cambridge Scholars Publishing.

Adger, W.D. 2009. Are there social limits to adaptation to climate change? *Climate Change*, 93:335-354.

African National Congress. 1994. *Reconstruction and development programme: a policy framework*. Johannesburg: Umanyano Publishers.

Akpalu, D.A. 2005. Response scenarios of households to drought-driven food shortage in a semi-arid area in South Africa. Unpublished master's thesis, University of the Witwatersrand, Johannesburg.

Aliber, M. and Cousins, B. 2013. Livelihoods after land reform in South Africa. *Journal of Agrarian Change,* 13:140-165.

Amadhila, E., Shaamhula, L., Van Rooy, G. and Siyambango, N. 2013. Disaster risk reduction in the Omusati and Oshana regions of Namibia. *Jàmbá: Journal of Disaster Risk Studies*, 5:1-9.

Archer, E.R.M., Oettle, N.M., Louw, R. and Tadross, M.A. 2008. Farming on the edge in arid western South Africa: climate change and in agriculture marginal environments. *Geography*, 93:98-107.

Arid Zone Ecology Forum. 2009. Drought in the succulent Karoo: increasing the awareness of stakeholders through a better understanding of the physical, ecological, and socioeconomic effects, interactions, and responses. 30 June 2009.

Ashley, C. and Hussein, K. 2000. Developing methodologies for livelihood impact assessment: experience of the African Wildlife Foundation in East Africa. Overseas Development Institute, Working Paper No. 129.

Austin, W.D. 2008. Drought in South Africa: lessons lost and/or learnt from 1990 to 2005. Unpublished master's thesis, Faculty of Science, University of Witwatersrand, Johannesburg. Accessed 13 February 2011. http://wiredspace.wits.ac.za/bitstream/handle/10539/5991/MSc%20WD%20AUSTIN.pdf

Backeberg, G.R. 2005. Water institutional reforms in South Africa. *Water Policy,* 7. Water Research Commission, Pretoria, South Africa.

Backeberg, G.R. 2006. Reform of user charges, market pricing and management of water: problem or opportunity for irrigated agriculture? *Irrig. and Drain*, 55:1-12.

Bahta, Y.T., Jordaan, A. and Muyambo, F. 2016. Communal farmers' perception of drought in South Africa: policy implication for drought risk reduction. *International Journal of Disaster Risk Reduction,* 20:39-50.

Baloyi, K. 2010. An analysis of constraints facing smallholder farmers in the Agribusiness value chain: a case study of farmers in the Limpopo Province. Unpublished master's thesis, Natural and Agricultural Sciences, University of Pretoria.

Barnes, J.I., Macgregor, J. and Alberts, M. 2012. Expected climate change impacts on land and natural resource use in Namibia: exploring economically efficient responses. *Pastoralism*, 2:1-23.

Barrett, C.B., Bachke, M.E., Bellemare, M.F., Michelson, H.C., Narayanan, S. and Walker, T.F. 2011. *Smallholder participation in contract farming: comparative evidence from five countries*. Illinois: Cornell University, Ithaca.

Barrett, T., Feola, G., Khusnitdinova, M. and Krylova, V. 2017. Adapting agricultural water use to climate change in a post-soviet context: challenges and opportunities in southeast Kazakhstan. *Human Ecology*, 45:47-762, DOI: 10.1007/s10745-017-9947-9.

Basson. M.S. and Rosssow, J.D. 2003. Limpopo water management areas: overview of water availability and utilisation. DWAF Report No. P WMA01/000/00/0203.

Belay, A., Recha, J.W., Woldeamanuel, T. and Morton, J.F. 2017. Smallholder farmers' adaptation to climate change and determinants of their adaptation decisions in the Central Rift Valley of Ethiopia. *Agriculture & Food Security*, 6:24, March 6. https://doi.org/10.1186/s40066-017-0100-1

Belliveau, S., Bradshaw, B., Smit, B., Reid, S. and Sawyer, B. 2006. Farm level adaptation to multiple risks: climate change and other concerns. University of Guelph, Department of Geography, Guelph.

Bembridge, T.J. 1980. Contribution to the science of agricultural extension. Unpublished doctoral thesis, University of Stellenbosch, Stellenbosch, South Africa.

Bembridge, T.J. 1987. Aspects of cattle production in Transkei. Unpublished doctoral thesis University of Stellenbosch: Stellenbosch. *South Africa. Animal Science*, 17(2):74-78.

Bembridge, T.J. 2000. Guidelines for rehabilitation of small-scale farmer irrigation schemes in South Africa. Report No. 891/1/00. Water Research Commission, Pretoria, South Africa.

Benson, C. and Clay, E.J. 1994. The impact of drought on sub-Saharan African economies. *IDS Bulletin,* 25(4):24−32.

Bernstein, H. 2013. Commercial Agriculture in South Africa since 1994: 'natural, simply capitalism'. *Journal of Agrarian Change*, 1(13):23-46.

Bester, J., Matjuda, I.E., Rust, J.M. and Fourie, H.J. 2003. The Nguni: case study. In: FAO Community-based management of animal genetic resources. Rome: FAO: 45-68.

Bidogeza, J., Berentsen, P., De Graaff, J. and Lansink, O.A. 2009. A typology of farm households for the Umutara Province in Rwanda. *Food Security*, 1:321-35.

Bocher, T.F. 2016. Modeling crop yield and farmer adaptation to rainfall variability: the case of Southern Ethiopia. Unpublished doctoral thesis, University of Hohenheim, Ethiopia.

Bohle, H.G. 2001. Vulnerability and criticality perspectives from social geography. *IHDP Update*, 2:3-5.

Bose, M.M., Abdullah, A.M., Harun R, Jamalani, M.A., Elawad, R.E. and Fallah, M. 2014. Perception of and adaptation to climate change by farmers in the semi-arid zone of north-eastern Nigeria. *IOSR Journal of Environmental Science, Toxicology and Food Technology*, 8:52-57.

Bourne, A., Donatti, C., Holness, S. and Midgley, G. 2012. Climate change vulnerability assessment for the Namakwa District municipality: full technical report. Conservation South Africa: Cape Town, South Africa.

Boutwell, M.W. 2015. Agricultural water problems and solutions – what you need to know. *Wake Up World,* 1-6.

Calzadilla, A., Zhu, T., Rehdanz, K., Tol, R.S.J. and Ringler, C. 2014. Climate change and agriculture: impacts and adaptation options in South Africa. *Water Resources and Economics*, 5:24-48.

Cape Agency for Sustainable Integrated Development in the Rural Areas. 2018. CASIDRA profile. Cape Town, South Africa.

Carter, M.R. and May, J. 1999. Poverty, livelihood and class in rural South Africa. *World Development*, 27:1-20.

Centre for Disease Control and Prevention (CDC). 2016. Agricultural water. https://www.cdc.gov/healthywater/other/agricultural/index.html Page last updated: October 11, 2016.

Chapman, R., Slaymaker, T. and Young, J., 2003. *Livelihoods approaches to information and communication in support of rural poverty elimination and food security*. London: Overseas Development Institute.

Chikowo, R., Zingore, S., Snapp, S. and Johnston, A. 2014. Farm typologies, soil fertility variability and nutrient management in smallholder farming in sub-Saharan Africa. *Nutr Cycl Agroecosyst*, 100:1-18.

Chishwakwe, E. 2010. Southern Africa sub-regional framework on climate change programmes report. First draft working document. SADC-UNEP.

Cobbett, M. 1982. Sugarcane farming in KwaZulu-Natal: two communities investigated. Carnegie Conference Paper: 58, Cape Town.

Collier, P. and Dercon, S. 2009. African agriculture in 50 years: smallholders in a rapidly changing world? FAO expert meeting on how to feed the world in 2050, 24-26, June 2009.

Council for Scientific and Industrial Research (CSIR). (2010). Geospatial analysis platform (GAP). Available online: http://www.gap.csir.co.za/images/images/GAPmesozones2010.pdf

Council for Scientific and Industrial Research (CSIR). 2010. Climate change handbook for northeastern South Africa. Available online: http://www.rvatlas.org/k2c/download/handbook_climate_change.pdf.

Cousins, B. 1995. Agrarian reform and the two economies: transforming South Africa's country side. In: Hall, R. and Netsebeza, L. (eds), *The land question in South Africa: the challenge of transformation and redistribution.* Programme for Land and Agrarian Studies (PLAAS), School of Government, University of the Western Cape, South Africa.

Cousins, B. 2010. What is a 'smallholder? Class-analytical perspective on small-scale farming and agrarian reform in South Africa. PLAAS, University of the Western Cape, Working Paper, 16.

Cousins, B. 2013. Smallholder irrigation schemes, agrarian reform and 'accumulation from above and from below' in South Africa. *Journal of Agrarian Change,* 13(1):116-139.

Cross, C., Mngadi, T., Sibanda, S. and Jama, V. 1996. Making a living under land reform: weighing up the chances in KwaZulu-Natal. In Lipton, M., Ellis, F. and M. Lipton (eds.), *Land, labour and livelihoods in rural South Africa*. Durban: Indicator Press.

Daniel, J., Naidoo, P., Pillay, D. and Southall, R. (Eds.). 2010. Development or decline? *New South African Review 1.* Johannesburg: Wits University Press.

David, A., Braby, J., Zeidler, J., Kandjinga, L. and Ndokosho, J. 2013. Building adaptive capacity in rural Namibia: community information toolkits on climate change. *International Journal of Climate Change Strategies and Management*, 5:215-229.

Daze, A., Ambrose, K. and Ehrhart, C. (Eds.). 2009. Climate vulnerability and capacity analysis: handbook. *CARE*, May 2009. Available at: http://www.careclimatechange.org

De Fraiture, C. and Wichelns, D. 2010. Satisfying future water demands for agriculture. *Agricultural Water Management*, 97:502-511.

De Haan, L.J. 2012. The livelihood approach: a critical exploration. *Erdkunde Bd,* 4(66):345-357.

Denby, K. 2013. Institutional integration and local level water access in the Inkomati catchment management area, South Africa. Unpublished master's thesis. Norwegian University of Life Sciences, Aas, Norway.

Denison, J. and Manona, S. 2007. Principles, approaches and guidelines for the participatory revitalisation of smallholder irrigation schemes: concepts and cases. WRC Report, No. TT 309/07.

Denison, J., Dube, S.V., Masiya, T.C., Moyo, T., Murata, C., Mpyana, J., Van Averbeke, L.L. and Van Averbeke, W. 2016. Smallholder irrigation entrepreneurial development pathways and livelihoods in two districts in Limpopo Province WRC Report No. 2179/1/16.

Department for International Development. 1999. Sustainable livelihoods guidance sheets. Great Britain.

Department of Agriculture, Forestry and Fisheries. 2005. *Drought management plan 2005.* Pretoria, South Africa.

Department of Agriculture, Forestry and Fisheries. 2012. *A framework for the development of smallholder farmers through cooperatives development*. Pretoria, South Africa.

Department of Agriculture, Forestry and Fisheries. 2012. *Draft business plan: revitalization of irrigation schemes Part 1, irrigation infrastructure.* Pretoria, South Africa.

Department of Agriculture, Forestry and Fisheries. 2012. *Integrated growth and development plan*. Pretoria, South Africa.

Department of Agriculture, Forestry and Fisheries. 2013. *Strategic plan for smallholder support*. Pretoria, South Africa.

Department of Agriculture, Forestry and Fisheries. 2016. *DAFF provides much needed drought relief assistance through media briefing.* Pretoria, South Africa.

Department of Environmental Affairs (DEA). 2013. *Long term adaptation scenarios flagship research programme (LTAS) for South Africa. Climate trends and scenarios for South Africa*. Pretoria, South Africa.

Department of Environmental Affairs (DEA). 2015. *The 2012 South Africa environment outlook*. Pretoria, South Africa.

Department of Environmental Affairs and Tourism. 2004. *National climate change response strategy*. Accessed from http://unfccc.int/files/meetings/seminar/application/pdf/sem_sup3_south_africa.pdf

Department of Rural Development and Land Reform (DRDLR). 2016. Riparian rights of farmers. Presentation to the Portfolio Committee on Water and Sanitation. 02 November 2016.

Department of Water Affairs and Forestry (DWAF), 2003. *Reports on overview of water resources availability and utilisation: Limpopo water management area.* Pretoria, South Africa.

Department of Water Affairs and Forestry (DWAF). 1998. *National Water Act*, Act No. 36 of 1998. Pretoria, South Africa.

Department of Water and Sanitation (DWS). (2013). *National water resource strategy*. 2nd ed. Pretoria, South Africa.

Department of Water and Sanitation (DWS). 2014. The national state of water resources quarterly report July to September 2014. Department of Water and Sanitation, Pretoria.

Department of Water and Sanitation (DWS). 2015. Limpopo Province state of dams 2015-11-02. Accessed from https://www.dwaf.gov.za/hydrology/Weekly/Storage.aspx

Department of Water and Sanitation (DWS). 2015. National eutrophication monitoring program. Accessed from https://www.dwa.gov.za/iwqs/eutrophication/NEMP/report/NEMPyears.aspx

Department of Water and Sanitation (DWS). 2018a. National water and sanitation master plan, Volume 1: call to action (Version 8.3) Ready for the future and ahead of the curve, 18 January 2018.

Department of Water and Sanitation. 2018b. Overview of the South African water sector. Accessed 17 August 2018 from http://www.dwa.gov.za/IO/Docs/CMA/CMA%20GB%20Training%20Manuals/gbtrainingmanualchapter1.pdf

Descheemaeker K., Amede T. and Haileslassie A. 2010. Improving water productivity in mixed crop-livestock farming systems of sub-Saharan Africa. *Agricultural Water Management,* 97:579-586

Disaster Management Act. (2002). *Act number 57 of 2002*. Pretoria, South Africa. Accessed from: https://www.westerncape.gov.za/Text/2004/10/a57-02.pdf

Dixon, J., Tanyeri-Abur, A. and Wattenbach, H. 2004. Framework for analysing impacts of globalization on smallholders. Smallholders, globalization and policy analysis; Agricultural Management, Marketing and Finance Service, Occasional Paper, 5.

Dube, K. and Sigauke, E. 2015. Irrigation technology for smallholder farmers: a strategy for achieving household food security in lower Gweru Zimbabwe. *South African Tydskr, Landbouvoorl,* 43(1):1-11.

Dube, P.O. and Sekhwela, M. 2007. Community coping strategies in semi-arid Limpopo basin part of Botswana: enhancing adaptation capacity to climate change. *AIACC Working Paper*, 47:1-42.

Dubihlela, J. and Park, C. 2016. Transactional costs inhibiting sustainable entrepreneurial agrarian growth: reflective evidence from small scale farmers (SSFs) in South Africa. *Journal of Human Ecology*, 54(2):87-100.

Ellis, F. 1993. *Peasant economics: farm households and agrarian development*. Cambridge, UK: Cambridge University Press.

Elum, Z.A., Modise, D.M. and Marr, A. 2017. Farmers' perception to climate change and responsive strategies in three selected province of South Africa, climate risk management. Accessed from http://dx.doi.org/10.1016/j.crm.2016.11.00

Eriksen, S., O'Brien, K. and Rosentrater, L. 2008. Climate change in Eastern and Southern Africa. Impacts, vulnerability and adaptation. Oslo: University of Oslo.

Eriksen, S., Silva J.A. 2008. The vulnerability context of a savanna area in Mozambique. *International Journal of Climate Change Strategies and Management,* 11(1).

Eriksen, S., Brown, K., Kelly, P.M. (2005). The dynamics of vulnerability: locating coping strategies in Kenya and Tanzania. *Geogr. J.*, 171:287-305.

Essa, J. and Nieuwoudt, L. 2003. Socio-economic dimensions of small-scale agriculture: a principal component analysis. *Development Southern Africa*, 20(1):67-73.

Everitt, B., Landau, S., Leese, M. and Stahl, D. 2011. *Cluster analysis*. 5th ed. London: Wiley.

Falco, S.D. and Veronesi, M. 2014. Managing environmental risk in presence of climate change: the role of adaptation in the Nile Basin of Ethiopia. *Environ Resource Econ,* 57:553-577.

Fan, S., Brzeska, J., Keyzer, M. and Halsema, A. 2013. *From subsistence to profit: transforming smallholder farms.* Washington. DC: International Food Policy Research Institute.

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

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

Food and Agricultural Organization. (FAO). 2004. *The state of food security in the world.* Washington DC: FAO.

Food and Agricultural Organization (FAO). 2016. Economy, agriculture and food security. Database. Food and Agriculture Organization of the United Nations. South Africa. Accessed from http://www.fao.org/nr/water/aquastat/countries_regions/ZAF/

Field, A. 2009. *Discovering statistics using SPSS*. 3rd ed. Los Angeles: SAGE.

Filmer, D. and Pritchett, L.H. 2001. Estimating wealth effect without expenditure data or tears: an application to educational enrolments in states of India. *Demography*, 38:115-32.

Förstera, J.J., Downsborough, A. and Chomba, M.J. 2017. When policy hits practice: structure, agency, and power in South African water governance. *Society & Natural Resources*, DOI: 10.1080/08941920.2016.1268658.

Funnell S.C. and Rogers P.J. 2011. *Purposeful Program theory: effective use of theories of change and logic models.* San Francisco, CA: Jossey-Bass.

Gaspar, P., Escribano, M., Mesías, F.J., de Ledesma, A.R and Pulido, F. 2008. Sheep farms in the Spanish rangelands (dehesas): typologies according to livestock management and economic indicators. *Small Ruminant Research*, 74:52-63.

Gbetibouo, G.D. and Ringler, C. 2009. Mapping South African farming sector vulnerability to climate change and variability: a subnational assessment. A paper presented at the 2009 Amsterdam Conference on the Human Dimensions of Global Environmental Change 'Earth system governance: People, Places and the Planet', Theme: Adaptiveness of earth system governance, 2-4 December 2009.

Goldin, J.A. 2010. Water policy in South Africa: trust and knowledge as obstacles to reform. *Review of Radical Political Economics*, 42(2):195-212.

Gomo, T., Senzanje, A., Dhavu, K. and Mudhara, M. 2014. Assessing the performance of smallholder irrigation and deriving best management practices in South Africa. *Irrig. and Drain*, 63:419-429.

Gordon, L.J., Finlayson, C.M. and Falkenmark, M. 2010. Managing water in agriculture for food production and other ecosystem services. *Agricultural Water Management*, 97:512-519.

Green Cape. 2017. Market intelligence report. Cape Town, South Africa,

Hall, R. 2004. A political economy of land reform in South Africa. *Review of Africa. Political Economy*, 100:23-27.

Hall, R. 2013. Another countryside? Policy options for land and agrarian reform in South Africa. *Journal of Military Studies*, 41(2):155-158.

Hall, R. and Aliber, M. 2010. The case for re-strategising spending priorities to support small-scale farmers in South Africa. Institute for Poverty, Land and Agrarian Studies. Working Paper 17, University of the Western Cape.

Hall, R. and Cliffe, L. 2009. Introduction. In Hall, R. (ed). Another countryside? Policy options for land and agrarian reform in South Africa. Institute for poverty land and agrarian studies. University of the Western Cape.

Hamdan, I., Oweis, T. and Hamdallah, G. 2006. Water use efficiency network: proceedings of the expert consultation meeting, 26-27 November 2006, Aleppo, Syria. ICARDA, Aleppo, Syria: 1-244.

Harvey, C.A., Rakotobe, Z.L., Rao, N.S., Dave, R., Razafimahatratra, H., Rabarijohn, R.H., Rajaofara, H. and MacKinnon, J.L. 2014. Extreme vulnerability of smallholder farmers to agricultural risks and climate change in Madagascar. *Royal Society,* 369:2-12.

Hendriks, M. 2014. Connecting small-scale farmers in Grabouw, South Africa to formal markets: an assessment of the key constrains. International Development Studies. Unpublished master's thesis, Wageningen University.

Herrero, M., Thornton, P.K., Notenbaert, A.M., Wood, S., Msangi, S., Freeman, H.A, Bossio, D., Dixon, J., Peters, M., van de Steeg, J., Lynam, J., Parthasarathy Rao, P., Macmillan, S., Gerard, B., McDermott, J., Seré, C., and Rosegrant, M. 2010. Smart investments in sustainable food production: revisiting mixed crop-livestock systems. *Science*, 327:822. DOI: 10.1126/science.1183725.

Intergovernmental Panel on Climate Change (IPCC). 2014. Climate change 2014 synthesis report – summary for policymakers.

Field, C.B., Barros, V., Stocker, T.F. and Dahe, Q. eds., 2012. Managing the risks of extreme events and disasters to advance climate change adaptation: special report of the intergovernmental panel on climate change. Cambridge University Press.

Iraizoz, B., Gorton, M. and Davidova, S. 2007. Segmenting farms for analysing agricultural trajectories: a case study of the Navarra region in Spain. *Agricultural Systems*, 93:143-69.

Isaacs, M. and Mohamed, N. 2000. Co-managing the commons in the new South Africa: room for manoeuvre? Constituting the commons in the new South Africa. (Commons southern Africa occasional article; no. 5). Harare/Cape Town: Centre for Applied Social Studies, University of Zimbabwe/Programme for Land and Agrarian Studies, University of the Western Cape.

Jacobs, P.T. 2009. Agricultural market reforms and the rural poor in South Africa. Accessed from http://www.plaas.org.za/newsevents/wom/papers/working-on-the-margins-conference-paper-peter-jacobs/file

Jennings, G. 2001. *Tourism research*. 2nd ed. Sidney John Wiley and Sons.

Jolliffe, I. 2005. *Principal component analysis*. John Wiley & Sons, Ltd.

Jordaan, A.J. 2011. Adaptation to drought and extreme weather. Drought risk reduction in the Northern Cape, South Africa. Unpublished doctoral thesis, University of the Free State, South Africa.

Jordaan, A.J. 2012. Drought risk reduction in the Northern Cape, South Africa. Doctoral thesis, University of the Free State, Bloemfontein.

Jordaan, A.J., Sakulski, D. and Jordaan, A.D. 2013. Interdisciplinary drought risk assessment for agriculture: The case of communal farmers in the Northern Cape Province, South Africa. *South Afr. J. Agric. Ext.*, 41, 1-16.

Kaiser, H. 1970. A second generation little jiffy. *Psychometrika,* 35:401-15.

Kandjinga, L., Zeidler, J., Nunes, I., Chunga, R. and Ndokosho, J. 2010. How to reach out to local communities and assist them to adapt to climate change. ICID+18, 2nd International Conference: CARIAA-ASSAR Working Paper 37 Climate, Sustainability and Development in Semi-arid Regions. 16-20 August 2010, Fortaleza – Ceara, 20.

Kherallah, M. and Kirsten, J. 2001. The new institutional economics: applications for agricultural policy research in developing countries. Markets and Structural Studies Division, discussion paper: 41. Washington DC: International Food Policy Research Institute.

Khulisa Management Services. 2016. Summary report of diagnostic evaluation of the government-supported smallholder farmer sector.

Kiem, A.S. and Austin, E.K. 2013. Drought and the future of rural communities: opportunities and challenges for climate change adaptation in regional Victoria, Australia. *Global environmental change*, (23):21307-1316, June 7. http://dx.doi.org/10.1016/j.gloenvcha.2013.06.003 [23 June 2017].

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

Knox J., Hess T., Daccache A. and Wheeler T. 2012. Climate change impacts on crop productivity in Africa and South Asia. *Environ. Res. Lett*.,7(034032):8pp.

Koch, I.C., Vogel, C. and Patel, Z. 2007. Institutional dynamics and climate change adaptation in South Africa. *Mitigation and Adaptations Strategies for Global Change*, 12:323-1339.

Komba, C. and Muchapondwa, E. 2012. Adaptation to climate change by smallholder farmers in Tanzania. Economic Research Southern Africa, working paper 299, July 2012.

Kubayi, M.K. 2016. The impact of the South African drought as experienced by smallholder farmers over the June 2015 February 2016 period in the Mopani district of Limpopo, South Africa.

Lahiff, E. and Cousins, B. 2005. Smallholder agriculture and land reform in South Africa. Institute of Development Studies. *IDS Bulletin*, 36(2), June.

Lahiff, E., Maluleke, T., Manenzhe, T. and Wegerif, M. 2008. Land redistribution and poverty reduction in South Africa: the livelihood impacts of smallholder agriculture under land reform. Programme for Land and Agrarian Studies. University of the Western Cape: Research Report, 36.

Limpopo Department of Agriculture (LDA). 2004. Veterinary services annual report: Polokwane, Limpopo Province.

Limpopo Department of Agriculture (LDA). 2005. *Department of Agriculture strategic plan 2005-2010.* Polokwane, Limpopo Province.

Limpopo Department of Agriculture (LDA). 2010. Unpublished data base of Limpopo Department of Agriculture. Polokwane, Limpopo Province.

Limpopo Department of Agriculture (LDA). 2012. Unpublished data base of Limpopo Department of Agriculture. Polokwane, Limpopo Province.

Limpopo Department of Agriculture (LDA). 2016. Unpublished data base of Limpopo Department of Agriculture. Polokwane, Limpopo Province.

Limpopo Department of Agriculture Integrated Development Plan (IDP). 2012. Unpublished data base of Limpopo Department of Agriculture. Polokwane, Limpopo Province.

Limpopo Department of Agriculture Integrated Development Program (IDP). 2012. Unpublished report of Limpopo Department of Agriculture. Polokwane, Limpopo Province.

Limpopo Department of Agriculture. Data base. n.d. Unpublished data base of Limpopo Department of Agriculture. Polokwane, Limpopo Province.

Limpopo Department of Economic Development, Environment & Tourism (LEDET). 2013. Limpopo Green Economy Plan including provincial climate change response. Prepared by Dr. A. Letsoalo, Manager Environmental Research and Planning. Polokwane, Limpopo Province.

Limpopo DFED. 2004. Limpopo state of the environment report (Phase 1). Unpublished report of the Limpopo Department of Finance and Economic Development. Polokwane, Limpopo Province.

Limpopo EDET. 2006. State of the environment report. (Phase 2). Unpublished report. Limpopo Department of Economic Development, Environment and Tourism (LEDET). Polokwane, Limpopo Province.

Lipton, M., De Klerk, M. and Lipton, M. 1996. *Land, labour and livelihoods*. Durban: Indicator Press.

Lodge, T. 2002. *Politics in South Africa.* Cape Town: David Phillip.

Machete, C.L., Mollel, N.M., Ayisi, K., Mashatola, M.B., Anim, F.D.K. and Vanasche, F. 2004. Smallholder irrigation and agricultural development in the Olifants River Basin of Limpopo Province: Management transfer, productivity, profitability and food security issues. University of the North, School of Agriculture and Environmental Sciences. WRC, Report No.1050/1/04, December 2004.

Machete, C.L., Venter, G.C.H., Mothabele, M. and Ngobese, P. 2004. Unpublished paper presented at the regional fertilizer trade, marketing and distribution conference, 22-26 Feb, Pretoria.

Madigele, P.K. 2017a. Efficiency of common-pool resource institutions: focusing on water users associations in South Africa. *Environ Dev Sustain*, 20(2):825-840, DOI 10.1007/s10668-017-9912-1.

Madigele, P.K. 2017b. South Africa's water regulatory and policy framework: a new institutional economic review. Sustain. *Water Resource Management*, DOI 10.1007/s40899-017-0167-7, August 2017.

Makhura, T.M. 2001. Overcoming transaction costs barriers to market participation of smallholder farmers in the Northern Province of South Africa. Unpublished doctoral thesis, University of Pretoria, Pretoria.

Mancosu, N., Snyder, R.L., Kyriakakis, G. and Spano, D. 2015. Water scarcity and future challenges for food production. *Water,* 7:975-992.

Manly, B. 1986. *Multivariate statistical methods: a primier*. Londen: Chapman and Hall Ltd.

Mapedza, E., van Koppen, B., Sithole, P. and Bourblanc, M. 2015. Joint venture schemes in Limpopo Province and their outcomes on smallholder farmers livelihoods. *Physics and Chemistry of the Earth*, 92:92-98. http://dx.doi.org/10.1016/j.pce.2015.10.016

Maponya, P. and Mpandeli, S. 2013. Climate change and agricultural production: impact and adaptation options from selected municipalities in Limpopo Province, South Africa. Lap Lambert Academic Publishing, 66121, Saarbrücken, Germany.

Maponya, P.I., Venter, S.L., Du Plooy, C.P. and van Den Heever, E. 2017. The status of drought on smallholder farmers: a case of Winterveld area, Tshwane, Gauteng province. Oral presentation, 10th International Symposium on Agricultural Research, 10-13 July 2017, Athens, Greece

Marais, F. J. 2012. Pinching shoes: the use of business plans in South African land redistribution to foster the experts' vision of development. Unpublished master's thesis, Rural Development Sociology, Wageningen University and Research Centre.

Marcus, T. 1996. Black micro, surplus and commercial producers. Land and Agricultural Policy Centre. Durban: Indicator Press.

McKenzie, D.J. 2003. Measure inequality with asset indicators. Bureau for Research and Economic Analysis of Development Center for International Development, Harvard University. BREAD Working Paper No. 042.

Midgley, G.F., Chapman, R.A., Hewitson, B., Johnston, P., de Wit, M., Ziervogel, G., Mukheibir, P., van Niekerk, L., Tadross, M., van Wilgen, B.W., Kgope, B., Morant, P.D., Theron, A., Scholes, R.J., Forsyth, G.G. 2005. A status quo, vulnerability and adaptation assessment of the physical and socio-economic effects of climate change in the Western Cape. Report to the Western Cape Government, Cape Town, South Africa. CSIR Report No. ENV-S-C 2005-073, Stellenbosch.

Mniki, S. 2009. Socio-economic impact of drought induced disasters on farm owners of Nkonkobe local municipality. Unpublished thesis, University of the Free State, Bloemfontein.

Mnyaka, S., Ncube, B. and Mazvimavi, D. 2015. Contribution of water allocation reforms to smallholder emerging farmers in the Breede-Gouritz Catchment Management Agency. Conference: 16th WaterNet/WARFSA/GWPSA Symposium held at Mauritius, October 2015.

Moeletsi, M.E., Mellaart, E.A.R., Mpandeli, N.S. and Hamandawana, H. 2013. The use of rainfall forecasts as a decision guide for small-scale farming in Limpopo Province, South Africa. *The Journal of Agricultural Education and Extension,* 19:133-145.

Mohamed, S.S. 2006. Livelihoods of plot holder homesteads at the Dzindi smallholder canal irrigation scheme. Unpublished doctoral thesis, Department of Crop Sciences, Tshwane University of Technology.

Mongi, H., Majule, A.E. and Lyimo, J.G. 2010. Vulnerability and adaptation of rain-fed agriculture to climate change and variability in semi-arid Tanzania. *African Journal of Environmental Science and Technology*, 4(6):371-381, June.

Morison, J.I.L., Baker, N.R., Mullineaux, P.M. and Davies, W.J. 2008. Improving water use in crop production. *Philos Trans R Soc Lond B Biol Sci*, 363(1491): 639-658.

Morton, J.F. 2007a. The impact of climate change on smallholder and subsistence agriculture. *Natural Resources Institute, University of Greenwich, United Kingdom* (104):19680-19685, December 11.

Moss, S. 2004. Complex drought in southern Africa – a water and sanitation perspective. *Waterlines,* 22(4), pp.19-21.

Mpandeli, N. S. and Maponya, P.I. (2014). Constraints and challenges facing the small-scale farmers in Limpopo Province. *Journal of Agricultural Science,* 6(4):135-143. http://dx.doi.org/10.5539/jas.v6n4p135

Mpandeli, S. and Maponya, P. 2013a. Coping with climate variability in Limpopo Province, South Africa. *Peak Journal of Agricultural Sciences*, 1:54-64.

Mpandeli, S. and Maponya, P. 2013b. The use of climate forecasts information by farmers in Limpopo Province, South Africa. *Journal of Agricultural Science,* 5:47-55.

Mpandeli, S. and Maponya, P. 2014. Constraints and challenges facing the small scale farmers in Limpopo Province, South Africa. *Journal of Agricultural Science*, 6:120-135.

Mpandeli, S., Nesamvuni, E. and Phokele Maponya, P. 2015. Adapting to the impacts of drought by smallholder farmers in Sekhukhune District in Limpopo Province, South Africa. http://dx.doi.org/10.5539/jas.v7n2p115

Mpandeli, S., Simalenga, T., Siambi, M., Ramgondo, R., Mailula, N. and Liphadzi, K. 2005. Constraints and challenges to agricultural development in Limpopo province, South Africa.

Msibi, M.I. and Dlamini, P.Z. 2011. Water allocation reform in South Africa: History, processes and prospects for future implementation. Water Research Commission: report 1855/1/11.

Msofi, L. 2014. Impacts of agricultural development projects on gender relations in farming households: a case study of Blantyre Rural, Malawi.

Mthembu, N.N. and Zwane, E.M. 2017. The adaptive capacity of smallholder mixed-farming systems to the impact of climate change: the case of KwaZulu-Natal in South Africa. *Journal of Disaster Risk Studies,* 9(1). https://doi.org/10.4102/jamba.v9i1.469

Muchara, B. 2014. The economics of smallholder irrigation water management: institutions, water-use values and farmer participation in Kwazulu-Natal, South Africa. University of Kwazulu-Natal, South Africa.

Mukheibir, P. 2008. Water resources management strategies for adaptation to climate-induced impacts in South Africa. *Water Resource Manage,* (22):1259-1276, October 22.

Müller, C. 2009. Climate change impact on sub-Saharan Africa? An overview and analysis of scenarios and models. Social Science Open Access Repository, Discussion Paper, No. 3.

Muller, C. and Shackleton, S.E. 2014. Perceptions of climate change and barriers to adaptation amongst commonage and commercial livestock farmers in the semi-arid Eastern Cape Karoo. *African Journal of Range and Forage Science*, 31:1-12.

Mvelase, T.C. 2016. Developing practical solutions to problems and constraints faced by smallholder irrigation schemes in South Africa. Bio Resources Engineering Programme, School of Engineering, University of KwaZulu-Natal.

Namara, R.E., Hanjra, M.A., Castillo, G.E., Ravnborg, H.M., Smith, L. and Van Koppen, B. 2010. Agricultural water management and poverty linkages. *Agricultural Water Management*, 97:520-527.

National Planning Commission, 2013. National development plan vision 2030.

National Treasury. 2011. Water and sanitation. Local government budgets and expenditure review, 9 Sept 2011.

National Water Resource Strategy (NWRS). 2004. Chapter 2 – South Africa's water situation and strategies to balance supply and demand. September 2004. Pretoria, South Africa.

National Water Resource Strategy (NWRS). 2013. Water for an equitable and sustainable future, June 2013. Pretoria, South Africa.

Ncube, B. 2018. Constraints to smallholder agricultural production in the Western Cape, South Africa. Physics and Chemistry of the Earth, Parts A/B/C. (in press). https://doi.org/10.1016/j.pce.2018.05.012

Ndlela, S. 2015. Agricultural extension, sustainable livelihoods and self-reliance: the case of Illovo's small-scale sugarcane farmer development programme (Noodsberg, South Africa). Unpublished master's thesis, Agricultural Extension and Rural Resource Management, University of KwaZulu-Natal.

Nel, E.L., Binns, T. and Hill, T.R. 1997. Development from below in the new South Africa: the case of Hertzog, Eastern Cape. *South African Geographical Journal,* 163(1):57-64.

Neuman, W.L. 2000. *Social research methods: quantitative and qualitative methods*. (3rd ed). Boston: Allyn and Bacon.

Newsham, A.J. and Thomas, D. 2009. Agricultural adaptation, local knowledge and livelihood diversification in north-central Namibia. Research technical report, Tyndall Climate Change Research Centre.

Newsham, A.J. and Thomas, D.S.G. 2011. Knowing, farming and climate change adaptation in north-central Namibia. *Global Environmental Change,* 21:761-770.

Newton, G.L., Baker, J.F., Dove, C.R., Bernard, J. K., McCranie, M.D., Boken, V.J., Thomas, D.L. and Hoogenboom., G. 2003. Agricultural water use associated with animal production systems in Georgia. In K. J. Hatcher (ed.). Proceedings Georgia Water Resources Conference,

Ngaka, M.J. 2012. Drought preparedness, impact and response: A case of the Eastern Cape and Free State provinces of South Africa. *Journal of Disaster Risk Studies*, 4(1):1-10. http://dx.doi.org/10.4102/jamba.v4i1.47

Ngomane, T. 2012. Rural development in South Africa: the role of agriculture. Kempton Park, South Africa.

Nieuwoudt W.L. and Backeberg, G.R. 2011. A review of the modelling of water values in different use sectors in South Africa. *Water SA*, 37(5).

Njiraini, G.W. 2016. Water policy in South Africa: effects, impacts, and the associated transaction costs in the Olifants Basin. Inaugural dissertation, Rheinischen Friedrich-Wilhelms-Universität Bonn.

Nomquphu, W., Braune, E. and Mitchell, S. 2007. The changing water resources monitoring environment in South Africa. *South African Journal of Science,* 103:16-310.

Nthakheni, N.D.,2006. A livestock production systems study amongst resource poor livestock owners in the Vhembe District of Limpopo Province. Unpublished doctoral thesis, University of the Free State, Bloemfontein, South Africa.

Nwafor, C.U. 2015. Prospects of commercialization among small scale potato farmers in Bizana. Unpublished master's thesis, Central University of Technology, Free State, South Africa.

Nyong, A., Adesina, F. and Elasha, B.O. 2007. The value of indigenous knowledge in climate change mitigation and adaptation strategies in the African Sahel. *Mitig Adapt Strat Glob Change,* (12):787-797, June 14.

O'Farrell, P.J., Anderson, P.M.L., Milton, S.J. and Dean, W.R.J. 2009. Human response and adaptation to drought in the arid zone: lessons from southern Africa. *South African Journal of Science,* 105:34-39, January/February.

Oladele, O.I. and Mudhara, M. 2016. Empowerment of women in rural areas through water use security and agricultural skills training for gender equity and poverty reduction in KwaZulu-Natal and North West Province: report to the Water Research Commission, Pretoria.

Olaleye, O.L. 2010. Drought coping mechanisms: a case study of small-scale farmers in Motheo District of the Free State Province, South Africa.

Olivier, D.W. 2019. Urban agriculture promotes sustainable livelihoods in Cape Town. *Development Southern Africa*, 36(1):17-32.

Oo, A.T., Huylenbroeck, G.V. and Speelman, S. 2015. Determining factors for the application of climate change adaptation strategies among farmers in the Magwe District in the dry zone region of Myanmar, 16-18, September.

Opiyo, F., Wasonga, O., Nyangito, M., Schilling, J. and Munang, R. 2015. Drought adaptation and coping strategies among the Turkana Pastoralists of Northern Kenya. *Int J Disaster Risk Sci,* 6:295-309.

Organization for Economic Co-operation and Development. 2006. South Africa's agriculture policy review. Highlights from OECD country reviews. Paris: OECD.

Ortmann, G.F. and King, R.P. 2006. Small-scale farmers in South Africa: Ccn agricultural cooperatives facilitate access to input and product markets? Staff paper: P06-4. Department of Applied Economics, University of Minnesota.

Overberg District Municipality. 2014. Accessed from https://www.localgovernment.co.za

Pasquini, L., Ziervogel, G. and Cowling, R. 2013. Facing the heat: barriers to mainstreaming climate change adaptation in local government in the Western Cape Province, South Africa. *Habitat International*, 40:225-232.

Pegram, G. and Baleta, H. 2014. Water in the Western Cape economy. Report to the Water Research Commission. WRC Report No. 2075/1/13, March 2014.

Pereira, L.S. 2005. "Water and agriculture: facing water scarcity and environmental challenges". Agricultural Engineering International: the CIGR Journal of Scientific Research and Development. Invited Overview Paper. Vol. VII. February 2005.

Perret, S. 2002. Water policies and smallholding irrigation schemes in South Africa: a history and new institutional challenges. Working Paper 2002-19. *Water Policy*, 4(3):283-300.

Pienaar L. and Traub L.N. 2015. Understanding the smallholder farmer in South Africa: Towards a sustainable livelihoods classification. Paper presentation at International Conference for Agricultural Economists, Milan, Italy, 8-14 August 2015.

Pienaar, G.J. and van der Schyff, E. 2007. The reform of water rights in South Africa. Paper prepared for the workshop entitled 'Legal Aspects of Water Sector Reforms' to be organised in Geneva from 20 to 21 April 2007 by the International Environmental Law Research Centre (IELRC) in the context of the Research partnership 2006-2009 on water law sponsored by the Swiss National Science Foundation (SNF).

Pienaar, P.L., 2013. Typology of smallholder farming in South Africa's former homelands: Towards an appropriate classification system (Doctoral dissertation, Stellenbosch: Stellenbosch University). Pophiwa, N. 2012. Training them to catch fish? Farmer education and training programmes in Uganda's organic agricultural sub-sector. Training brief. Africa Institute of South Africa, Briefing no. 70.

Porteus, D. 1990. Land reform: potential and priorities for South Africa. Paper presented at a conference of the Newick Park initiative, Land Reform and Agricultural Development, UK, Jubilee Centre Publications.

Ramaru, J., Hagmann, J., Mamabolo, Z. and Netshivhodza, M. 2009. Innovation through action – an action research journey with smallholder farmers in Limpopo Province, South Africa: Experiences of soil fertility management. In Almekinders, C., Beukema, L. and C. Tromp (eds.), *Research in action – theories and practices for innovation and social change.* Wageningen University, Netherlands, 45-66.

Reardon, T., Timmer, C.P. and Minten, B. 2012. Supermarket revolution in Asia and emerging development strategies to include small farmers. *International Food Policy Research Institute*, 109(31):12332-12337, July 31.

Reinders, F. 2010. Standards and guidelines for improved efficiency of irrigation water use from dam wall release to root zone application. Water Research Commission, Pretoria, South Africa.

Reinders, F.B., Van Der Stoep, I. and Backeberg, G.R. 2013. Improved efficiency of irrigation water use: A South African framework. *Irrigation and Drainage*, 62:262-272.

Republic of South Africa. 1998. National Water Act (No. 36 of 1998). Gov. Gaz. 398(19182). Pretoria: Government Printers.

Republic of South Africa. 2011. *National climate change response*. White Paper. Pretoria: Government Printer.

Ringler, C., Bryan, E., Hassan, R.M., Alemu, T. and Hillesland, M. 2011. *How can African agriculture adapt to climate change? Insights from Ethiopia and South Africa.* Washington: International Food Policy Research Institute.

Roberts, B. 2005. *Empty stomachs, empty pockets: poverty and inequality in post-apartheid South Africa. State of the nation: South Africa 2004-2005*. Cape Town: HSRC Press: 479-510.

Roncoli, C., Ingram, K. and Kirshen, P. 2001. The costs and risks of coping with drought: livelihood impacts and farmers' responses in Burkina Faso. *Inter-Research Science Center*, 19:119-132, December 4. http://www.jstor.org/stable/24866774 [01 July 2017].

Rootman, G.T., Stevens J.B. and Mollel, N.M. 2015. Policy opportunities to enhance the role of smallholder livestock systems in Limpopo province of South Africa. *South African Journal for Agricultural Extension,* 43(2):91-104.

Rossi P.H., Lipsey, M.W. and Freeman H.E. 2004. *Evaluation: a systematic approach*. 7th ed. Los Angeles: SAGE.

Schirmer, S. 2000. Policy visions and historical realities: land reform in the context of recent agricultural developments. *African Studies*, 59:1-9.

Schlemmer, L. 2001. The situation in South Africa with special reference to rural productivity. In Vorster S., *Land reform in Southern Africa,* Conference Paper, Democratic Union of Africa, Cape Town.

Scoones, I. 1998. Sustainable rural livelihoods: a framework for analysis. IDS Working Paper No.72.

Serrat O. 2017. The sustainable livelihoods approach. *Knowledge Solutions*:21-26., Singapore

Seward, P and Yxu. 2015. Key interventions to improve local groundwater governance. WRC Report No. 2238/1/15, October 2015.

Sinyolo, S., Mudhara, M. and Wale, E. 2014. The impact of smallholder irrigation on household welfare: the case of Tugela Ferry irrigation scheme in KwaZulu-Natal, South Africa. *Water SA,* 40:145-156.

South African Vulnerability Assessment Committee (SAVAC). 2016. Results.

Speelman, S. and Veettil, P.C. 2012. Comparing the scope for irrigation water rights reforms in India and South Africa. Paper prepared for presentation at the International Association of Agricultural Economists (IAAE) Triennial Conference, Foz do Iguaçu, Brazil, 18-24 August 2012.

Speelman, S. and Veettil, P.C. 2013. Heterogeneous preferences for water rights reforms among smallholder irrigators in South Africa. *Bio-based and Applied* Economics 2(2): 131-149.

Stats-SA. (Statistics South Africa). 2013. Mid-year population estimates, 2015. Statistical release P0302. Stats SA, Pretoria, South Africa.

Stats-SA. (Statistics South Africa). 2015. Mid-year population estimates, 2015., Statistical release P0302. Stats SA, Pretoria, South Africa.

Stevens, J.B. and Letty, B. 2014. Understanding the dynamics of multi-stakeholder innovation systems and the opportunities for joint learning by small-scale farmers. *S.Afr. Tydskr. Landbouvoorl./S. Afr. J. Agric. Ext,* 42(2):24-38.

Stringer, L.C., Dyer, J.C., Reed, M.S., Dougill, A.J., Twyman, C. and Mkwambisi, D. 2009. Adaptations to climate change, drought and desertification: local insights to enhance policy in Southern Africa. *Environ Sci. Policy*, 12:748-765.

Tesfay, K.G. 2014. Smallholder farmers' adaptation strategies climate change in Ethiopia (the case of Adwa Woreda Tigtrai region). Unpublished master's thesis, Mekelle University, Ethiopia.

Thamaga-Chitja, J.M. and Morojele, P. 2014. The context of smallholder farming in South Africa towards a livelihood assets building framework. *Journal of Human Ecology,* 45(2):147-155.

Thapa, G. and Gaiha, R. 2011. Smallholder farming in Asia and the pacific: challenges and opportunities. Paper presented at the IFAD conference on new directions for smallholder agriculture 24-25 January, Rome.

Theewaterskloof Municipality. 2012. 3rd Generation IDP 2011-2016. Operational Plan.

Thomas, D.J.J. 1994. *A critical assessment of the promotion of small-holder agriculture in South Africa*. University of the Witwatersrand, Johannesburg.

Thomas, D.S., Twyman, C., Osbahr, H. and Hewitson, B. 2007. Adaptation to climate change and variability: farmer responses to intra-seasonal precipitation trends in South Africa. *Climatic Change,* 83:301-322.

Trollip, K. 2017. *Irrigation farming: a lifeline for budding 'agripreneurs'.* Water Research Commission: The water wheel, January/February 2017.

Tshoni, S. 2015. Analysis of smallholders' farm diversity and risk attitudes in the Stellenbosch local municipal area. Unpublished master's thesis, Stellenbosch University.

Tshuma, M. C. 2014. Review. Understanding the small-scale agricultural sector as a precondition for promoting rural development in South Africa. *African Journal of Agricultural Research,* 9(31):2409-2418.

Turshen, M. 1986. Food and hunger in the Ciskei. In Lawrence, P. (Ed.), *World recession and the food crisis in Africa*. London: James Currey.

Ubisi, N.R. 2016. Smallholder farmers' perceptions and adaptation to climate change interventions and support systems in Limpopo province, South Africa. School of Agricultural, Earth and Environmental Sciences (SAEES), College of Agriculture, Engineering and Science University of KwaZulu-Natal.

Valipour, M. 2015. Land use policy and agricultural water management of the previous half of century in Africa. *Appl Water Sci*, 5:367-395.

Van Averbeke, W. and Mohamed, S.S. 2006. Smallholder farming styles and development policy in South Africa: the case of the Dzindi Irrigation Scheme. *Agrekon*, 45(2):136-157.

Van Averbeke, W., Denison, J. and Mnkeni, P.N.S. 2011. Smallholder irrigation schemes in South Africa: a review of knowledge generated by the Water Research Commission. *Water SA*, 37:797-808.

Van der Stoep, I., du Plessis, F.J. and Pott, A. 2008. Awareness creation, implementation plans and guidelines for management of sustainable on farm and on-scheme water measurement: interim report on preparatory workshops and final questionnaire. Water Research Commission, Pretoria.

Van Der Walt, M.M. 2011. The concept "beneficial use" in South African water law reform. Unpublished thesis, North-West University, Potchefstroom, South Africa.

Van Koppen, B., Schreiner, B. and Fakir, S. 2011. The political and economic context and changing water policy in South Africa post-1994. In Schreiner, B. and Hassan. R. (eds). *Transforming water management in South Africa. Designing and implementing a new policy framework*: 1-17. Global Issues in Water Policy 2. Berlin, Germany: Springer.

Van Rooyen, C.J., Vink, N. and Christodoulou, N.T. 1987. Access to the agricultural market for small farmers in South Africa: the farmer support programme. *Agrekon*, 4(2):207-223.

Van Zyl, J., McKenzie, C. and Kirsten, J. 1996. Natural resource management issues in rural South Africa. Agricultural land reform in South Africa: policies, markets and mechanisms: 236-259. Cape Town: Oxford University Press.

Verchot, L.V., Noordwijk, M.V., Kandji, S., Tomich, T., Ong, C., Albrecht, A., Mackensen, J., Bantilan, C., Anupama, K.V. and Palm, C. 2007. Climate change: linking adaptation and mitigation through agroforestry. *Mitig Adapt Strat Glob Change,* (12):901-918, April 28.

Verschoor, A., Ngcobo, T., Ceballos, J., Hawkins, R., Chitsike, C. and Chaminuka, P. 2009. Shaping agricultural research for development to Africa's needs: building South African capacity to innovate. In Sanginga, P. C., Water-Bayer, A., Kaaria, S., Njuki, J. and Wettasinha, C. (eds). *Innovation Africa: enriching farmers' livelihoods.* Earthscan: London, UK.

Vetter, S. 2009. Drought, change and resilience in South Africa's arid and semi-arid rangelands. *S. Afr. J. Sci.,* 105:29-33.

Vink, N. and Van Rooyen, J. 2009. The economic performance of agriculture in South Africa since 1994: implications for food security. Development planning division working paper: series 17. Midrand, South Africa.

Water Research Commission (WRC). 2001. The state of rivers report – Letaba and Luvuvhu River Systems. Pretoria: WRC.

Water Research Commission. (2007). The water wheel: smallholder irrigation. November/December 2007. Pretoria: WRC.

Weiner, D., Levin, R. and Chimere-Dan, O. 1997. Understanding the Bantustans through socio-economic surveys. In Levin, R. and Weiner, D. (eds). *No more tears: struggles for land in Mpumalanga, South Africa.* Asmara, Eritrea: Africa World Press Inc.

Wentink, G.J. and Van Niekerk, D. 2017. The capacity of personnel in disaster risk management in South African municipalities. *The Journal for Transdisciplinary Research in Southern Africa,* 13(1). https://doi.org/ 10.4102/td. v13i1.427

West Coast District Municipality. 2015. Integrated development plan, 2012/2016. https://www.localgovernment.co.za

Western Cape Department of Agriculture. 2019. http://www.elsenburg.com/about-us/services (Accessed 19 August 2019)

Western Cape Department of Agriculture. 2016. *Western Cape Provincial drought and water scarcity management plan.* Cape Town, South Africa.

Western Cape Department of Agriculture. 2018. *Departmental evaluation plan 2018/19.* Cape Town, South Africa.

Western Cape Department of Agriculture. 2018. *Drought relief 2018/2019 and 2019/20 Implementation plan.* Cape Town, South Africa.

Western Cape Department of Agriculture, 2017. *Informing the Western Cape agricultural sector on the 2015-2017 drought. A drought fact sheet, November 2017.* Cape Town, South Africa.

Wilhite, D. A. 1993. *Drought assessment, management, and planning: theory and case studies.* Boston: Kluwer Academic Publishers.

www.pnas.org/cgi/doi/10.1073/pnas.1003160108 [27 May 2017].

Xaba, T. and Dlamini, C.S. 2015. The comprehensive agricultural support programme's (CASP). Training and capacity building: an impact analysis on income levels of emerging farmers in Limpopo province (South Africa). *American Journal of Economics,* 1(3):153-163.

Zeidler, J., Kandjinga, L. and David, A. 2010. Study on the effects of climate change in the Cuvelai Etosha Basin and possible adaptation measures. Integrated Environmental Consultants of Namibia, Windhoek.

Ziervogel, G., New, M., Archer van Garderen, E., Midgley, G., Taylor, A. and Hamann, R. 2014. Climate change impacts and adaptation in South Africa. *Climate Change*, 5:605-620.

9 9. APPENDICES

9.1 Guiding Questions for Focus Group Discussions in the Western Cape Province

GROUP NUMBER:_____

DATE:_____

TOWN(s):_____

DISTRICT:_____

VENUE:_____

OBJECTIVE: Determining smallholder farmer livelihoods, coping and adapting strategies during drought periods

FACILITATOR: _____

PARTICIPANT NAMES:

1. Characteristics / background of participants			
Number of participants:			
Enterprise:	Livestock production =	Crop production =	Mixed production = Vegetable production =
Age category of participants:	Youth =	Middle aged =	Elderly =
Gender of participants:	Males =	Females =	
Support:	Supported =	Not supported =	

2. Contextual and background information

What other activities for living are you involved in besides farming?

3. In-depths questions

A. ASSETS

- What do you think is the future of farming 20 years from now? **(youths participation, role of elderly in promoting farming)**
- What is your opinion on the farm-related events offered in your area? **(challenges when attending the events, benefits)**
- How has the current drought shaped your perception on farming as the only source of income?
- What is your opinion on borrowing as an option of running your farming business? **(access, challenges, consequences for borrowing etc.)**
- Please share your experiences of farming on a leased/rented land
- What are your experiences with your current water authorisation type? **(challenges according to type)**
- How do you feel about the water infrastructure in your community or on your farm? **(adequacy, access, condition etc.)**
- What storage facilities do you have? (**storage for feed, cold storage, vegetables etc.**)
- How do you feel about farming groups in your community?

B. COPING STRATEGIES FOR AGRICULTURAL WATER USE (CROP/LIVESTOCK/MIXED)

What is your view on the current drought in your area and how are you surviving it?

C. ADAPTING STRATEGIES FOR AGRICULTURAL WATER USE (CROPS/LIVESTOCK/MIXED)

- Given your own experience with the current drought, what is your plan for any future droughts?

D. ROLE OF ORGANISATIONS IN SMALLHOLDER FARMER LIVELIHOODS STRATEGIES

Early warning systems and indigenous knowledge systems

- What sources of drought warning information are available in your area? **(existence of formal and informal drought warning systems; adequacy, relevance and use of information, challenges with ways used to disseminate information, perceptions on indigenous knowledge systems value and suggestions for uptake of indigenous knowledge systems by organisations)**

Support provided by organisations and individuals

- List the organisations that support you in your farming **(Net-mapping)**
- What kind of support do they give you? **(Net-mapping)**
- How does the involvement of these organisations in your farming affect your decision-making? **(Net-mapping)**
- Which among the organisations that support you are the most important? **(Net-mapping)**

4. Conclusion

Is there anything else about yourself that you may want to share with us before we start the discussion?

9.2 Publications

9.2.1 Journal Articles

- Carelsen, C.R.P., Ncube, B. and Fanadzo, M. Classification and characterisation of smallholder farmers in South Africa: a review. *South African Journal of Agricultural Extension.* (**under revision, Manuscript ID: SAJAE571)**
- Fanadzo, M., Ncube, B., French, A. and Belete, A. Smallholder farmer coping and adaptation strategies during the 2015-18 drought in the Western Cape, South Africa. *Journal of Physics and Chemistry of the Earth* (**under review JPCE_2020_190**).
- Pili, O and Ncube, B. Coping and adaptation strategies for agricultural water use during drought periods in the Overberg and West Coast Districts, Western Cape, South Africa. (**ready to be submitted to *Water SA***)
- Fanadzo, M., Ncube, B., Belete, A. & French Adam. The role of the South African government in drought coping and adaptation by smallholder farmers: a review (**written, to be submitted)**
- Fanadzo, M., Ncube, B., Belete, A. & French Adam. Livelihoods analysis of smallholder farmer's in the Western Cape (draft, to be submitted)
- Fanadzo, M., Ncube, B., Belete, A, & French Adam. The role of organisations in smallholder farmer's coping and adaptation strategies in the Western Cape during the 2015-18 drought (draft, to be submitted)
- Carelsen, P.R.C., Ncube, B. and Fanadzo, M. Understanding the roles and effectiveness of extension services in supporting the smallholder farmers in the Western Cape during drought periods. (To be submitted to the Journal of Agricultural Education and Extension)
- Kudzai Mugejo Journal paper – 2021
- Synthesis Paper 2021 – Ncube B and Reference group members
- Kgabo Chantel Seanego Journal paper – 2021
- Mahole Sharllot Journal paper – 2021

9.2.2 Theses

- An analysis of smallholder farmer livelihood, coping and adaptation strategies during drought, Western Cape Province, South Africa – **PhD CPUT – Mercy Fanadzo**
- Coping and adaptation strategies for agricultural water use during drought periods in the Overberg and West Coast District, Western Cape, South Africa – **Masters CPUT – Olwethu Pili**
- Understanding the roles and effectiveness of extension services on the livelihoods of smallholder farmers during drought periods in the Western Cape – **Masters CPUT – Coolridge Paul Recardo Carelsen**
- Analysing drought risk preparedness by smallholder livestock farmers: An application of Protection Motivation Theory in Blouberg Local Municipality, Limpopo Province – **Kgabo Chantel Seanego – MSc University of Limpopo**
- Stomatal activities and yield of two forage cultivars grown under different nitrogen levels in distinct agro-ecological zones of Limpopo Province – **Mahole Sharllot – MSc University of Limpopo**

- Infrastructure performance and irrigation water governance in Genadendal, Western Cape, South Africa – **Masters CPUT – Kudzai Mugejo**

9.2.3 Conference Presentations

- Fanadzo, M., Ncube, B., French, A. and Belete, A. 2019. Drought coping and adaptation strategies by smallholder farmers in South Africa. 20th WaterNet/WARFSA/GWPSA Symposium. Johannesburg. October 2019.
- Pili, M. and Ncube, B. 2019. Coping and adaptation strategies for agricultural water use during drought periods in the Overberg and West Coast Districts, Western Cape, South Africa. 20th WaterNet/WARFSA/GWPSA Symposium. Johannesburg. October 2019.
- Carelsen, P.R.C., Ncube, B. Classification and characterisation of smallholder farmers in the Western Cape. Provincial Extension and Advisory Symposium, 17-19 July 2019.
- Pili, O. and Ncube, B. 2018. Coping and adaptation strategies for agricultural water use during drought periods in the Overberg and West Coast Districts, Western Cape, South Africa. 6th International U6 Conference: Research, Innovation & Technology for African Development. 4-6 September 2018 held at the Cape Peninsula University of Technology, Cape Town, South Africa.
- Fanadzo, M. and Ncube B. 2018. Analysis of smallholder farmer livelihoods, coping and adapting strategies during drought periods in South Africa. 6th International U6 Conference: Research, Innovation & Technology for African Development. 4-6 September 2018 held at the Cape Peninsula University of Technology, Cape Town, South Africa.

9.3 Capacity building

Individual Capacity

Seven students were recruited into the project, one student left although he remained registered with CPUT. Three of the students have submitted their theses for examination, and the other three who started later were in the middle of field data collection when lockdown started. They are trying to use remote methods to collect some of the data. One of the students who are about to complete is an Extension Officer at the Western Cape Department of Agriculture, so the project contributed to capacity building in the government department. All students attended meetings and conferences and they were trained in research writing and presentation skills.

Community development

Participatory tools were used throughout the project to engage with farmers. Studies in South Africa have shown a huge information gap between support institutions and smallholder farmers in drought management. This project sought to close the information gap through empowering communities to participate in debates concerning drought support. Institutions have been struggling with coordination and what criteria to use to develop effective support programs, especially during droughts. Some in-depth analyses were done, and these will feed into some of the institutional strategies. Engagement with the farmers provided a platform to develop appropriate farmer support strategies.

The action research process has also helped the researchers to advocate for new ways of finding solutions with farmers, therefore empowering them to improve their livelihoods. The project

helped farmers to reflect on the meaning of development within their set-up and therefore fostered the will to act and find solutions to the problems.

Organisational Capacity
The project generated knowledge that is contributing to a better understanding of the different types of smallholder farmers and their livelihoods. Documentation of action research processes that were developed with farmers will further add to better processes of engaging with farmers. Knowledge dissemination is a continuous process throughout the project. The research team utilized knowledge dissemination processes that the catchment management areas and the Department of Agriculture are already using such as the newsletters, farmer workshops and knowledge days. The results will also be published in scientific and/or popular publications for wider sharing. Researchers also participated in national and international conferences and made presentations that drew media attention. Dissemination workshops are planned for other interested government departments and policymakers.

9.4 Archiving of data

Centre for Water and Sanitation Research

Centre for Water and Sanitation Research
Cape Peninsula University of Technology
Bellville Campus, Symphony Way
PO Box 1906, Bellville 7535
Cape Town
South Africa

Tel: +27 21 953 8706/+27 21 959 6111
Email: ncubeb@cput.ac.za

The Centre for Water and Sanitation Research has a system of archiving project data that sits in a central server within the unit. All the field reports and project deliverables are filed in this system. The research unit also has a resource centre where hard copies of deliverables and the final report are kept.

Cape Peninsula University of Technology

Cape Peninsula University of Technology
Bellville Campus, Symphony Way
PO Box 1906, Bellville 7535
Cape Town
South Africa
https://www.cput.ac.za/

Tel: +27 21 959 6767

The university has a records and archives department that keeps all university information and records. When the project is finalised all the deliverables and the final report will be sent to the

department for archiving. Published reports and journal papers will be sent to be uploaded into institutional repository libraries for public access. Some of the reports will also be made available via the university website. Project communication emails are currently in a separate folder in the principal researcher's mailbox. The university periodically archives all emails within the university email system.

Water Research Commission

The Water Research Commission has a system of archiving all the reports submitted under projects. All deliverables are currently downloadable. In addition, the final report will be published in hard copy form as well as in electronic form for public access via the knowledge hub. Web address: http://www.wrc.org.za/