

**Investigating the role of extension officers in supporting social learning of
rainwater harvesting practices amongst rural smallholder farmers in
Nkonkobe Local Municipality, Eastern Cape**

A half-thesis submitted in fulfillment of the requirements for the degree of
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ABSTRACT

Water is essential for food production, however South Africa's water is already under pressure due to increasing population, food demand, and climate change, amongst other factors. Over the past years, there has been increasing demand for agricultural water use for food production due to these factors. Rainwater harvesting and conservation (RWH&C) for food production is one of the most promising approaches to address increasing demand of water. The Rhodes University Environmental Learning Research Centre have led a project with the Water Research Commission (Project No. K5/2277) focusing on the dissemination of RWH&C practice knowledge that involves some of the extension services in the Nkonkobe Municipality in the Eastern Cape, called the 'Amanzi [Water] for Food' project. While extension services were included in the project, the wider role of extension services in 'disseminating' RWH&C knowledge amongst farmers is not clear, a problem which provides the focus for this research, especially since there are changes in the designated role of extension services to become more responsive and reflexive in relation to farmers emerging needs, and in response to wider issues such as climate change and water scarcity.

In general, there is agreement that the role of extension is to be active within the farming community, to facilitate social interactions and collaborative processes that often focus on activities that are intended to find, assess, interpret and adapt information, knowledge and evidence that are suitable for farmer's needs. Extension should also be available to identify arising issues that the farmers experience that can be solved by the use of research knowledge. However, little is known with regard to whether extension officers are taking up this role effectively, especially in relation to RWH&C knowledge.

Using document analysis, semi-structured interviews, field-based observations and focus group discussions, this research seeks to demonstrate the role of extension services in facilitating and supporting social learning of RWH&C practices amongst rural smallholder farmers for improved food security. It provides insight into the way in which extension officers are able to facilitate social learning using RWH&C knowledge, and the issues that affect the adoption of social learning approaches to extension support related to RWH&C knowledge uptake and dissemination.

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ACRONYMS

DAFF	South Africa Department of Agriculture Forestry and Fisheries
NGO	Non-governmental organisation
RWH	Rainwater Harvesting
RWH&C	Rainwater Harvesting and Conservation
WRC	Water Research Commission
IDP	Integrated Development Plan

CHAPTER 1

CONTEXT AND INTRODUCTION TO THE STUDY

1.1 Introduction

This chapter provides the context and background of the study. It outlines the research purpose and research questions, and provides an overview of the chapters contained in the thesis. It also introduces the study site.

This fieldwork for this study was located within a Water Research Commission Project entitled *Water use and food security: Knowledge dissemination and use in agricultural colleges and local learning networks for home food gardening and small scale agriculture* (Lotz-Sisitka et al., 2016; WRC Report No. 2277/1/16). To simplify project communications, the project was named the *Amanzi [Water] for Food* project. This is a project focusing on knowledge dissemination of Rainwater Harvesting and Conservation (RWH&C) practices in the agricultural sector as a response to supporting food security amongst smallholder farmers and homestead food producers. This study was one amongst other studies in the wider programme (Lotz-Sisitka et al., 2016). It specifically investigated the roles of extension officers in facilitating and supporting social learning of rainwater harvesting and conservation practices amongst rural smallholder farmers in the Eastern Cape Province South Africa, in the context of the *Amanzi for Food* project.

1.2 Broader context of the study: Water Research Commission and the Amanzi for Food project

As development practitioners in South Africa have come to realise the central importance of household food security, they have shifted focus to the potential role of smallholder farmers and homestead food production. Attention being given to a realisation that lack of water has prevented many households from growing crops in their homesteads (Botha & de Lange, 2006). A reliable supply of good quality water is essential to growing food and when growing food, 'Water is life'. As the user of 62% of South Africa's available water, the agricultural sector has a major responsibility to ensure the most efficient use of this most precious of resources, including amongst smallholder farmers and household food producers (www.amanziforfood.co.za).

The Water Research Commission (WRC) recognises smallholder farming and homestead food production (especially food gardening), as a coping strategy for poor households. It provides a safety net and in some cases can even help to overcome some of the vulnerabilities caused by poverty. In recognising the importance of supporting this level of farming and efficient water use, the WRC developed learning materials on RWH&C practices for smallholder farming and homestead food production (see Figure 1.1). Materials include:

- *A comprehensive learning package for education and the application of water harvesting* (WRC Report No's: TT/492/11; TT 493/11; TT494/11; TT495/11; TT496/11) [referred to as **WH&C materials** in the Amanzi for Food Project (Denison, Smulders, Kruger, Ndingi & Botha, 2011)]; and
- *Agricultural Water Use for Homestead Gardening Systems – Resource Material for Facilitators and Food Gardeners* (WRC Report No. TT 431/09) [referred to as **AWUHGS materials** in the Amanzi for Food Project (Stimie, Kruger, de Lange & Crosby, 2010)]

While these materials contain much needed information for smallholder farmers and household food producers on how to catch, store and use water for farming at this level, a challenge was identified by the WRC that related to their effective use (Lotz-Sisitka et al., 2016). Thus, the question that was brought by the WRC to the Rhodes University Environmental Learning Research team (of which I am a member) was how to put the valuable ideas and guidelines on practice contained in the material into use so as to influence wider practice so that local level successful practices described in the materials can be scaled up to reach other stakeholders (Water Research Commission, 2013).

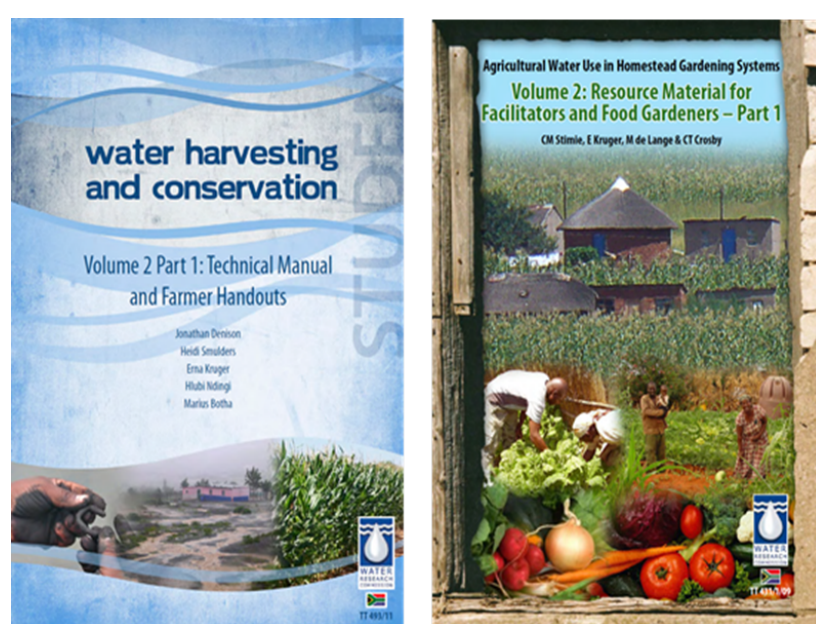


Figure 1.1: Two sets of WRC materials that informed Amanzi for Food Programme activities

Following an open process of proposals, in which the WRC called for projects that could address this problem, in 2013 the WRC contracted the Rhodes University Environmental Learning Research Centre to undertake research work focusing on the following objective:

To develop a strategy for achieving effective knowledge dissemination and practical training to encourage productive water use for food crop production [amongst small holder farmers and food growers in South Africa] (Lotz-Sisitka, et al., 2016, 1)

Developing an action-oriented strategy for knowledge dissemination and training for skills development of water use in homestead gardening and rainwater harvesting for cropland food production for smallholder farmers and food growers in South Africa, necessitated getting involved in actions to show how such a strategy could work. The *Amanzi for Food* project is therefore an action-oriented project, which aims to support the dissemination and uptake of research-based information on rainwater harvesting practices (RWH&C), and it encourages RWH&C to be seen as a mainstream activity across small-scale and household farming scales (Lotz-Sisitka et al., 2016; see also www.amanziforfood.co.za). Extension officers, who form the focus of my study, are critical role players in such a system of knowledge dissemination, as I will discuss further in this study.

1.3 My research interest and how it is situated in the Amanzi for Food Project

This study, which forms part of the wider Amanzi for Food project and WRC research programme mentioned above, describes facilitation and mediation process of social learning of rainwater harvesting in agricultural extension. Agricultural extension is mainly a highly technical and input driven sector, but the sector is being challenged by new policy to adopt stronger social learning approaches (see Section 2.5).

Within the Amanzi for Food project, a learning network was established to strengthen social learning approaches to the mediation of the knowledge in the WRC materials (Weaver, 2016; Lotz-Sisitka et al., 2016). This learning network included college lecturers, research institutions, universities, farmers associations, the local economic development directorate in the municipality, farmers and *agricultural extension officers* (the focus of my research interest). It involved extension officers in supporting the use of these learning materials and associated dissemination of knowledge to farmers. Following the focus of the Amanzi for Food project and the WRC materials, the emphasis was on RWH&C practices for smallholder farmers and household food security. I focussed on the role of the extension services involved in the wider

learning network, and investigated facilitation and mediation processes within the project and how they constitute social learning processes of rainwater harvesting in agricultural extension (or not).

Motivation for the study was based on being part of the Amanzi for Food project team. I have an Honours qualification in agricultural extension and rural resource management and I was interested in focusing more on the role of extension services in mediating such knowledge. I have noted that the main role of an extension officer is to be a process facilitator in rural communities, yet little is known about how they facilitate social learning processes. Thus my research sought to understand how these processes take place if they do.

1.4 Purpose of the study and research questions

The purpose of the study was to explore facilitation and mediation of rainwater harvesting knowledge and information by extension services in smallholder farming and household food production contexts in a rural area. It also captures farmers' learning experiences during the process and how the interactions between extension officers and farmers might be constituted as social learning processes (or not).

Main research question

How do extension services facilitate and support social learning of rainwater harvesting and conservation amongst rural smallholder farmers?

Sub-questions:

1. What is the role of extension officers in ensuring knowledge and information is shared between farmers and researchers?
2. What are the farmers' experiences in learning about RWH&C with the extension officers?
3. How does the facilitation of rainwater harvesting practices reflect social learning processes (or not)?

1.5 Description of the study site area, which provides the specific context of the study

1.5.1 The Nkonkobe local municipality

The Nkonkobe municipality is located in the Eastern Cape Province, South Africa. This municipality was established 16 years ago (www.nkonkobe.gov.za). The municipality is made up of Alice, Middledrift, Fort Beaufort, Hogsback and Seymour/Balfour where the Amanzi for

Food project developed its strongest learning network (Sonandi, 2016; Lotz-Sisitka et al., 2016). It is the second largest municipality in the Eastern Cape Province and constitutes 16% of the surface area of the Amathole District municipality. This is a countryside/rural municipality and is located on the foot of the Winterberg mountain range. Figure 1.2 shows a map of the Eastern Cape Province showing location of the study.

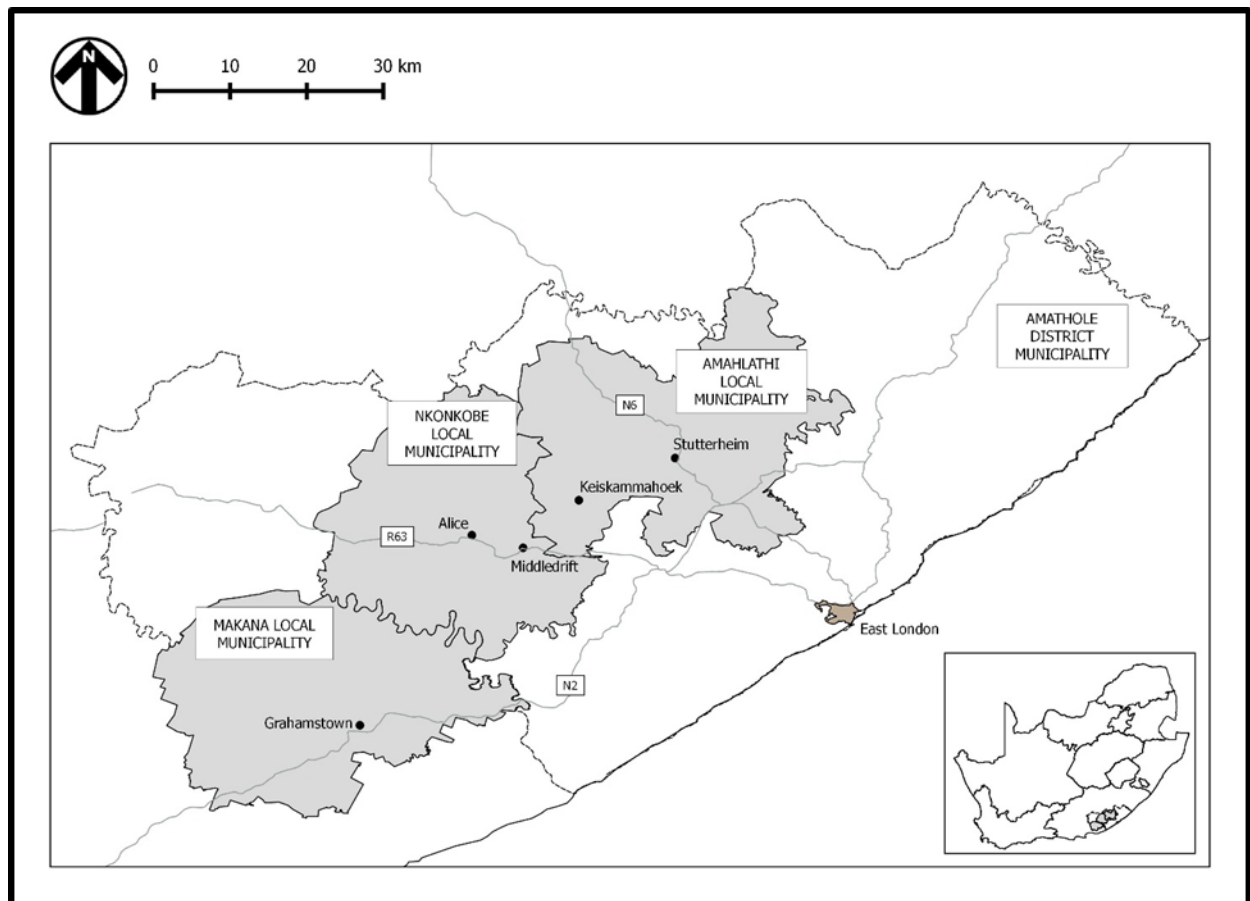


Figure 1.2: Map of the Amathole District Municipality with focus on Nkonkobe local municipality (study sites). Grahamstown is situated in Makana Local Municipality.

The population in the area are mainly isiXhosa speakers, and the area encompasses a former Bantustan area (formerly the Ciskei region). The region is semi-arid and water is not in abundance. This is mainly a rural agrarian municipality and despite the scarcity of water, agriculture is a primary and major economic activity in the municipality. According to the Nkonkobe Integrated Development Plan 2013, the “total number of people living in poverty is less than 40%, this is attributed to other social and government services such as social grants, and seasonal jobs offered by the citrus industry, and contribution by municipality in terms of infrastructure development”. Westaway (2012) argued that levels of poverty in the area are due

to unemployment rates of approximately 58.7% and this impacts on the levels of household food security.

The participants in this study are from the Nkonkobe municipality, including the extension services/officers and smallholder farmers. Participants are described in more detail in Chapter 3.

1.5.2 Agricultural extension in the Nkonkobe Municipality

Within the Nkonkobe municipality, the critical stakeholders are the farmers together with the Agricultural extension officers from the Department of Agriculture in the Nkonkobe municipality. This is mainly because the municipality is situated in an agricultural environment. Generally problems flow from the farmers to the extension officers and within the department as the departmental extension officers mainly work directly with the farmers, assisting in solving their agricultural related problems (Sonandi et al., 2016).

In the municipality, the farmers are predominantly black smallholder farmers who own small pieces of land. The land reform policy is to transfer 30% of white-owned commercial land to emerging black farmers. This poses risks of food insecurity and loss in productivity, and presents challenges for the extension services to facilitate this process (Xingwana, 2008). The extension services from the public sector in the municipality are responsible for working with farmers and for assisting in assessment and support services such as information, knowledge, training, land, farming inputs and so on (www.drdar.gov.za). These efforts have been largely ineffective as the extension services are challenged to help farmers help themselves and to establish sustainable use of the resources base which could assist in poverty alleviation and food security in the area. The issue of adequate human capacity within the extension services is also a challenge as is the development of appropriate agricultural extension approaches. There are various approaches but the technological and input driven approach is predominant and most visible in the extension services in this municipality.

1.6 Key concepts used in the study

Rainwater Harvesting and Conservation (RWH&C): Rainwater harvesting is an organised form of rain-fed agriculture and has potential to increase crop production in dry areas. Run-off farming and rainwater harvesting are considered under the same term (Denison & Wotshela, 2012). Denison and Wotshela (2012) argued that through ingenious means, water harvesting

can be set up in ways that require little or no technology, and little capital. As such, this system is well suited for developing countries and is relevant to the context of South African smallholder/rural farmers. The Amanzi for Food programme shows a range of different RWH&C practices that can be used in smallholder farmer settings, that also require little capital and technology (Kruger & De Lange, 2010; Stiemie et al., 2010; Denison & Botha, 2011). Conservation Agriculture is a proposed method used to address agricultural problems in smallholder farming systems. It seeks to address soil degradation resulting from intensive agriculture that depletes organic matter and nutrients in the soil. RWH&C is normally associated with Conservation Agriculture (Denison & Botha, 2011; Sivanappan, 2006).

According to Hobs, Sayre and Gupta (2007) Conservation Agriculture is defined as minimal soil disturbance and permanent soil cover (mulching) combined with crop rotation. This agricultural management system involves cultivation that has minimal or no tilling of land and improving soil fertility. Conservation Agriculture is a modern practice that enables farmers to achieve sustainable agricultural production. As Conservation Agriculture involves permanent or semi-permanent soil cover, the soil cover (crop residues) are a significant factor for crop production through their effects on soil physical, chemical and biological functions as well as water and soil quality (Kumar & Goh 2000).

Agricultural extension: Agricultural extension officers are referred to as bridge builders, as they link researchers (who produce scientific knowledge) and practitioners (who produce research based knowledge) with rural/smallholder farmers. Being knowledge brokers, extension officers are also seen as important role players in fostering relationships and creating operational farmers capable of producing tangible results and ensuring ongoing agriculture and success in farmer network alliances. Authors Williams, Mayson, de Satge, Epstein and Semwayo (2008) suggested that the core function of extension officers requires establishing trusting relationships that encourage conversations about the introduction of changes in farming practices, indicating that this is not simply a technical role. Extension officers are seen as promoting mutual understanding that gives researchers, farmers, and associated practitioners better understanding of each other's environment and cultures, and helps spread awareness and adoption of innovations.

Smallholder farming/farmer: The South African agricultural sector, like other sectors in South Africa, is in a process of transformation. It is highly complex, encompassing farming activities ranging from very small-scale ‘subsistence’ level production to highly sophisticated and capitalised commercial enterprises serving the export market. In this study, extension officers worked mainly with what is termed ‘smallholder farmers’. In the Amanzi for Food programme, the following framework was developed to further differentiate the meaning/s of smallholder farmer, cited from the Amanzi for Food final report (Lotz-Sisitka et al., 2016, 45-46):

The smallholder farming context and level of agricultural practice in South Africa is differentiated, and differentiation tends to occur as shaped by farmer aspirations and levels of resources including land holding size ... the [Amanzi for Food] project developed the following framework to describe this segment of the agricultural sector further, in order to provide access to the Water Research Commission materials and their use in these contexts:

➤ **Scale 1: Umzi / garden / homestead, where focus is on subsistence level production**

This is the smallest scale band and includes homestead gardens and shared community gardens, with the focus very much on production for own use, although with potential for sharing, barter, and limited sales. This scale of agricultural practice can include keeping small numbers of small livestock. The production sites are either attached to or quite close to the farmers’ (or gardeners’) homes. This context of food production is unlikely to involve employment of farm workers from outside the family. It is characterised by low input costs, with little or no financial income. Areas involved are usually less than 1ha, and can be a backyard garden. This scale of farming also generally uses low cost water harvesting technologies:

- Technologies – basic gardening equipment
- Skills and understanding – as required for basic gardening
- Cost R0 – R1000
- Maintenance – none, one or two days a year, simple repairs

➤ **Scale 2: Small arable (field), where the focus is smallholder commercial production**

This mid-scale band includes larger shared community/co-operative gardens, and dedicated arable plots, with the focus on production for income generation, with some for own use, sharing and bartering. The focus is generally on producing fresh produce, although with potential for processing and value-adding. The produce market tends to be focused on supplying local and nearby, and potentially some national markets. These enterprises can also include small livestock production. Production areas may be some distance from the farmers’ homes and may involve employment of workers from outside the family. This scale of farming generally involves increased input costs with generation of some income. Farming area sizes are generally areas of 1 – 2ha. This level of agricultural practice generally uses medium range water harvesting technologies:

- Technologies – simple testing or measuring kits, tanks, pipes
- Skills and understanding – as required for small-scale business
- Cost R1000 – R10 000

- Maintenance – regular but infrequent checking/repair, 7 – 10 days/year, technical repairs
- **Scale 3: Large arable and livestock (farm), focusing on full commercial arable production, and differing levels of (small and large) livestock production**

This level of agricultural practice is focused on production for income generation with little, if any, for own consumption. The products include some fresh produce, but also produce grown for mass processing. This can include production of crops not consumed locally, for national or international markets. Production areas may be some distance from the farmers' homes. Almost invariably this scale of production involves employment of workers from outside the family. There is a relatively high input cost, producing a reasonable income. Farm sizes are generally areas of more than 2ha (2-20 ha). This scale of farming can make use of more extensive or a higher level of water harvesting practices and technology:

- Technologies – specialised equipment (tractors, mechanical pumps, laboratories etc.)
- Skills and understanding – as required for professional specialists
- Cost >R10, 000
- Maintenance – essential regular and frequent checking and repair, up to 50 days/year, complex technical repairs

... This provided a framework for considering how the WRC materials under study could be used in the South African agricultural sector, with emphasis on the smallholder farmer, and household food producer, which ... is a critical part of the agricultural sector from a transformation and social justice perspective, as well as a food security perspective.

Figure 1.3 Below illustrates this framework that was used for describing smallholder farmers in the Amanzi for Food programme.

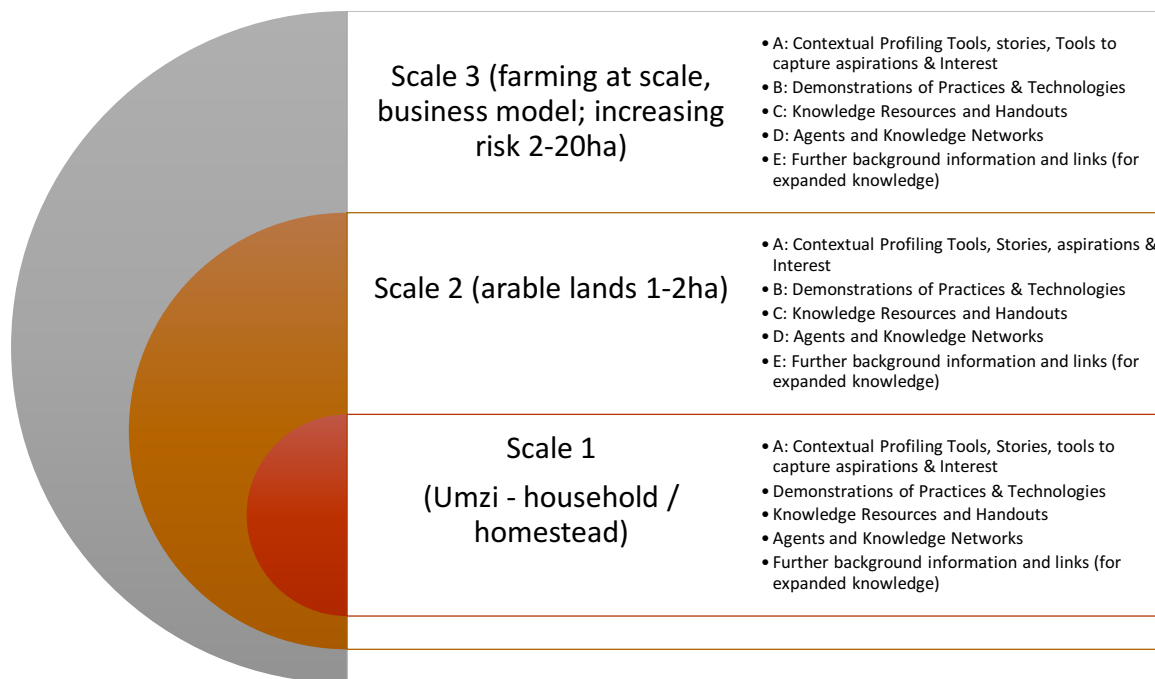


Figure 1.3: Framework for accessing 'Amanzi [Water] for Food' knowledge resources and tools for changing practice and learning (adapted from Denison et al., 2015 in Lotz-Sisitka et al., 2016, 46)

Cousins and Walker (2015) noted that the term 'smallholder' is problematic in a South African context because it obscures inequalities and significant class based differences between large communities engaged in agricultural production on a relatively small scale. Additionally, the assumption of smallholder suggests that smallholder farmers are homogenous and it fails to differentiate between types of producers. Use of the term may also draw attention away from internal tensions within households. It may also inaccurately indicate that there is a common interest amongst smallholder farmers. It may further homogenise divergences in class and gender, interests and other forms of social differentiation (ibid.). In this study I sought to be alert to the differentiations within the concept of 'smallholder farmer'.

Social learning: This study draws on theory of social learning as, according to Wals, van der Hoeven and Blanken (2009), social learning both characterises and contributes to a 'learning system' in which people learn from and with one another and, as a result, collectively become more capable of withstanding setbacks, dealing with insecurity, complexity and risks. Such a system needs people who not only accept one another's differences but are also able to put these differences to use. Such an approach to extension services development would appear to be suitable to the Extension Recovery Plan which seeks to support re-orientation of extension

training, especially when applied to the uncertain context of climate change influences (Wals, 2007). Social learning as a concept is further discussed in more detail in Chapter 2.

1.7 Overview of the study

Chapter 1 has introduced the context of the study, the research questions, and some of the key concepts. It therefore helps to situate and introduce the study. It provides introductory background to the research programme in which this study was located, namely a Water Research Commission research programme seeking to address knowledge flow concerns amongst smallholder farmers and household food producers, especially related to rainwater harvesting and conservation practice knowledge.

Chapter 2 provides further detail on the water related agricultural problem context, and associated extension services policy context of the study, as well as the conceptual and theoretical background informing the study. It begins by looking at the agricultural water issues and challenges in South Africa and how these challenges are affecting smallholder agriculture and homestead food production and food security. It then looks at rainwater harvesting and conservation practices as a response to water challenges and household food security at smallholder farmer and household food production levels. This is then followed by a discussion of agricultural extension as a mechanism for facilitating sustainable farming practices through various extension approaches. Furthermore, there is a discussion of the theory of social learning with specific emphasis on Wals' (2009) social learning process framework which forms the theoretical framework of the study.

Chapter 3 discusses the orientation of the study and its methodology. It also describes the data generation tools and data generation processes. This is followed by a discussion on how data was organised, analysed and interpreted through the lenses provided by the conceptual and theoretical frameworks discussed in Chapter 2. This chapter also discusses the issues of validity of the research findings, ethics and limitations of the study.

Chapter 4 presents the findings of the study using thick description. This chapter begins by highlighting the roles and practices of extension services. It then focusses in more detail on their roles and practices in the Amanzi for Food project in response to research goal 1 of the study. This is followed by description of the farming practices by the smallholder farmers and

rainwater harvesting practices in the Nkonkobe Municipal district. The chapter then discusses extensively the facilitation and mediation of social learning process of rainwater harvesting practices in response to goal 2 and 3 of the study, drawing on the data generated.

Chapter 5 discusses the research findings of the study more synthetically in relation to goals and aims of the study. The chapter is presented using analytical statements and is based on the conceptual and theoretical framework presented in Chapter 2 and data presented in Chapter 4. This chapter draws the strands of the study together into a conclusion. It also provides recommendations from the research and possible recommendations for future research.

CHAPTER 2

CONTEXTUAL, CONCEPTUAL AND THEORETICAL BACKGROUND

2.1 Introduction

This chapter provides further detail on the contextual, conceptual and theoretical background to the study. As will be discussed in this chapter, agricultural water is a key issue for development, and is relevant to a focus on smallholder farmers and household food producers, especially in the context of climate change (section 2.2). Many within the farming community are not aware of climate change and its impacts. Bunclark and Lankford (2011) suggested that a means of adaptation targeted particularly towards smallholder and subsistence farmers would therefore be to disseminate knowledge on already established RWH&C practices.

As noted in Chapter 1, the Amanzi for Food initiative, which is a project of the Water Research Commission (WRC) being implemented by the Rhodes University Environmental Learning Research Centre (www.amanziforfood.co.za), aims to support the dissemination and uptake of research-based information on RWH&C practices, and encourage RWH&C to be seen as a mainstream activity across small-scale and household farming scales for food production (section 2.3). It is in this context that I introduce and discuss the role of extension services (section 2.4), which is crucial in the agricultural sector as extension services are one of the main means of communication between research-based information and farmers.

The role of extension services (section 2.4) involves being active within the farming groupings, to facilitate social interaction and collaborative processes. Extension services focus on activities that are intended to find, assess, interpret and adapt information and evidence that farmers seek, and identify arising issues that can be solved by the use of research knowledge (Muchena, 1990). This leads to a focus on social learning theory (section 2.5) in this chapter which is based on recommendations in changes to extension workers roles in emerging extension services policy. Social learning theory is used as a theoretical framework to inform the analysis in this study.

2.2 Agricultural water issues and challenges in South Africa

Production of food is linked to use of water. Water is one of the most importance resources for food production, and without water we cannot grow food. Food production is one of the most water intense activities in any society and it is also a limiting factor to food production. Factors such as rainfall patterns are linked to arable land, drought, water sources and storage, costs associated with accessing, and means of accessing the water influences food production.

The agricultural sector in South Africa is a highly diverse sector in terms of its economic activities and socio-economic context. However it is estimated that only 12-14% of the country's land is considered arable, with only one fifth of the land having high agricultural potential. WWF (SA) (n.d., 1, 3), commented on this, as well as on the increasing demand for agriculture in the country:

Climate soil combinations leave only 12% of the country suitable for the production of rainfed crops. With only 3% considered truly fertile land, South Africa falls short of other countries, such as India, where arable land covers 53% of the country ... South Africa's population is growing at almost 2% per year. The population of 49 million in 2009 is expected to grow to 82 million by the year 2035. Food production or imports must more than double to feed the expanding population, and production needs to increase using the same or fewer natural resources.

The climate limitations are important in determining potential agricultural activities and suitability across the country particularly from a water perspective. WWF (SA) (n.d., 10) commented further on the South African situation as follows:

Southern Africa is the second region in the world to be confronted by a debilitating water deficit (the first was the Middle East and North Africa) (Turton, 2000). Within the region, South Africa stands out as one of the most water scarce countries. The country is also characterised by extremely variable rainfall, both geographically and over time. In the 12% of the country that is suitable for the production of rainfed crops, productivity tracks rainfall, making farming a challenging business. Climate change predictions are that rainfall will be more infrequent but more intense. This will shrink the country's arable land and increase agricultural unpredictability. Farmers will find it increasingly difficult to increase productivity to meet the growing demand for food. This highlights the need for sound cropping and rangeland production practices to retain soil integrity despite these predicted intense rainfall events.

Water is important for life and is used in various ways according to needs of use such as agricultural/food production. It is also part of a larger ecosystem on which the reproduction of biodiversity is dependent. It has been reported that South Africa's water systems are being degraded and are under threat, especially in the face of climate change as noted in the DEA's Long Term Adaptation Scenario (South Africa. Department of Agriculture [DEA], 2013, 30):

Climate change is expected to have a major impact on South Africa, with resultant consequences for the economy, people and ecosystems. It is also widely acknowledged that water resources are the primary medium through which the impact of climate change is going to be felt in South Africa. The impacts originate through direct effects of climate change on rainfall and evaporation, the latter being in turn affected by climate drivers such as wind speed and air temperature. These primary effects are propagated through the hydrological system via characteristics of soils, geology, land cover and topography within the water catchments of the country.

It is estimated that agricultural production uses 60% of the country's water and is therefore a key focus in developing climate change adaptation responses that involve water (South Africa. DEA, 2013). The DEA's Long Term Adaptation Scenario puts forward a framework for long term planning for water management and resilience, of which service provision (which is where the role of extension services fits in) forms a part. The DEA (2013) suggested that there is need for considering the impacts of the water scenario on rural food security and on the reliance on current approaches to rural agricultural development, and that there is need for research to strengthen responsive adaptation in these areas from a water services and support perspective.

Douglas (2006) argued that threats to, and the degradation of water resources and services, often affects poor people who are mainly concentrated in rural areas, without recourse to alternatives of water for food production. The impact is felt directly by these communities as they are directly dependent on natural resources for their goods and services. Irrigation and conservation practices can overcome some limitations experienced by farmers in relation to rainfall constraints, but these require considerable resources to install and maintain. Although commercial farmers can insulate themselves from environmental degradation via irrigation, the cost is often too much to bear for rural farmers who operate at smallholder or household food production levels (Douglas, 2006), and alternatives are therefore required.

Botha et al. (2011) suggested that food security has deteriorated over the past 10-15 years in the southern African region as drought and water shortages continue to pose threats to food security (Botha et al., 2011). In rural areas (especially former homeland areas in South Africa such as where this study is situated), people are mainly dependent on subsistence farming and have inadequate irrigation infrastructure, which results in crop failure (ibid.). Inadequate irrigation systems, or poor management of irrigation systems results in further water loss, and this, combined with poor agricultural practices and unsustainable water use has also resulted in environmental degradation in the region.

The quality of water resources (rivers, dams, aquifers) is also deteriorating, further affecting a regular and efficient supply of reliable water for food production (Gyuse & Kalideen, 2010). Increasing demand for water is also raising concerns around water quality, as pollutant loads have increased rapidly due to industrialisation, population growth, chemical, fertilisers and so on, often making water unsafe for food production. This further reduces water availability for food production (Gyuse & Kalideen, 2010).

Access to and the price of water also affects food security in rural communities as water tends to be costly and / or unstable in terms of supply, whether in monetary value or in relation to the time and effort farmers spend to acquire and access the water. Backeberg and Sanewe (2010) indicated that rural subsistence households often have to travel long distances to acquire water which makes food production at household level difficult. Improved access to, and control of water is one of the ways of improving food security in rural areas. Current water policies on use of water are making it difficult for smallholder farmers and household food producers, for example no one is allowed to use municipal tap water in their gardens. Farmers thus need other means of accessing water and this requires resources and finances which they lack and this hinders levels of food production (Backeberg & Sanewe, 2010).

In addition to the interrelated issues raised above, is a larger question which relates to whether the country has sufficient water to meet current and future demand, as all of the country's water resources are already allocated. With future population growth and development plans, there is a high possibility of demand exceeding supply. This makes storage and conservation of water a critical issue.

According to Gyuse and Kalideen (2010), South Africa has had good runoff over the past 13 years leading to satisfactory dam storage. However, despite good runoff, drought has been occurring and affecting the sources and supply of water and therefore alternatives need to be explored such as rainwater harvesting practices in various forms. There are also serious questions and concerns regarding life spans of dams (ibid.), and other options need to be in place for supporting smallholder farmer's water use at household levels.

Research innovations and sustainable solutions that address challenges surrounding water supply, storage and use are crucial especially for smallholder farmers and household food

producers in South Africa, as these are some of the most marginalised farmers. This demands a special focus on alternatives that can facilitate efficiency of water infrastructure and water quality and thus, in turn, food production for household consumption. Harvesting rainwater may be an alternative for smallholder farming production (Botha et al., 2007).

There are various climate change adaptation options for the South African agricultural sector as reported in the South African Long Term Adaptation and Mitigation Scenario (ibid.). For smallholder farmers, these consist mainly of implementing small scale rainwater harvesting and conservation (RWH&C) practices at household or smallholder farming level (www.amanziforfood.co.za) (see also section 2.4 below). RWH&C practices can be implemented in ways that result in minimal soil disturbance, prevent water loss, and help to manage topsoil. Practices such as infield rainwater harvesting, and capturing runoff water for food production provide benefits that are currently well established at small scales (DEA, 2013; Denison et al., 2011; Stimie et al., 2010).

2.3 Food security/food production issues and challenges for smallholder farmers in South Africa

There are various definitions of smallholder farmers and each definition has policy implications for investment in smallholder farmers and thus impacts on rural livelihoods. Smallholder farming uses mainly family and manual labour. However, the definition of smallholder does not have a one size fits all reference point. In the South African context, smallholder farmers are mainly black rural farmers in former homelands (Machethe, 2004). There are black commercial farmers in rural areas but they may still classify themselves as smallholder farmers because of policy implications and benefits derived from extension and government services.

According to Aliber and Hart (2010), there are approximately 4 million black people involved in agriculture at some level. About 92% of these people are subsistence oriented smallholders while 8% are commercially oriented smallholders (ibid.). Women make up 61% of all those involved in farming and contribute to food production (Denison, Murata, Conde, Perry, Monde and Jacobs, 2015). Women are most disenfranchised when it comes to landholding, which in turn affects their capacity for participation in more sustainable and expansive forms of agricultural production. This is the context of agriculture and segment of agricultural practice in South Africa for this study and the Amanzi for Food project (Lotz-Sisitka et al., 2016). In

this research, smallholder farmers refer mainly to black (often women) farmers in rural former homeland communities who have small pieces or plots of land they are farming. This definition does not take into account resource availability, productivity of the land, type of crops grown, although it does recognise that produce is mainly for household consumption and sale at markets to provide, or supplement subsistence income (Van Auerbeke & Khosa, 2007). Smallholder farmers, as referred to here, rely on their farms for food production and rely on income to supplement food. They tend to be part of social networks where they exchange information, resources, and farm inputs and so on. They also participate in existing institutions to improve provision of services, and may also belong to various farmer associations should these be operational in the area (Aliber & Hart, 2009).

To support rural smallholder farmers to continue to produce food for household consumption, and to extend their capacity for selling food, extension services have been targeting project-based farmers, rather than individual farmers and households. This was to enable government to reach a wider number of people (Abdu-Raheem & Worth, 2011). However, research in South Africa suggests that farming co-operatively, or using project based farming at smallholder farmer level has not been particularly successful as it has been found that farmers have different motives, goals and objectives which often leads to conflict and failure of these projects and cooperatives (Department of Trade and Industry [DTI], 2012). Over the years, small scale food production has been recognised as an important aspect of household security and thus also the need for focusing on farmers on individual basis, and at household level as they produce food for household consumption (Statistics South Africa, 2012). There has been a shift in focus from project based farming to a focus on household food gardening and rural smallholder farmers. Extension services have also started to realise that water scarcity is preventing farmers from producing food at these levels (Abdu-Raheem & Worth, 2011).

As noted in the Amanzi for Food project report (Lotz-Sisitka et al. 2016, 43-44), the National Development Plan (2012) includes an envisaged expansion of smallholder agricultural development, involving increased support and conversion of opportunities for smallholder farmers, coupled with successful land reform. These approaches are expected to increase food security and empowerment of these communities. It proposes:

To achieve this (job creation and poverty reduction impact), irrigated agriculture and dry-land production should be expanded, with emphasis on smallholder farmers where possible. The 1.5 million hectares under irrigation (which produce virtually all South Africa's horticultural harvest and some field crops) can be expanded by at least 500 000

hectares through the better use of existing water resources and developing new water schemes.

This vision suggests 500,000 ha of new smallholder irrigation and suggests that smallholder irrigated agriculture will be the ‘driving force’ of growth and change in the country's rural areas to achieve job creation and poverty alleviation. The National Planning Commission (NPC) states explicitly that the expansion of irrigated agriculture, supplemented by dry-land production where feasible is the main strategy for addressing underdevelopment, including in the former homelands (NPC, 2012, 218). Due to the fact that most of the country’s water resources are already allocated, and the country is facing increased water pressure and scarcity, Denison et al. (2015) however suggested that,

The only way the target of 500,000 ha could be attempted seems to be to adopt a more expansive definition and extend ‘irrigation’ to ‘agricultural water’, thereby including smallholder irrigation plus all water-harvesting interventions in the programme. The reach of these combined technologies is much greater than formal irrigation, which requires a massive budget, and a target of 500,000ha is also within the practical soil and water resource limitations of the country.

This emphasis on supporting smallholder farming expansion builds on earlier policy discussion in the Department of Agriculture, where it was noted that,

One of the encouraging developments in recent years has been the growth in support for home gardens, especially in peri-urban and urban areas, where small plots, of vegetables in particular, can contribute significantly to both livelihoods and nutritional standards. (Ministry for Agriculture and Land Affairs, 1998, 12)

Most recently, the Department of Agriculture, Forestry and Fisheries (DAFF), in its most recent Strategic Plan (2015-2020) (DAFF, 2015) stated that “the challenge of growing the smallholder sector (small-scale farmers who produce for the purpose of deriving an income) is closely linked to the challenge of making smallholder agriculture more remunerative. Currently, more than half of all smallholder households live below the poverty line”. It stated further that,

Presently, about three-quarters of smallholders farm within the former homelands, and the rest of them are split between urban areas and commercial farming areas. There is scope to increase the size of the smallholder sector in each of these areas. In the former homelands, there are thousands of hectares of under-utilised arable land that can be put back into production, especially with a concerted support for input access, mechanisation services, technical support and linkages to markets. Smallholders in urban areas are poorly supported at present, but could contribute to local vegetable production in particular. (DAFF, 2015, p. 12)

At household and smallholder farming level, farmers participate in varying degrees of food production activity. Land for each farmer varies and as noted above, the highest levels of smallholder crop production and crop production potential, are located in former homeland areas. Aliber and Hart (2009) noted that approximately 4.5 million people are dependent on agriculture for their livelihood, and despite this, food production has gradually declined over the past decade, with a contributing factor being water challenges for crop production (Aliber & Hart 2009), hence also the need for the above development plans.

Improved food production does not mean food security for all, and here it is important to note who produces the food, for what purposes, and who has access to knowledge, skills and expertise to produce the food. These questions address the social justice, inclusivity and access related concerns around food security for those who are more marginalised in the food production system. These questions are of interest to rural smallholder farmers, where there is continuous threat of food insecurity and where the impact of poor quality education also leaves gaps in knowledge of food production, alternative methods to improve food production and thus access to food for everyone involved (New Partnership for Africa's Development [NEPAD], 2003; Van Auerbeke & Khosa, 2007).

Although rainwater harvesting and conservation farming practices are being used in South Africa, it is evident that a large number of farmers are not using these practices, with lack of knowledge in RWH&C often being a limiting factor to food production. Hall and Aliber (2010) suggested that when human capital improves so does farming production, particularly in the form of capacity for farmers to adapt, innovate and improve their farming practices. A focus on improving human capital also shows potential for institutions and farmers to come together and learn to improve the farmers and extension officers' capacity (ibid.).

2.4 Rainwater harvesting and conservation as response to food security for rural smallholder farmers

Rainfall and soil are very important dynamics of terrestrial and aquatic ecosystems that provide goods and services for rural communities, as availability and quality of water are key determinants in agricultural and natural productivity systems. Natural and agricultural systems suffer the most when water and soils become scarce due to changes in climatic conditions, such as seasonal drought and flooding, with development also adding pressure to already

deteriorating systems (Wani, Rockström, & Oweis, 2009). More than 80% of food production around the world is rainfed agriculture, therefore rainwater is of high importance for food production (Falkenmark, Fox, Persson, & Rockström, 2001), which is also the case in the rural former homeland farming areas that I have referred to above.

Adaptation of natural and human systems is a feature of human social-ecological relations, and humans have, since the first agricultural revolution in 10,000 BC, developed and adjusted farming practices to make changes that influence their survival and well-being. With increasing cases related to issues such as soil degradation, water scarcity and climate change, all of which represent new challenges and complexities in the social-ecological system, conventional ways of doing things are no longer efficient, and there are increasing calls for more efficient, sustainable, and conservation oriented farming practices (WWF, n.d). These include practices for adapting to water shortages and scarcity, increased climatic variability and longer term climate change (WWF, n.d). These are often also determined by ability of communities to act collectively (Altaweel, 2008). RWH&C is one of the adaptation strategies that the agricultural water sector needs to take into consideration to cope with water challenges in the country (Denison et al., 2011). Despite good knowledge of such practices, currently there is little use of RWH&C practices, despite their high potential for addressing at least some of the water challenges in smallholder farming contexts, especially because RWH&C practices are relatively easy to implement and can also be low cost (Lotz-Sisitka et al., 2016; Denison et al., 2011; Botha et al., 2007).

Definitions of rainwater harvesting are only slightly different, as various authors (Botha et al., 2014; Douglas, 2006; Falkenmark et al., 2001) have emphasised. The definitions tend to include collecting, catching and storing of rainwater in various ways for different domestic and agricultural use. For the purpose of this research, Water Harvesting and Conservation Practices' implies 'water-related' conservation and not resource conservation in general. While equally important, the latter falls outside the study. Water conservation, in the context of water harvesting, is defined as methods that reduce unproductive water loss from crop fields by evaporation, runoff and deep drainage (Falkenmark et al., 2001; Douglas, 2006; Botha, 2014)

The term 'rainwater harvesting' involves collection of rainwater or runoff from rainwater for agricultural production. Instead of water running away naturally after falling, it is collected and

used for food production. Rainwater harvesting is a productive form of soil and water conservation (Horrigan, Robert, & Walker, 2002). Yields can be more productive using this method. Rainwater harvesting is a basic form of irrigation. As there is no control over timing, surface runoff can be collected and stored during rainfall. In communities where crops are entirely dependent on rainfall, reduction in seasonal rainfall might result in crop failure. However, if during the rainfall period, water is collected and concentrated in smaller areas such as ponds, or dams, or run into fields via trenches, the yields might be achieved. Of course, during the dry season and prolonged periods of drought, there might be no water to collect, but efficiency in water harvesting practices will improve plant health even during the drought season (Botha et al., 2014).

South Africa has the potential for using RWH&C strategies as some parts of the country do receive rainfall which can be stored for crop production. Various forms of water harvesting can help retain runoff water, and this can not only provide water for crops but can also add to underground water and reduce soil erosion. Water can be collected from local catchments and can be stored in the soil profile or else via constructed local storage facilities such as ponds and other structures such as dams or tanks during the dry season. Conservation agriculture practice is also effective in improving soil conservation and in holding moisture (Botha et al., 2014) thus improving efficacy of rainwater use. Rainwater harvesting is subject to the amount and frequency of rainfall, and there are high risks of reduced crop production during dry seasons, which are not always easy to predict. When facing prolonged dry periods – as the country has been experiencing for the past year – it is difficult to ensure continuous availability of water for crops. However, with robust rainwater harvesting and conservation practices, farmers can still produce food for their household food security, especially if they ensure more substantive storage facilities (e.g. larger dams, or a number of tanks, or large underground tanks).

With the country facing water quality issues (noted above in section 2.2), rainwater is relatively clean and is also a free source of water, and there are no restrictions on the catching or use of rainwater for smallholder farmers. Catching and storing rainwater is therefore a socially acceptable and environmentally responsible form of providing water for crops at a smallholder farmer level. There are, of course, challenges associated with upstream diverting of rainwater resources into dams and ponds, as this might have implications for people further down the slope as they might not have access to runoff water (Karumba, n.d). For this reason, water used from rivers must be used under licence, if over a certain amount. In South Africa, the National

Water Act (2008) replaced the previous system of water rights and entitlements, which was based on the ownership of riparian land, with a new system of administrative limited-period and conditional authorisations to use water.

Innovative ways such as efficient rainwater harvesting are one of the opportunities to enable human development without compromising ecosystems. There is an increasing shift towards at looking at the potential of rainwater harvesting in improving food production for household food security without compromising the environment (Douglas, 2006). Rainwater harvesting practices also reduce dependency on irrigation, which is costly and requires continuous management of infrastructure. Capturing runoff water has ecological benefits such as minimising impacts of flooding and soil erosion (Makwara, 2010). RWH&C can therefore play a role in rural communities to address issues of water scarcity and can create synergies between good management of water, ecosystems and human wellbeing (Denison et al., 2011; Stimie et al., 2010; Douglas, 2006).

RWH&C are relatively cheaper than more complex irrigation methods as they do not require high tech resources. This raises the question whether these are the most suitable practices and technology for the poor. The Department of Agriculture, Forestry and Fisheries has argued that “Declining agricultural performance is a major driving force behind growing poverty among African small holder farming populations, and its recovery offers the greatest prospects for rural populations to escape out of poverty” (South Africa. DAFF, 2012, p. 1). They cited “lack of assets, information and access to services hinders smallholder participation in potentially lucrative markets” (ibid.) as impeding smallholder farmer production. The question is whether rainwater harvesting and conservation technologies and techniques can address at least some of these issues. Some argue that they do, and that they are a very important source of development support (Denison et al., 2011) given the current contexts and conditions, while others claim that higher levels of mechanisation and precision agriculture would have greater yield benefits for smallholder farming development and that more reliable irrigation systems should be implemented (Massyn, 2014). There is also evidence that RWH&C technologies and approaches have failed in some communities and therefore the suitability and sustainability of the practices can be questioned, their appropriateness for target communities, institutions and stakeholders (Bunclark & Lankkford, 2011). DAFF (2012) has argued that smallholder farming is best developed via co-operative structures where human capital, soil resources and quality, land, and water resources are all developed simultaneously.

Botha (2006) argued that while RWH&C may well seem to be a very suitable option for smallholder farmers, this is not always the case, as these practices may not prove to be effective in all communities as communities and institutions are heterogeneous. To date, the efficacy of implementation has mainly focused on the technical sides of RWH&C and with this, the learning process taking place during dissemination of RWH&C knowledge has been given less attention (Rivers, 2014; Lotz-Sisitka et al., 2016). This calls for a broader recognition of non-technical issues associated with RWH&C. It also foregrounds the need to give more attention to the complexity and dynamics of social processes associated with RWH&C, such as experiences of farmers in using and learning about these practices, the mediating roles of NGOs and other local institutions such as extension services in disseminating information and knowledge on RWH&C to farmers, cultural influences on the learning that is taking place, how these are mediated and who mediates these practices (Rivers, 2014). Focusing on the mediation of RWH&C knowledge amongst rural women, Rivers (2014, p. iii) found that “by understanding and taking account of their history, context, struggles and experiences, their learning and practices can be better supported through more relevant learning resources and programmes”.

Reynolds and Nierenberg (2012) emphasised the need to address issues that look into sustainability of RWH&C practices, and how various role players and influential institutions such as extension services can better ensure sustainability of these practices, so that these can be shared with more farmers and institutions in various communities. Rainwater harvesting may improve food production, but implementation of the practices also need to take into consideration factors such as farmers finances, land, labour and agency which may also play major roles in enabling and constraining uptake of RWH&C by the farmers, as well as gender related factors (Rivers, 2014). RWH&C may require physical input initially as this is a labour intensive period, and this may be challenging for farmers, even when there is willingness to practice RWH&C. For example, in the Amanzi for Food case study, elderly rural women struggled to provide the labour needed for digging furrows and ponds for their communal gardens, and youth in the communities were not prepared to assist them. In some cases, there may be a lack of knowledge and skill amongst farmers as to which of the RWH&C may be best to implement, and despite training and knowledge, food production can remain low (Douglas 2006; Botha et al. 2007). Depending on the scale of practice, RWH&C must also be

cognisant of land policies of communities and land use specifications, as land in rural homeland areas mainly belongs to traditional authorities (Giupponi & Sgobbi, 2013).

An increasing water demand for agricultural production affects water availability for other users and uses such as water use for terrestrial and aquatic ecosystems and other humans needs (e.g. drinking water provisioning). Upgrading rain-fed agriculture through rainwater harvesting practices may result in trade-offs with downstream users and ecosystems. Depending on the scale of rainwater harvesting downstream, however, trade-offs can be small, and investing in management of rain-fed agriculture such as RWH&C can reduce environmental and land degradation and improve availability of water thus enabling more food production and water quality downstream (Horrigan et al., 2002). It can also provide for other household water needs.

RWH&C is perfectly sustainable when properly conducted; this means recognising that communities and farmers are heterogeneous, what works in one context may not work in another. It is important to consider which practices work best in which contexts, and also to recognise that RWH&C practices can be adjusted to local conditions and adapted and improved according to farmers' needs. RWH&C have costs and benefits and decisions need to be based on the perceived balance between these two. The context is crucial when applying RWH&C practices which must show flexibility and prove to increase food production (Thomas et al., 2007).

The Amanzi for Food programme worked with sixteen different RWH&C practices (see Box 2.1. below) introduced via a navigation tool and participants such as farmers, extension agents, researchers, and college lecturers were asked to choose those practices which seemed most appropriate for use in different circumstances. Some were more suitable for household food gardens, while others were more appropriate for larger plots of land such as communal food gardens, or smaller farming plots.

Box 2.1: RWH&C practices promoted in Amanzi for Food

- *Roof water harvesting*: collecting water from roof for garden use. I observed that most farmers were harvesting roof water.
- *Grey water harvesting*: Using household waste water (bathing, cooking, cleaning water) for garden.
- *Fertility pits*: pits that are filled with organic matter such as compost or manure and enables runoff to be captured and absorbed
- *Gelesha*: turning the ground ready to receive rain before plantation.
- *Diversion furrows*: direct rainwater runoff to a crop area or storage tank.
- *Trench bed*: packed with dry grass and leaves, compost manure and soil used in food gardens, creates highly fertile soil which can absorb and store water.
- *Mulching*: spreading organic material like compost, dry grass and leaves on to the surface of the soil to reduce evaporation.
- *Homestead ponds*: small scale storage ponds to catch and store surface runoff.
- *Terraces (benches)*: used in home gardens and smaller fields, mainly used in steeper sloping areas for cropping.
- *Tied ridges*: crops are planted on either side of the ridge. Runoff from the unplanted area is caught in the furrow and infiltrates into the root zone.
- *Swales*: the swale intercepts runoff, spreads it out and helps it infiltrate deep into the ground. Used in home-gardens and smallholder fields. Widely used within permaculture systems. Good groundwater recharge.
- *Stone bunds*: Slow down, filter and spread out runoff water. Increase infiltration and reduce soil erosion. Sediment is slowly captured on the upper sides, forming natural terraces.

2.5 Agricultural extension as mechanism for facilitating RWH&C practices for food production

The National Climate Change Response White Paper (Republic of South Africa [RSA], 2011) suggests that in order to expedite adaptation to the added uncertainties of climate change, subsistence smallholder farmers need efficient and informative agricultural extension services to provide advanced and state of the art research based knowledge on climate change adaptation and food security. This would include information on RWH&C practices at smallholder and

household farmer levels. The South African Long Term Adaptation Scenario Report recommends that the extension services needs to be strengthened in number and capacity (South Africa. DEA, 2013). The National Framework for Extension Recovery Plan (ERP) (South Africa. DAFF, 2011) states that extension is a systematic process of working with farmers or communities to help them to acquire relevant and useful agricultural or related knowledge and skills to increase farm productivity. The ERP has as its fourth pillar, a focus on re-skilling and re-orientation of extension services, but this does not give attention to the re-orientation and re-skilling of extension services under complex conditions such as climate change (South Africa. DAFF, 2011).

The need for enhancing the role of extension services within rural agricultural systems is well documented with many pointing to the ‘knowledge brokering’ role of extension officers (Islam, et al., 2011, Karbasioun, Mulder & Biemans, 2007; Adhikarya, 1994). According to Islam et al., (2011), extension officers are referred to as bridge builders, as they link researchers who produce scientific knowledge and practitioners who produce research based knowledge with rural/smallholder farmers. Being knowledge brokers, extension officers are also seen as important role players in fostering relationships and creating operational farmers capable of producing tangible results and ensuring ongoing agriculture and success in farmer network alliances. Williams et al. (2008) suggested that the core function of extension officers requires establishing trusting relationships that encourage conversations about the introduction of changes in farming practices, indicating that this is not simply a technical role. Extension officers are seen as promoting mutual understanding that gives researchers, farmers, and associated practitioners better understanding of each other’s environment and cultures, and helps spread awareness and adoption of innovations.

Agricultural extension is a highly recognised and important mechanism for sharing information, knowledge and innovation between farmers and research. Extension is one of the key tools in promoting socially sustainable farming practices; this study therefore emphasises extension services because they are influential and work directly with the farmers. There is a growing need for agricultural, rural and sustainable practices as knowledge is intensifying and as the field of agriculture is facing challenges in keeping up with increasing population, water shortages, food security, and environmental degradation. This will therefore require farmers to be more knowledgeable on these emerging issues (Islam et al., 2007).

The arguments put forward above on the concerns facing smallholder farmers and the potential for RWH&C (see sections 2.3 and 2.4 above) point to some of the potential roles of agricultural extensionists i.e. their role in fostering development of rural smallholder farmers through improved agricultural production and maximizing returns. The emphasis outlined above (see section 2.4) on the need to focus on the social dimensions of RWH&C also has implications for extension services, and training of extension services to understand and share knowledge of RWH&C. There is also a need to consider extension approaches that facilitate exchange of knowledge and information with the farmers. Extension services further need support to learn new knowledge and skills (e.g. of RWH&C) as they too are faced with the challenge of dealing with emerging issues, alternative solutions, conflict resolution and nurturing of emerging community learning initiatives (Kachilonda, 2014).

Effective extension services are needed because research and farmers are separated often by long distances and available technological communication is not always accessible to, or applicable to rural smallholder farmers as few use the full range of new information technologies (Karbasioun, Mulder, & Biemans, 2007). Very few knowledge resources are accessible to rural communities and particularly rural smallholder farmers, which is a result of inadequate dissemination of resources and low literacy levels amongst the communities (Muchena, 1990). Extension services are meant to have direct access to farmers and should work with them as researchers who are producing new knowledge of farming practices are not in communities for long periods of time and are also not specialists in knowledge dissemination. They are therefore the ‘official’ mediators of farming knowledge, bridging the gap between research innovation and farmers.

Often, however, it is the nature of the research, and the packaging of up-to-date research information and knowledge that presents difficulties for both farmers and extension services. The Food and Agricultural Organisation (FAO, 1997a) suggested that this problem lies in the skills needed to translate research knowledge into suitable forms and to judge the suitability of information, knowledge, and materials for both extension officers and farmers to truly learn new sustainable agricultural practices. This suggests a mediation and knowledge translation problem. This is related to the complex mediation role of extension officers. They require an ability to interpret new scientific knowledge, bridge the technical divide, and identify knowledge and skills gaps of farmers. They also have to know how to present new knowledge

to farmers, and how best to share knowledge in appropriate ways so that farmers can translate this information into applicable solutions on their farms.

Agricultural extension plays a vital role in changing in farmers' attitudes, skills and farming practices in ways that are environmentally responsible. For years there has been increasing development of environmental concerns in agricultural production as the field of sustainable agriculture has developed (Mukute, 2010). With increased concern for water related issues, materials on RWH&C have been developed; however, the integration of environmental aspects have been mainly concerned with agricultural production, with less focus on conservation aspects (International Institute of Rural Reconstruction [IIRR], 1998; Williams et al., 2008). Institutions such as the Water Research Commission (WRC) in South Africa have included environmental aspects with production aspects, with an emphasis on supporting the production of smallholder agriculture, hence also the production of the materials that were referred to in Chapter 1, which form of the focus of the Amanzi for Food programme. Through such programmes and materials, there is potential for agricultural extension to extend the knowledge, skills and practices of farmers for conservation and sustainable use of natural resources, while also expanding the agro-knowledge base of farmers about alternative methods of food production and agricultural water use (IIRR 1998; Williams et al., 2008; Denison et al., 2011).

Environmental problems are complex and require interdisciplinary approaches. The main and most established tradition in agricultural extension is to use technological and input driven approaches (Mukute, 2011). However, over the years these approaches have been changing and now include more proactive approaches to co-engagement, co-learning and problem solving. Extension approaches also now include approaches that support access to information, and that recognise the validity of different kinds of knowledge such as knowledge on RWH&C, and tried and tested farmers' knowledge of the environment. Current practice does not however show inclusion of RWH&C into the training of extension services in extension programmes. There continues to be a pressing need for changes in agricultural extension and training systems in order to fully integrate sustainable agricultural and environmental concerns (Hagman et al., 1998; Islam et al., 2011).

Extension services are one of the most influential institutions in rural communities and may hinder or contribute to the success of any project. Therefore, it is very important for programmes such as Amanzi for Food to link with extension services as they are working closely with the farmers as agricultural advisors and thus are crucial to the uptake of WRC materials and knowledge. The extension services are also very influential in the farmers' decision-making processes; for example, they influence the type of produce and therefore can also influence the farmer in use of WRC materials and uptake of RWH&C practices (Williams et al., 2008). The National Climate Change Response White Paper (RSA, 2011) suggests that, in order to expedite adaptation to the added uncertainties of climate change, subsistence smallholder farmers need efficient and informative agricultural extension services to provide advanced and state of the art research based knowledge on climate change adaptation. This would include information on RWH&C practices at smallholder and household farmer levels.

Social skills and capacity support of extension may have major impacts on the success of RWH&C practices. Extension services are a key factor in ensuring that RWH&C practices progress from being disseminated to sustainably adapted, implemented and managed to improve food production (Karbasioun et al., 2007). A lack of emphasis from the extension services may minimise the impact of the Amanzi for Food programme designed to encourage uptake of RWH&C as noted in Chapter 1. It is also important to note that extension services might themselves reduce the impact of the project as work with farmers if they have certain agendas, and if they are following approaches or policies that might reduce adaption rate for RWH&C amongst the farmers. It is therefore crucial to integrate the RWH&C practices within existing programmes of extension so that they are not in conflict with each other.

One of the issues raised repeatedly across policy and studies on extension services is the strengthening of extension services. Lotz-Sisitka et al. (2016) reported on a study undertaken by Tregurtha et al. (2010) which, in March 2008, was commissioned by the Presidency. This fifteen-year review of agricultural policies and support instruments (1994-2007) identified some less helpful policies including the decentralisation of extension offices, which was criticised because those employed as extension officers were not provided with proper training, or prepared adequately to take on broader roles as the sector grew (ibid., 61-62). The South African Long Term Adaptation Scenario Report very recently recommended that the extension services need to be *significantly strengthened in number and capacity* (South Africa. DEA,

2013). The National Framework for Extension Recovery Plan (ERP) (South Africa. DAFF, 2011) has as its fourth pillar, a focus on re-skilling and re-orientation of extension services. This, however, does not give attention to the re-orientation and re-skilling of extension services under complex conditions such as climate change (South Africa. DAFF, 2011). This issue is discussed in detail in the Lotz-Sisitka et al. (2016) report on the Amanzi for Food programme to which I contributed. I therefore draw on this report (pages 10-12) to share the insights into the extension policy and how this relates to my research focus within the programme.

The most recent DAFF Strategic Plan (2015-2020) (South Africa. DAFF, 2015) stated that the footprint of government support services reaching smallholders has been improving. For instance, in 2010, only 8% of smallholders were visited by extension officers, but this increased to 14% in 2012/13, despite the considerably larger number of smallholders in 2012. The DAFF Strategic Plan notes that this momentum must be increased and other forms of support must improve as well. The DAFF (2015) Strategic Plan for (2015-2020) re-affirmed the mandate of the agricultural extension services to foster development of smallholder farmers through improved agricultural production compatible with the natural and other resources available to them. It suggested that climate smart and conservation farming approaches need to be expanded, and this implies the need to mainstream RWH&C in extension services systems, and extension approaches. Extension officers therefore need new skills and knowledge (e.g. rainwater harvesting and conservation) to deal with emerging issues, and to work with farmers to develop alternative solutions.

There has been a process to develop a *National Policy on Extension and Advisory Services to Agriculture, Forestry and Fisheries* (the draft Version 5 - 29 March 2013 was reviewed with comments on its presentation to Parliament in March 2015). This draft policy (as yet unadopted at the time of writing) was developed in recognition of the absolute centrality of a fully functional extension service to the imperative of transforming the agriculture, forestry and fishery sectors. It has been developed for DAFF by the Chief Directorate of National Extension Support in response to a commitment in the department's strategic plan (2012/2013 – 2016/2017) to prepare an integrated extension policy to support the three sectors. I include the outline of the framing of extension and advisory services in Box 2.2 below as this shows the changing role and expectations of extension services.

Box 2.2: Extension and advisory services as framed in the draft policy

1. **For the purpose of this policy**, extension and advisory services refer to the active collaborative engagement of all stakeholders, actors and role-players involved in the agricultural, forestry and fishery value chains to support wise decision-making about the socially, economically and environmentally sustainable use of resources in the pursuit and advancement of their livelihoods to ensure the optimal contribution of each sector to the economy and the welfare of society.
2. **Active collaborative engagement** includes, among other things, facilitating access to knowledge, information and technologies, fostering learning and practical partnerships, and assisting all parties to develop their technical, organisational and management skills and practices. Participants include primary producers, agri-businesses, processors and research, education, and other relevant organisations.
3. Unlike traditional top-down approaches, the extension and advisory services proposed for agriculture, forestry and fisheries in this policy focus on **the provision of services that respond to users expressed needs, ambitions and circumstances**, which are linked to **participatory, shared research and learning** through combined efforts of extension and advisory personnel, producers and processors. Those involved in providing extension and advice **play facilitation roles**, helping individuals, groups and organisations to access a wide range of information, advice and services within, and sometimes beyond, these sectors with the express aim of aiding the farmer, fisher or forester and others in the respective sectors to make wise decisions about the resources at their disposal. Rather than promoting simple adoption, a key outcome of any engagement with extension and advisory services is to share knowledge and strengthen individual and collective capacity to work with greater self-reliance and confidence. This enables producers and processors to contribute to, and benefit from the prosperity of South Africa while pursuing their chosen livelihoods.
4. Modern strategy for extension and advisory services is **pluralistic**, recognising that there are roles for the state, the private sector, non-profit organisations and for producers themselves in delivering services. The new approaches thus reflect a **reduced operational role for the state**, which, in addition to providing policy direction appropriately fills certain extension and advisory niches, but leaves other functions which can be better performed by the private sector, by NPOs, through public-private partnerships and, indeed, by producers and producer organisations themselves.
5. In South Africa, there are serious questions about the effectiveness of extension and advisory services delivered by government and about the coherence of services delivered by the private sector and NPOs. **A new strategy is needed** that reflects current economic, environmental and social realities and aspirations, and assigns appropriate roles to all elements of society engaged in agriculture, forestry and fishing. Global trends in extension and advisory services emphasise the need for new thinking about how best to deliver extension and advisory services. In South Africa, this policy represents the first step in that direction.
6. The policy commits South Africa to developing, delivering and maintaining a **pluralistic, harmonised, co-ordinated extension service** for agriculture, forestry and fisheries sectors that operates on a common set of principles and values and which responds to the needs, aspirations, opportunities and other circumstances of the many actors in the respective value chains.

In discussing the current approaches to extension (in contrast to traditional ‘top-down’ approaches), the draft policy (ibid.) states:

Current approaches

1. *In recent decades, **the concept of extension has broadened**. Rather than simple technology transfer from the informed to the ‘ignorant’, current approaches emphasise the concepts of advice, facilitation, empowerment and learning within a revised understanding of the roles of the state.*
2. ***Facilitation and learning-based extension** places the extension worker in a more responsive role as ‘knowledge broker’ or guide through unfamiliar organisational or technical landscapes to the advice or information that the user needs. She or he may help build systems of mutual learning among groups of interested people, or help identify sources of expertise from the state or private sectors. Building capacity among farmers to learn and to develop and share their own solutions also comes into the mix.*

This policy provides the principles and the framework within which the Amanzi for Food programme and the WRC materials mentioned in Chapter 1 must ultimately operate. Important for this study and providing the rationale for the focus on social learning theory (see section 2.6 below), is the new focus on the social learning role of extension, which is more strongly emphasised in this policy, as is the notion of ‘knowledge brokering’. It is also encouraging to note that there are no inconsistencies between the approach articulated here and the approaches adopted by the Amanzi for Food programme via the learning network approach (see section 1.3) (Lotz-Sisitka et al., 2016).

In his address to Parliament on the above mentioned policy in March 2015, the Minister of DAFF, Mr Senzeni Zokwana re-iterated the perspective above that the concept of extension has broadened to emphasise a more responsive, engaged social learning role for the extension worker. Additionally, and important for this study’s focus, he noted that there was need for giving attention to “how the transformation of the core competencies of extension practitioners” would emerge. He noted that “...the officers must be the ‘reservoir of information’ that was needed by producers” (Zokwana, 2015).

Also relevant to this study are critical comments on the draft agricultural extension policy document, which indicate that inadequate attention has been paid to *how* the policy suggestions will be implemented to give effect to international trends in favour of farmer focused, demand-led, experiential approaches (Aliber, 2012). This study, with its emphasis on social learning theory and processes, therefore potentially offers insights into *how* aspects of the policy could

be implemented in a way that builds responsive, social learning capacity amongst agricultural extension and education systems. To more fully understand this recommended approach, there is also need for a critical, theoretical understanding of social learning theory, which is discussed next.

2.6 Defining Social Learning

According to Wals, van der Hoeven and Blanken (2009), who draw on the work of Beck (1992), we currently live in risk society that is constantly changing and we are faced with challenges and problems with no readymade solutions. Environment and sustainability problems are such problems, as is the problem of water scarcity and climate change which were discussed in section 2.2 above. People in society need to develop solutions to these complex problems. However, sometimes the solutions are not ideal, because they are created via approaches that are focused on the present, or because they are limited to current ways of being and doing, and thus are inadequate for the future. It is often difficult to find specific solutions to such problems, and they remain ongoing problems, or tomorrow's (future) problem. It is also not always possible to solve today's problems with solutions from the past. Coping with complex problems and risks and problems of this nature requires people from various backgrounds to work together, and to bridge the gap between individuals; for example, there is a need for farmers, extension officers and researchers to work together to address climate change and water scarcity in rural areas. The gaps between these individual people and groups must be bridged and this needs approaches that allow people to work and learn together. Such approaches also need to be creative, flexible, and should accommodate diversity and reflexivity in order to deal with the features of complex problems in a risk society.

Solving complex problems in an ongoing manner requires ongoing reflexivity (Beck, 1992). A reflexive society requires citizens that are prepared to change their existing practices as they learn new ways of coping with complexity. For example, farmers, extensions workers and researchers can, if working and learning together, facilitate the changing of existing farming practices. As mentioned in section 2.2 above, the agricultural sector is facing water and food production challenges, and thus there is a need for reflexivity. This is likely to involve farmers working with extension services and researchers in critically reviewing their farming practice, the norms that shape these practices, in order to change these as required. This could involve improving existing farming practices using rainwater harvesting to improve their water and

farming practices. As noted in section 2.3 above, these practices also need to be sustainable, so farmers may need to review their practices continuously to see if they are sustainable and how they can improve them daily. Mukute (2010) noted that this involves learning from previous practice, improving and building on previous practices and using new knowledge, the combination of which leads to a better understanding of farming practice. Such a process can be described as a social learning process.

With the challenges facing people in contemporary society, social learning is needed at local levels, but should combine to have an impact at wider levels, given the threats to the earth system posed by climate change, water scarcity, biodiversity loss and global changes (UNESCO, 2014). There is increasingly a call for re-examination of assumptions and values as part of this social learning (ibid.). This might also be the case in the assumptions of rainwater harvesting, as critical thinking and new creativity may be needed to facilitate a shift in meaning-making on the part of the farmer and extension officers via their learning experiences.

The Amanzi for Food programme report (Lotz-Sisitka et al., 2016) suggested that in the case of the project, researchers can learn from farmers about their farming practices, and farmers can learn from researchers and extensions officers about new farming practices such as RWH&C. The learning together brings ideas, expertise and experience from different people and as a result, the groups becomes collectively more capable of withstanding setbacks, dealing with droughts, and food insecurity, thus systems are needed to put the diversity into use (farmers, extension officers, researchers). Blackmore et al. (2011) noted that the more diversified the options, the more resilient the learning system is. Blackmore et al. (2011) also warned, however, that though it might seem a straightforward process where different groups come together and learn, there are differences, dissonances, conflicts and discomforts within a learning system that are real impediments to learning; the challenge is to put these to use in order to facilitate learning.

Steyart et al. (2007) explained that social learning involves people learning from one another, not seeing anyone in particular as an expert but seeing all as learners, as individuals are all experts of their local conditions and context and can learn from each other. When people are faced with uncertainties, they are often compelled by policy or crisis to take action. One of the ways in which they do this is by building social cohesion and trust between those involved in

the learning and making collective meaning and sense (ibid.). Kachilonda (2014) argued that in order to understand social learning it is critical to have an in-depth understanding of the different people involved in the learning process. Farmers are experts of their own local conditions and they use local knowledge to adapt to changing circumstances; however they do not have all the research-based new scientific knowledge. Extension officers as mediators have this knowledge and this creates possibilities for a shared space in which farmers and extension officers can learn together. Pahl-Wostl (2006) suggested that since we live in a changing world, to overcome challenges there is need to use different kinds of knowledge such as research based/scientific knowledge together with everyday based knowledge such as local knowledge in social learning processes.

The learning environment is also of great importance as it frames the context in which learning takes place. Cousins and Deepwell (2005) noted that the learning environment is both the physical and intellectual environment facilitating the learning processes. For example, as in the case of this study, farmers and extension workers learn in their farming context, however Craps et al. (2003) argued that the learning environment is not simply the learning environment but also includes the enabling pre-conditions of learning.

Facilitation is a core skill in social learning processes, and therefore extension officers with such skills can network with farmers and other agencies and amongst themselves, provide mutual support for RWH&C learning processes (Steyaert & Jigging, 2007). Extension officers who can organise farmer to farmer site and study visits, and support experiential learning on RWH&C, and dissemination of knowledge and information, would require such facilitation skills. Steyaert et al. (2007) recommended, however, that as farmers and extension officers recognise their interdependence, the understanding constituted in learning materials (e.g. as in the WRC materials on RWH&C), scientific and technical experts must be brought into confrontation with the understanding of extension officers and farmers which is created in their own context; it is this combination of knowledge and interaction that will result in shared meaning of what RWH&C actually is and how to use it (ibid.).

As noted above in section 2.5, extension officers are seen to be important facilitators, and they are expected to assume a role in helping and offering guidance to farmers when asked as well as facilitating group discussions amongst farmers. Salomon and Perkins (1998) suggested that

extension officers need to take part in discussions as contributors rather than always leading the discussions, and to provide research backstopping for the farmers. They need to learn to work in a capacity with farmers. They are colleagues and advisors that can be consulted by farmers and other extension officers about specific problems and can provide new ideas and information on local situations (ibid.). From this, it is possible to see that extension officers have a key role to play in facilitating social learning as outlined above.

In discussing social learning, it is crucial to point out the distinction between information, knowledge and learning. Van Kerkhoff and Lebel (2006) characterised knowledge as enabling humans to understand, intervene in or resolve particular problems in meaningful ways. In the case of the Amanzi for Food programme, high quality, up-to-date information has been captured in the WRC materials on RWH&C to address issues of water scarcity for food production. This information is transferred into knowledge through meaning-making processes, which involves the knowledge systems, structures and interactions between various stakeholders (in this case, farmers, extension officers and researchers). Meaning-making is guided by the purpose that is co-defined by the agents and holders of knowledge in a relatively solid and bounded manner (O'Donoghue, 2014). Ernstman and Wals (2009) argued that knowledge systems do not necessarily have to have a fixed purpose, generally because purposes for knowledge are constantly being (co) defined by the agents in the system. The knowledge system component can vary from artefacts to the values used to communicate cultural beliefs and values (ibid.).

Learning involves process of gathering and producing knowledge by meaning-making from the data and information and being able to use this knowledge in one's context or practice (O'Donoghue, 2014). The meaning-making forms part of knowledge system and is mainly a product of relational evolution between people and the socio-ecological context in which they live (Hayek, 2007). With knowledge, societies can act and improve their local conditions, and better come to understand complexities around them. However, they may sometimes not be able to act appropriately in response to these complexities, due to lack of resources such as enabling institutions or the freedom needed to do so (McIntyre et al., 2009).

For social scientists and social learning theorists, knowledge is not only contained in set books, although they acknowledge the importance of books as repositories of knowledge and

information. Knowledge captured in written texts, however, is only a part of what is considered knowledge in social learning processes. Knowledge can also be held by people in their experience and practices, and their contributions add to the vitality, application and evolution of practice and knowledge itself. For example, the WRC materials contain knowledge and information on RWH&C practices; however, these materials require people that will contribute to the knowledge, use this knowledge and apply it in their farming practices. They will also need to adapt and adjust it so that it becomes a full body of knowledge. One could go so far as to say that by themselves, the WRC materials are ‘dead’ without the processes of application, vitality and evolution of the practices as the knowledge and information moves into use (Blackmore et al. 2011; Hayek, 2007; Steyaert et al., 2007).

There is also a need to look at the role and meaning of knowledge as a driver of learning in transformation and changes in farming practices rather than only focusing on the practices themselves (Lotz-Sisitka, 2012). Knowledge can be exchanged between social spaces in different sectors such as extension sharing and exchanging knowledge with the food security sector, and in turn, sharing this with other extension colleagues and other farmers. Extension services in the Alice community have their own body of knowledge and ways of knowing, and various extension officers and farmers involved in Amanzi for Food project might not share a single perspective, value, or belief regarding rainwater harvesting, hence the need for learning, not only individual learning, but social learning (Blackmore, 2007).

The outcomes of social learning can be shown in the knowledge of individual actors, or by particular transformations in collective agents’ behaviour and actions, for example in implementation of RWH&C practices. They can also be seen in changes in institutions or social structures, or changes in social units (Reed et al., 2010). The outcomes of social learning may, however, take time, and may result in some gradual change in agents’ behaviour and actions or their farming practices or social institutions. Tschakert and Dietrich (2010) argued that learning should bring about changes, improvement, and transgressions in normal farming practices.

In arguing how to obtain the best outcomes for social learning, Weaver (2016) and Rivers (2014) both argued for a situated approach to social learning. They suggested that knowledge should be shared in ways that encourage farmers to question their practices and consider

adaptation options, and therefore knowledge dissemination should encourage co-engagement with farmers over water issues they are experiencing in their communities. They criticised government institutions for failing to create co-engaged approaches to social learning which results in the failure of knowledge being disseminated and shared with farmers in ways that actually change practices (ibid.).

Reed et al. (2010) suggested that rather than focusing on individual people's learning only, there is also need to give attention to institutions in the social learning process, and how institutions adopt the practices. In the context of this study, it might be important therefore to consider how the knowledge of RWH&C is taken up not only by farmers, but also by the extension services in their normal practice, as well as by farmers' associations and other relevant institutions. Considering the institutional outcomes of social learning involves looking at how the institutions own them, adjust them to their local conditions and change practices. Weaver (2016) suggested that social learning networks can facilitate individual and institutional social learning.

Social learning in the context of this study is centred on farmer learning, and allows for farmers to learn, investigate costs and benefits of alternative agricultural practices reflexively for improving their food production (Pesanayi, 2007). This approach offers an alternative to traditional extension approaches, where farmers are seen merely as passive recipients, and where extension knowledge is developed without farmers and then demonstrated to farmers by extension field agents. Reed et al. (2010) suggested that social learning is a learning process in which farmers can be presented with new sustainable technologies, new ideas, and new ways of doing things in collectives, but that it involves their participation and engagement to make sense of the knowledge as argued above. The knowledge acquired through these learning processes builds on prior knowledge and thus enables farmers to adapt existing practices to become more productive and more responsive to changing conditions such as water shortages. In such a case, participatory approaches are required if extension is to respond successful to farmers' social, economic and environmental needs. As noted in the new extension policy referred to in section 2.6 above, there is need to focus on *how* extension officers come to engage with social learning processes and for this, one needs to work with a social learning theory that provides explanatory power and insight into the *how* of social learning.

2.7 Wals, van der Hoeven and Blanken's (2009) Theory of Social Learning

The theory of social learning according to Wals, van der Hoeven and Blanken (2009) both characterises and contributes to a 'learning system' in which people learn from and with one another and, as a result, collectively become more capable of withstanding setbacks, of dealing with insecurity, complexity and risks. This is the case in this research where it seeks to examine the role of extension offices in facilitating farmers to engage with knowledge and practices related to RWH&C in a changing and risk oriented social-ecological context. Such a system needs people who not only accept one another's differences but are also able to put these differences to use. Such an approach to extension services development would appear to be suitable to the Extension Recovery Plan of the DAFF (see section 2.5) which seeks to support re-orientation of extension training, especially when applied to the uncertain context of climate change influences (Wals, 2007).

There are various ways to describe social learning depending on its conceptualisation (Hubert & Ollivier, 2007; Reed et al., 2010) but it is essentially about bringing together people of various backgrounds and with different values, perspectives, knowledge and experiences, both from inside and outside the group or organisation, in order to engage in a 'creative' or open ended quest for answers to questions for which no ready-made solutions are available. According to Wals (2007), social learning is a process in which people are stimulated to reflect upon implicit assumptions and frames of reference, in order to create room for new perspectives and actions as shown by the model put forward by Wals et al. (2009, see Figure 2.1 below).

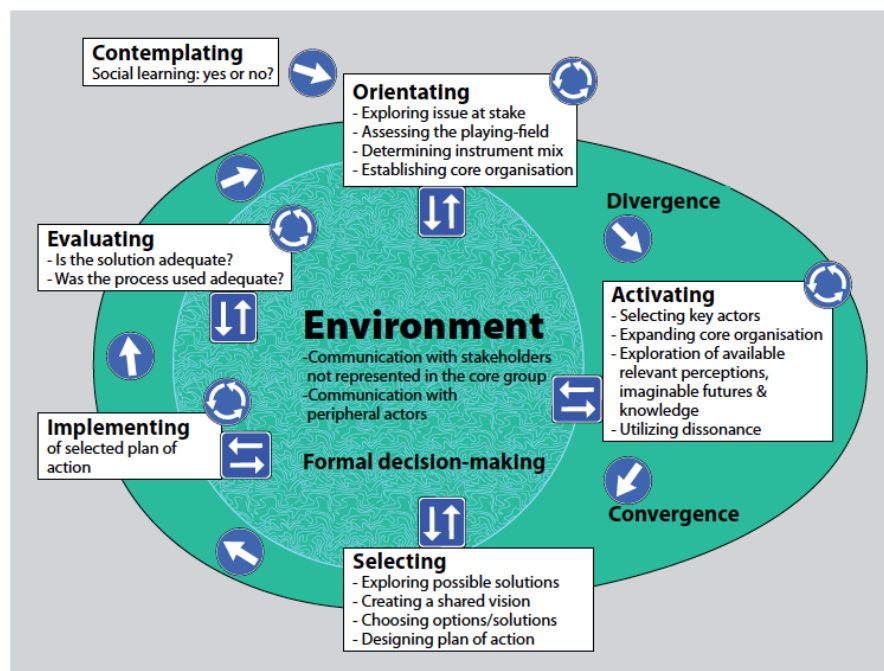


Figure 2.1: Macro and micro-learning cycles in social learning processes (Wals, van der Hoeven and Blanken, 2009)

As can be seen from the diagram depicting macro and micro-learning cycles in social learning processes from Wals et al. (2009), the authors propose a series of processes that are involved in social learning. These are of interest in this study as they could be helpful to analyse *how* extension officers engage with rural smallholder farmers in mediating and sharing knowledge of RWH&C practices, especially in the context of extension and farmer learning where both extension officers and farmers are seen as part of a knowledge-practice system.

The phases of social learning as outlined by Wals et al. (2009) suggest the following, after a process of contemplating whether social learning might be relevant or not:

- *Orientating*: exploring the problem, analysis of playing field;
- *Activating*: in larger context, involving more people, multiple perspectives, utilising dissonance;
- *Selecting*: making choices regarding directions towards solutions;
- *Implementing*: execution of the solution(s); and
- *Evaluating*: assessing the process and the results at their true value.

It is to be noted that the phases of social learning are outlined as a linear process, stages or phases. This research does not claim that learning is a linear process, however for the purpose of the study, will draw on this framework to critically review how extension officers facilitate social learning and knowledge of RWH&C practices with rural smallholder farmers.

Undertaking such research is important because it provides perspective on the learning process and experiences of both farmers and extension officers and allows for understanding if the knowledge and information on RWH&C brings about changes/improvements in the farming practices of smallholder rural farmers. It also potentially provides new approaches for thinking about agricultural extension services' re-skilling and re-orientation as required in the extension recovery plan (ERP) and the proposed new role of extension officers described in section 6.6 above (FAO, 1997b; Steyaert et al., 2007; South Africa. DAFF, 2011; South Africa. DAFF, 2015).

2.8 Concluding summary

The purpose of this chapter was to situate this research within the field of agricultural extension, and framed the need for giving attention to social learning theory. It also outlined aspects of social learning of relevance to this study, and presented a theoretical framework for analysing social learning which will be applied later in the study. The chapter presented the conceptual and theoretical frameworks to frame the research. The next chapter focuses on the research design.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter presents the research design and methodology. It introduces the readers to the research orientation, research methods and tools used in the process of data collection and data analysis. The chapter also explains why the methods and tools were used and also how and where they were used in the research. The chapter further explains how data was collected, stored and managed during the process of data collection and post data collection. The chapter then explains the process of data analysis, validity of data and research ethics as dealt with in this thesis. This chapter prepares for the data presentation in Chapter 4.

3.2 Research orientation: An interpretive and naturalistic case study

3.2.1 *Methodological approach: Qualitative research paradigm*

The study sought to understand a phenomenon in context – farmer learning as mediated by extension officers in the Amanzi for Food project. The approach adopted was naturalistic and required the use of qualitative research approaches. The study findings were derived from real world settings not by means of statistical procedures. The study sought illumination, understanding, and extrapolation to similar contexts. A naturalistic approach goes with the flow of social action and naturalistic enquiry unfolds as the study progresses. This study emphasised the importance of face-to-face and observational data rather than other forms of data generation (Berg & Lune, 2004).

A qualitative research paradigm was deemed appropriate as it allowed for deeper understanding of social learning processes of RWH&C by the researcher learning through interaction with the case and research participants in the case context (McMillan & Schumacher, 2006). It also allowed me, as researcher, to learn about people's subjective experiences in the Amanzi for Food project and to realise how real and important these experiences are. This occurred as I listened to and interacted with them as they shared their learning experiences in the Amanzi for Food Project. I was conscious that my research participants were experts of their own local conditions, and as researcher I was also learning from them. With this in mind, the research

design allowed me, as the researcher, to seek deeper insight into the learning experiences of both extension officers and farmers in RWH&C, their perceptions regarding RWH&C, their day to day practices, and how their learning of RWH&C reflects social learning processes or not.

3.2.2 Research site and research participants

As introduced in Chapter 1, the research site was located where the Amanzi for Food project is currently taking place in the Eastern Cape in the Nkonkobe Municipality, where engagement with smallholder farmers and extension officers (amongst other stakeholders) was underway to mediate RWH&C in a learning network (Lotz-Sisitka et al., 2016). The research participants were those who were already involved in the project i.e. farmers that have received training in RWH&C and also extension officers involved in the project (ibid.). Three extension officers in the area received training on how to mediate RWH&C practices through use of productive demonstrations in the local area. As noted in Chapter 1, the participating extension officers and their relations with the local smallholder farmers was the focus of this research.

3.2.3 A qualitative Case study research design

In explaining what a case is, Yin (2013) suggested that the term refers to an event, an entity, an individual or even a unit of analysis. It is an empirical inquiry that investigates a contemporary phenomenon within its real life context using multiple sources of evidence. Case studies are concerned with how and why things happen, allowing the investigation of contextual realities and the differences between what was planned and what actually occurred. Case study is not intended as a study of an entire organisation. Rather it is intended to focus on a particular issue, feature or unit of analysis (Noor, 2008). Qualitative case study uses a variety of data sources which allows for multiple facets of the phenomenon to be revealed and understood (Baxter & Jack, 2008).

A qualitative, exploratory case study approach was used in this study to explore the role of extension officers in facilitating social learning of RWH&C in the Nkonkobe municipality. This involved in-depth investigation of extension services and farming practices in the Nkonkobe municipality and allowed for a detailed account of the case under investigation (Schwandt, 1997). As noted in Chapter 1, and above, the case study was particularly focusing on the Amanzi for Food Project and provided insights into this unique context. This was aligned

with my research purpose as I intended to find out how extension officers facilitate social learning of RWH&C in this project and draw recommendations on how social learning can be improved in extension services in the municipality. This research sought to understand the role of extension officers within the case and how extension officers and farmers are learning. It emerged during the study that RWH&C demonstration sites provide conducive spaces for learning and I followed this in my data generation as will be reported in Chapter 4. I also looked at how this learning has shaped current farming practices and how it has improved food production for the smallholder farmers in this case.

This research acknowledges the shortfalls and complexities of case study methodology for example “language” among others (Schwandt, 1997) which often presents a social complexity to obtain shared meaning in case study research. Despite this, I found the case study method important in my research as it allowed me to engage deeply with research participants in a particular space at a particular time. The case study was also appropriate because of the choice of unit analysis, in this case investigating social learning of RWH&C in one context with three extension officers. It was appropriate too as it allowed the researcher to investigate the phenomenon within a real context (Gillham, 2000), in this case, in the Nkonkobe Municipality described briefly in Chapter 1. It allowed for the capturing of detail, and variance which shed light on the case context and enquiry phenomena. This method was also appropriate because it provided a systematic way of collecting data, analysing data and reporting the findings (Flyvbjerg, 2006) (see Chapter 4).

3.3 Data collection process

3.3.1 Overview of the data collection process

The data collection process is the space where I engaged with actual interactions with the case and research participants. This process was not linear; it required me, as the researcher, to work backward and forward in an iterative process. Pre-determined time frames and schedules often had to change as I had to adjust to people in the field and their agendas. Dealing with humans and social processes is complex and dynamic, nothing is stagnant, and as a result there were constant changes as the research took place. It was also a very important learning experience for me as researcher, as I learned to be more reflexive and adaptable to changes in the field (Yin, 1993).

In the data collection process I followed the three phases as proposed by O’Leary (2004). These three phases are: 1) acquiring access to research site and access to documents, 2) field observations, and 3) interviews and focus group discussions. These phases appear to be linear however, in reality this was not the case. I had to be reflexive and I found myself doing field observations and going through documents in between interviews and focus groups.

The first phase involved getting permission and access to the research site, participants and documents (see Appendices 1 and 2). I got permission from the Head of Extension services in the Eastern Cape to conduct the research and I also got permission to access and refer to the department policy and business plan documents for extension services. I also obtained permission to use the field visit reports and project reports that were being generated in the Amanzi for Food project, which were later consolidated into the final project report by Lotz-Sisitka et al. (2016). The second phase involved some ground truthing work which took place through being in the field. Here I undertook observations and probed insights I was obtaining from the document analysis process in relation to the observations. This was done through three periods of observation, where I was able to observe extension officers and farmers. The first two phases allowed me to obtain a better understanding of the context in which I was undertaking research. I was also able to get to know the research participants and gain their trust. The third phase involved the interviewing process, this included a process of verification, member checking and triangulation. I conducted three semi-structured interviews with the extension officers, one interview with the chairman of the farmer’s association in the municipality. I also conducted two focus group discussions with the farmers involved in the Amanzi for Food project.

Throughout the research process I maintained a traceable data trail using a spreadsheet to capture when I collected the data, which methods were used, and which participants were involved. I also established an indexing system to index my transcriptions, photographs, video clips, and I established a coding system that allowed me to make sense of the data. This analytical process is the foundation of Chapter 4 where I present the data, which is critically interpreted in Chapter 5. Table 3.1 below summarises the data collection process. This was done rigorously and systemically, and this process allowed for testing of the data collection tools, development of research schedules.

Table 3.1: Research processes showing data collection processes and methods

Month	Data collection methods	Data collection process
March 2016	Research access and research consent	• Prior project visit and field work to the research site • Writing consent letters • Seeking permission to conduct research from head of extension services in the Eastern Cape and extension officers • Permission granted and all consent letters signed
April 2016	Document analysis Field observations	• Analysing departmental documents and Amanzi for Food project document • Permission and prior visit arrangement • Actual Observation (OB1)
May 2016	Field observations Semi structured interviews	• Permission and prior visit arrangement • Actual observation (OB2) • Permission and prior visit arrangement • Actual Observation (OB3) • Prior arrangement • Actual interview (IEO1) • Actual interview (IF1)
June 2016	Semi structured interview Focus group discussion	• Prior arrangement and communication • Actual Interview (IEO2) • Actual Interview (IEO3) • Actual Interview (IEO1) • Prior arrangement and communication • Actual focus group discussion (FGD1) • Actual focus group discussion (FGD2)

Further detail on these data generation processes is provided below.

3.3.2 Document analysis

Documents can provide data on the context within which research participants operate. The texts help to illuminate the context. In this study, documents provided background information as well as historical insight. Information contained in the documents that I reviewed also pointed to questions that need to be asked and situations that needed to be observed as part of the research. They also provided supplementary research data (Fairclough, 2003).

Document analysis is a systematic procedure for reviewing or evaluating documents – both printed and electronic (computer-based and internet-transmitted) material. Like other analytical methods in qualitative research, document analysis requires that the data be examined and interpreted in order to elicit meaning, gain understanding, and develop empirical knowledge (Cohen, Manion & Morrison, 2013).

I undertook a systematic review of documents of that were relevant to the work and practice of the extension officers involved in the Amanzi for Food project. Table 3.2 below shows a list of the documents that I reviewed for this study.

Table 3.2: Full list of documents reviewed for this study

Name of Document	Reason for reviewing the document	Document index code
WRC Amanzi for Food Report – Deliverable 2	• Better understanding of the Amanzi for Food project • Understand context and roles of extension officers	DOC 1
Extension Recovery Plan (DAFF, 2011)	• This document is the revised extension policy. It provided deeper insights/analysis in to the extension services and agriculture in South Africa.	DOC 2
Extension Norms and Standards	• This document focuses on the norms and standards to guide the provision of extension and advisory services. • These norms and standards form the guidelines for the implementation of Agricultural Advisory Service Programme across all provinces.	DOC 3

As can be seen from Table 3. 2 above, these documents were valuable sources of information about the Amanzi for Food project and also extension services in the country particularly in the Eastern Cape Province. Reviewing the documents allowed me to understand the context and roles of extension services better, and to understand the Amanzi for Food project intentions better. The process also allowed me to question some parts of the documents and this provided me with ideas for constructing questions for the interviews and focus group discussions. These

documents further provided contextual information on food security and water issues in the province and also the Amanzi for Food project.

Analysis of the WRC reports allowed for a better understanding of the Amanzi for Food project, and the role of extension officers in the project. I also came to better understand what had been happening in the project before I joined it, and what had happened in the field with regard to learning processes associated with RWH&C and food security on the ground. The extension services documents allowed for deeper insights and overview of the extension services and agriculture in the country, hence analysis of these documents provided me with a means of questioning and critiquing what was happening on the ground in relation to the intended policy and roles of extension officers. These documents also helped me to clarify some contradictions arising from other research methods (Patton, 1990).

For document analysis I had to know exactly what I was looking for as I could take all of the information from the documents. To guide analysis and selection of information from the documents, I used my research questions. These guided what I was looking for, and allowed me to get a more focused picture, while at the same time allowing me to see the bigger picture that was emerging as I was analysing the documents (Aipinge, 2007, cited in Zazu, 2008).

3.3.3 Participant Observations

According to Ritchie, Lewis, Nicholls and Ormston (2013), observation is a data collection approach that is systemic and requires the researcher to use various tools to examine people in context or in a natural setting. Observations require prolonged engagement with social phenomena. Observations provide an opportunity to record and analyse learning processes that are taking place in the community as extension officers interact with farmers. This was the focus of the observations in this study. The observation process allowed me, as researcher, to capture experiences, events actions and interactions of the research participants. I describe myself as a participant observer because I was participating in the Amanzi for Food programme, however, in this research I mainly observed, rather than participated in shaping the work of the extension officers, thus I was more of an observer than participant in the practice.

As shown in Table 3.1 above, I undertook three participant observations over the period of the research. The observations involved watching what farmers and extension officers were doing and how they were interacting with one another, listening to what they were saying and also asking clarifying questions as they were interacting. Observations allowed me, as researcher, to get a better understanding of the situation on the ground between the smallholder farmers and extension officers in the Amanzi for Food project. It also allowed me to supplement and aid data that I collected from other methods (Huysamen, 1994, p. 169).

As noted above, the documents analysis and my research questions gave me background information, and a focus for what to look for in order to make sense of the observations. The observation process also gave me the opportunity of comparing, questioning and critiquing what was contained in the documents versus what is taking place on the ground. I had to be clear as to what I was looking for and be focused in my observations, while keeping an open mind. To guide my observations I used the research questions, and my theoretical framework (Wals et al. 2009) to guide my observations. This was not an easy process as social learning process are not straightforward and social processes are complex and dynamic (Gillham, 2000).

The participant observations involved visiting project sites, attending workshops of extension officers and farmers and joining them in field visits to generate rich data. I was able to take some video footage of practice in the field, as well as collect and generate photographic evidence and field notes. My focus throughout was on how farmers and extension officers learn together, the actual farming and work activities of the farmers, and how social learning of RWH&C is facilitated (Patton, 2002, p. 22). Participant observations in which I mainly observed the farmers and extension officers provided me, as researcher, with an opportunity to interact with the farmers and extension officers and their farming practices. I was also able to observe conflicts and complexities and how these might be opportunities for learning. I was able to triangulate insights that I gained from the first phase of document analysis and through this, develop in-depth understanding of what was happening on the ground in and also beyond the Amanzi for Food project (Angrosino & Rosenberg, 2011).

At first I thought that observations were going to be a straightforward process. I found, however, that they were very demanding in terms of time and effort. I endeavoured to plan my observations well and to conduct them during project field visits. I tried to avoid the danger of

recording what I thought has occurred rather than what actually took place on the ground (Simpson & Tucker, 2003). I was very alert to the roles and practices of extension officers, the current farming practises, RWH&C practices taking place on the ground, conflicts, contradictions, tensions, opportunities, teamwork, and problem solving on RWH&C practices for food production. I recorded the conversations of farmers and extension officers in the field, and members of the Amanzi for Food project team members assisted me by taking photographs and videos of some of the field work and workshop proceedings. I tried to watch out for evidence of social learning of RWH&C within their farming practices and I coded this within the three observations which were written up as OB1, OB2 and OB3.

The observations went according to plan using the project resources and whilst the project was still taking place. Initially I accompanied my colleagues to the field to get to know the project, which means that I did more observation in the field. However, for the purposes of this research I will only focus on three observations, as they were specifically conducted to probe dimensions of this study's research questions.

3.3.4 Interviews

Interviews are discussions, usually one-on-one between an interviewer and an individual, meant to gather information on a specific set of topics (Cohen et al., 2013). The semi-structured interview uses a clear interview schedule, but one is free to change the order, rephrase and repeat questions, and follow up wherever appropriate according to the purpose of the research. I used this style of interviewing with the three extension officers and one farmer in this study. Ritchie et al. (2013) suggested that one-to-one interviews are easier to manage, to control and ultimately to analyse.

The interviews allowed for a more confidential space, which enables more 'honest' data to emerge (Frey & Oishi, 1995). Interviews were conducted with the Director of Agricultural Extension and Advisory services in the Eastern Cape for insight into the extension services in the province. Interviews were also conducted with three extension officers that are part of the project to understand how extension officers facilitate social learning of RWH&C in the Amanzi for Food programme, and to gain a better understanding of their role in knowledge mediation of RWH&C.

These interviews allowed me, as the researcher, to probe more deeply some of the insights and details emerging from first two phases of data collection process (document analysis and observations). The interviews probed in more detail perceptions and experiences of being part of the Amanzi for Food project which did not emerge in other methods. Leedy and Ormrod (2005) argued that interviews allow the researcher to investigate and prompt things that one cannot observe.

The four interviews were conducted on different dates and in different venues depending on the availability of the interviewees. Interviewees' offices were chosen as a venue for the interviews. The work place was familiar, conducive and comfortable and they were able to use some of their work time for the interviews.

The interviewees were informed about the purpose of the interviews. They were given consent forms and asked for their permission to record the interviews and for taking photographs. I also assured them of anonymity. I emphasised confidentiality and explained that the recordings would not be used for anything but the purpose of the research.

Recording of the interviews was for transcription purposes so that as a researcher, I could listen and engage with the interviewees rather than taking notes. The recording also captured laughing and pauses, which are of great importance when analysing data. Recording also enabled me to go back and forth if I missed anything (Wimmer et al., 1997, 156).

The interviewees were very different in the way they answered questions, however they were all comfortable, knew what they were talking about, understood and engaged in the conversation. The interviews were focused on the subject matter and I asked relevant and focused questions in order to extract as much information as possible. During the interviews, I allowed room for some flexibility. I noticed certain issues that emerged in all four interviews that were similar, but not part of this research.

Bell (1993, p. 93) has critiqued interviewing as “a highly subjective technique and therefore there is the danger of bias”. Depending on the relationship, the interviewees might give the researcher the answers that they think she needs to hear and not be honest. Following this, the researcher might hear things she wants to hear and interpret them in her own way, or there may

be a different understanding between the interviewer and interviewee. Despite all this, the interviews were very important as they allowed me, as researcher, to probe the thought, values, perceptions, views, emerging issues and practices and how the extension officers and farmers interact in the learning of RWH&C (Wimmer et al., 1997, p. 156). I also managed a follow-up interview with one extension officer as I needed to probe deeper than the initial interview and this also allowed me an opportunity to validate the data from the first interview.

3.3.5 Focus group discussions

Focus group discussions are group interviews that take advantage of communication between the research participants. In order to generate data, the focus groups were explicitly used to elicit group interactions (Ritchie et al., 2013). Instead of a researcher asking questions, people were encouraged to talk to one another, asking questions, exchanging information. This method was useful in exploring farmers' knowledge and experiences. Focus group discussions are mostly appropriate when the interviewer has a series of open-ended questions and wishes to encourage research participants to explore issues of importance to them in their own vocabulary (Cohen et al., 2013). In this study, I used focus groups to capture farmers' experiences of learning on RWH&C which was by facilitated extension officers.

I conducted two focus group discussions, the initial plan was to have eight participants per focus group discussion. This did not happen as there were a number of farmers that wanted to be part of the group discussions, this resulted in quite a big group. Since the groups were fairly large the Amanzi for Food team members assisted in facilitating the group discussion, as they were familiar with my research and also part of the project. The farmers were mainly isiXhosa speakers, one of the contact persons (farmer) helped me organise the group discussions and assisted in translating and clarification the discussions. This was because the other Amanzi for Food project team members were not isiXhosa speakers and could not assist when it comes to translating. . My home language is isiZulu. isiXhosa and isiZulu are closely related Nguni languages. I was able to communicate mostly in the first language of the participants; however in some cases I needed assistance from my contact person to clarify issues.

Farmers are generally busy most of the time and there are group dynamics to consider. I chose to hold the group discussions during the farmers association meetings and asked for one and half hours during these meetings rather than scheduling other meeting. The group of farmers

were mainly elderly women and men as they are the ones responsible for food production in their households. These farmers have extension officers that were part of the Amanzi for Food project. The focus group session allowed a chance for true reflection of their learning on RWH&C.

Like the semi structured interviews, the focus group discussions involved the researcher asking a set of questions and then facilitating the discussions with the farmers (Wimmer et al., 1997). With the set of questions I was asking, people were encouraged to talk to one another, asking questions, exchanging information. This method was useful in getting farmers' to discuss and talk amongst the group.

Also like the interviews, farmers were told about the purpose of the research, given consent forms, assured of their anonymity and they were also asked for permission to record the discussion and take pictures as explained in the interview section above.

The focus group discussion sought to capture learning experiences of farmers on RWH&C, their relationships, interactions, conflicts, tensions, contradictions, difficulties, problem solving, their challenges, perceptions and farming practices and dissonances and opportunities in RWH&C. The focus group discussions provided an opportunity to collect rich data from the collective group and allowed to me to capitalise on the group dynamics of the farmers, and also observe social interactions and dynamics that happen on a day to day basis between the farmers (Dimitriadis & Kamberelis, 2005).

As researcher, I observed the dynamics between farmers. Most farmers were quiet and not engaging so as facilitator of the group discussion, I had to encourage participation and engagement and also asked the contact person to assist. The women were more engaging than the men. I was aware of the danger of assuming that what one farmer said is representative of the entire group simply because he/she is in a position of power and speaking on their behalf, and thus I tried to get more participation from all within the limited time.

3.6 Data analysis

Data analysis is the process of systematically applying statistical and/or logical techniques to describe and illustrate, condense and recap, interpret and evaluate data (SAS Institute, 2003).

In this research, I engaged in three stages of analysis. The first stage involved a process of exploration of relevant themes related to roles and practice of extension officers in sharing RWH&C knowledge with farmers. The second stage focused on farmers' experiences of engaging with extension officers. The third stage focused on how this may or may not reflect social learning practices using Wals et al.'s (2009) framework. The data was coded and this helped me to identify categories that in turn helped me to answer my research questions as will be explained in more detail below. Analytical memos were drawn up in order to assist in organising the data into categories relevant to the research questions. The analytic memos helped me to re-arrange and reduce data according to the relevant categories. An important step in the data analysis was managing the data carefully, which I explain next.

3.6.1 Data management and index coding

For data analysis it was critical to collect, write and retrieve data carefully, and this required a careful data management processes. I created a data management system that worked well and was easily accessible. This involved labeling of folders, indexing sources and interview transcriptions and I also created a spreadsheet tracking the entire data collection process. O'Leary (2004, p. 184) argued that all these tasks are done "to build or create a 'data set' that can be managed and utilized throughout the process of analysis".

Managing the data made it possible for the data to be analysed systematically, rigorously and in a logical manner. Data was stored in its original form and included recordings, photographs, videos, and hard copies of documents, interview transcripts, observation notes and focus group discussions. Keeping the data in this systemic manner allowed me, as the researcher, to index code the data in a consistent manner thus creating a rigorous system of tracking the data (Huberman & Miles, 1994, p. 428).

I kept a research journal and spreadsheet to document my research journey and data collection process. I recorded what was done on particular days, what data collection method was used, how it was used, how it worked, what didn't work and how I would improve it next time (Wolfe, 1992). I created a folder to keep transcribed colour coded interview transcripts and observations notes in an electronic folder and I also created a backup system for this data to protect it. I labeled the folder to link it with original data source. For example, labelling source document '*IEOI: analyzed for Memo1*' allowed me to maintain track of the original data source

which in this example was interview with extension officer one, which I analysed into Memo 1. Table 3.3 that follows shows how data was managed and indexed.

Table 3.3: Generated data and index coding of data sources

Document	Index Code	Appendix
Amanzi for Food Project Documents	Doc 1 AFF	4
Agricultural Extension Documents		
Field Observations: • Workshop of farmers and officers • Farming practices • Field visit of extension officers	• OB1 • OB2 • OB2	5
Semi-structured Interviews	• IEO1 • IEO2 • IEO3 • IF1	6
Focus Group Discussions	• FGD1 • FGD2	7

3.6.2 Data analysis – Phase 1, 2 and 3

There is no straightforward way of analysing data, but I did my best in representing the data and communicating the result effectively in the light of the purpose of the study. As a researcher, I had to be reflexive when doing the analysis. O’Leary (2004, p. 184) explained reflexive analysis as “involving, staying as close to the data as possible – from the initial collection right through to the drawing of final conclusions”.

As mentioned above, the data was analysed in three phases. The first and second phase was to reduce the data that was generated over couple of months to explore the roles and experiences of extension officers in mediating RWH&C knowledge and practices (Phase 1) and the experience of the farmers and their interactions with the extension officers (Phase 2). The third phase was to synthesise this within a social learning framework.

As explained above, I had participated in various project field visits, training workshops, field observations, interviews and focus group discussions. I generated a large amount of data, some of the workshops and field visits were related more to the entire Amanzi for Food project rather

than to my particular research question. However, these offered and contributed to the bigger picture of my research, I therefore had to ‘sift’ the contextual project data for relevance to my research topic.

Inductive and abductive analysis was chosen for data analysis. According to O’Leary (2004), inductive analysis allows researchers to explore and understand thoroughly generation and exploration of relevant themes that emerge from the data. This approach allows researchers to generate themes through prior engagement with the literature. This approach was used for Phase 1 and 2 of the data analysis. Abductive analysis according to Danermark, Ekstrom and Jacobsen (2002) allows researchers to recontextualise the data using theoretical and contextual frames of reference. In using abductive analysis, I recontextualised the data in Phase 3 of the analysis according to the Wals et al. (2009) theoretical framework described in Section 2.7. These approaches allowed me to address the three sub-questions of the research and the overall research question.

Using inductive analysis, various themes emerged from the data in Phase 1 and 2. Phase 1 of the analysis intended to understand the existing situation, with an emphasis on *the role of extension officers in ensuring knowledge and information is shared between farmers and researchers* (Question 1) in order to understand data in the second phase of analysis which focused on *the experiences of farmers in learning from extension services* (Question 2).

Table 3.4 below shows the categories identified for addressing Questions 1 and 2. I was able to create these categories by triangulating data from documents, observations and interviews as I was able to compare and contrast what was said in the documents with what was really taking place in the field. As can be seen in Table 3.4 I used a colour system to code the data.

Table 3.4: Colour codes for Phase 1 and 2 data analysis

Code	Colour
Roles of extension officers	Pink
Knowledge and information shared	Green
How is knowledge and information shared	Blue
Mediating artefacts	Yellow
Levels of co-engagement	Grey

Dissonances, conflicts and tensions	Red
Learning taking place	Purple
Facilitation processes	Light blue
How is learning applied in practice?	Bright green

From this process of data analysis, I was able to use this data to focus on the roles and practices of extension officers in sharing information and knowledge on RWH&C with smallholder farmers for food production, and on the farmers' learning experiences as reported in Chapter 4. As such, this part of analysis also addressed the second sub-question with regard to *learning experiences of farmers as the extension officers facilitated the social learning of RWH&C*.

For the first and second phase I had to engage extensively with the raw data that had been generated during data collection, before I could even develop the data analysis categories. This was not an easy or straightforward process; it was an iterative process and I had to work closely with the data. This proved to be the most critical process in the research as it provided the basis for Chapter 4 (data presentation) and 5 (discussion) but most importantly, it provided evidence for addressing the research questions. This meant I had to work with the data in a systematic, rigorous manner and I had to be honest in the way I worked with the data. The emerged sub-themes/categories and coding of all the data generated analytical memos which were used to analyse the data (see Appendix 8).

Phase 1 and 2 of the analysis provided a basis for analysis for the third sub-question which is *how these might be constituted as social learning processes or not?* The preliminary insights from the first two sub-questions assumed that learning processes have elements of social learning processes embedded in them, but did not take this for granted. The themes from this category are drawn from the Wals et al. framework (2009) shared in section 2.7, which was used as the theoretical framework for this study to guide analysis of the social learning processes to determine if and how they were realised in the field. A coding system based on the five dimensions of the cycle of social learning was developed as reflected in Table 3. 5 below.

Table 3.5: RWH&C practices reflecting social learning processes

Category	Colour
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Orienting	Green
Activating	Blue
Selecting	Yellow
Implementing	Purple
Evaluation	Red

Keeping a traceable data trail, analysing the data consistently and starting the analysis early was critical during this process. What was also important as a researcher was my reflexivity and positionality as I was also part of the Amanzi for Food project and had to be cautious about bias that might arise as I was analysing the data.

Table 3.6 below summarises how the data was analysed.

Table 3.6: Summary of data analysis

Research Goal	Analytical Phases	Questions emerging under themes/ sub categories	Relevant data set
The role of extension officers in ensuring knowledge and information is shared between farmers and researchers	Phase 1	Roles and practices of extension officers	Descriptive analysis of the context:
	Context analysis of extension services in sharing information between farmers and researcher	Knowledge and information shared How is knowledge and information shared? Facilitation processes	Document analysis, semi-structured interviews with extension officers describing the landscape of agricultural extension
Roles and practices of extension officers in sharing RWH&C knowledge with farmers for food production	Analysis of roles and practices of extension officers in the Amanzi for Food programme (see section 4.2)	Mediation and facilitation processes of RWH&C practices Mediating artifacts Levels of co-engagement Knowledge and information shared	Semi-structured interviews and observations to map out how RWH&C are mediated and facilitated by extension officers
Learning experiences of farmers as the extension officers facilitated the social learning of RWH&C social learning processes associated with RWH&C practices	Phase 2: Analysis of farmers and extension officers. What relationships and social learning processes were evident? (see section 4.3)	How are farmers learning? What learning is taking place? How is learning applied in practice?	Two focus group discussions with farmers about their experiences in learning about RWH&C Sourcing information of farmer's interactions that will sustain social learning

		Mediation and facilitation of RWH&C practices Dissonance, conflicts and tensions Levels of co-engagement	
	Phase 3 Wals et al.'s (2009) social learning framework proposed five phase process (see Chapter 2) and the facilitation and mediation processes found at each phase Wals et al.'s (2009) themes evident in the farmers and extension officers' interactions that will sustain social learning processes. The elements of social learning processes surfaced through the analysis (see section 4.4)	Orientation Activating Selecting Implementation Reviewing	• Amanzi for Food project reports, agricultural extension reports • Four semi-structured interviews on the roles and practices of extension officers in the Amanzi for Food • Two focus group discussions on farmers learning experiences on RWH&C and how they are applying it in practice • Three observations to capture elements of social learning processes

3.7 Validity and trustworthiness

Issues of data validity and trustworthiness were dealt with through data triangulation, member checking, a traceable data trail and thick descriptions.

Triangulation was used to compare the data from different sources. This required the researcher to use different data collection tools in order to compare and verify the data, as indicated above. Triangulation (Olsen, 2004) helps to circumvent personal biases and overcome the deficiencies embedded in a single study method, thus increasing validity and trustworthiness of findings. The agreement of findings between different data collection techniques strengthened the validation process, but also allowed for taking account of divergences in the data. As such, triangulation was not used as means of confirming existing data; rather it was used as a means

of enlarging the landscape of enquiry to offer a deeper and more comprehensive picture (Rossouw, 2003).

The processes of triangulation involved four methods, namely document analysis, observations, semi-structured interviews and focus group discussions as explained in detail above. This was done in order to check integrity, accuracy, validity of data drawing from different data sources and compensating for the weaknesses of each method. In this way I tried to ensure rigour and also trustworthiness of the data. I tried especially also to see if there was consistency in the data across different data collection methods, but also to take account of divergences (Rossouw, 2003).

Since the research was taking place within the existing project, during project field visits and workshops there was an opportunity for the researcher to discuss emerging issues from the data, contradictions that emerged and also to clarify discussions that emerged from the data. This helped me with interpreting the data as accurately as possible. I was also part of a research team and was able to check my interpretations with them as the process unfolded.

Member checking (Cohen et al. 2013) was also used as a validity mechanism, I did not have a schedule for member checking but it was part of the data collection process involving semi-structured interviews and focus group discussions. The insights were checked with various interviewees as I had a chance to go back to the field and do follow-up interviews with the research participants and also attend some of the farmer workshops. This helped me to ensure that my interpretations of the data were trustworthy.

Thick description (Olsen, 2004) involves providing as much detail as possible. In Chapter Four I endeavoured to provide a thick description of the data in order to give as detailed an account as possible of what actually happened in the field. This meant recording more than a single event in isolation, but rather involved recording the context of the place and what was actually taking place, using different data methods to provide in-depth perspectives. Using different methods allowed for a range of different types of data to be collected, which allowed me to describe the phenomenon in great detail and allowed for authentic real life stories of people and data to be recorded.

As mentioned above, I also kept a traceable *data trail* and data was labelled consistently. Organised and systematic storing of data allowed for easy access to the data. I could thus go back to the data and quickly verify anything I needed.

As researcher I also tried to pay attention to my positionality and reflexivity in the research process (Berg et al., 2004). I kept a record of my own interventions and tried to reflect critically on my role in the research programme and process. One of the challenges, for example, was to be part of the broader research programme, but to stay focused on my research topic, which was the extension services and social learning associated with their role.

3.8 Ethical considerations

Permission to conduct the research was sought in writing. A formal letter was sent to the research participants explaining the purpose of the research (see Appendix 1 and 2). As a researcher, I was fully aware that I would be engaging in a professional relationship with my research participants who were rural smallholder/scale farmers and extension officers. I communicated with those participants initially through the Amanzi for Food programme and ultimately on an individual basis face to face or via telephone. Before this research, I had already established a relationship with the Amanzi for Food project and was given permission to conduct my research through the project (the project has separate ethical clearance from the university ethics committee).

Through this initially I was able to communicate with the Amanzi for Food project members in Nkonkobe Municipality informing them about my research and requesting their assistance for my research. For my research project, I had to obtain specific ethics clearance for working with the farmers and the extension officers which was obtained when my proposal was accepted by the Education Higher Degrees Committee. Accordingly, participants were given informed consent forms (Cohen et al., 2013) to complete for participating in this research. They were not forced to participate in the study and were given the option to withdraw at any time. Since interviews were recorded for transcribing, participants were given a consent form prior to the interviews to inform them of their rights and to ask them to agree to participate in the research. Interviews and focus group discussions were scheduled according to availability of participants. As mentioned before I had already built a relationship with the research participants during the Amanzi for Food engagement. I requested the participant's permission

to take and use their photographs and videos during the research process. I explicitly explained to them during our engagements that the photographs will be used for project and research reporting purposes only. The research participants all gave permission to use their photographs in the research report.

I faced some challenges in balancing my research focus and the farmers' expectations (such as assistance for their various projects in the form of farming inputs, financial assistance and technical support etc.). I had to make them aware of my purpose as some assumed that I was an expert bringing things to the community. I had to sensitively inform them that I was there to learn from them and their real lived experiences as they were experts of their own conditions. I also could not promise that I would make things happen on their behalf as I did not have the capacity to do so but this did not result in participants withdrawing from the research as they were also benefitting from the training, materials and wider networking activities of the Amanzi for Food programme.

3.9 Conclusion

This chapter served to outline the research process, what was done, the methodology used and the purpose it served and how it took place on the ground. It has described the data generation and analysis process including validity, trustworthiness and ethics. This chapter forms the basis for the next chapter which focuses on data presentation. Chapter 4 presents the analysis of the data generated during the period of data collection based on the analytical process described above.

CHAPTER 4

SOCIAL LEARNING PROCESSES INVOLVING EXTENSION OFFICERS

4.1. Introduction

The purpose of this chapter is to present data generated from the study. This chapter builds upon Chapter 3 and describes the data analysis process. It provides evidence from the study which relates to and answers the research questions:

1. *What is the role of extension officers in ensuring knowledge and information is shared between farmers and researchers?*
2. *What are the farmers' experiences in learning about RWH&C with the extension officers?*
3. *How does the facilitation of rainwater harvesting practices reflect social learning processes (or not)?*

This chapter provides thick descriptions and detailed insight into the questions. The chapter is structured according to the key dimensions of the social theory framework that was used to inform and guide the data analysis process. Section 4.2 discusses extension, farming and rainwater harvesting and conservation practices focusing on question 1 and 2 above. This is followed by section 4.3 which discusses facilitation and mediation of social learning processes associated with rainwater harvesting and conservation practices, focusing on question 3 above. To help me understand and interpret the facilitation and mediation of social learning processes I used the Wals et al. (2009) six social learning contours, described in Chapter 2 as an analysis tool. The evidence presented in this chapter provides a foundation for the analytical statements and recommendations made in Chapter 5.

4.2. Extension, farming and rainwater harvesting and conservation practices

4.2.1. *Roles and practices of extension officers observed within the Amanzi for Food programme*

This section presents narrative accounts of the roles and practices of extension officers as observed within the Amanzi for Food programme. I draw on all data sources to construct the narrative account.

The document analysis showed a range of different roles that are assigned to extension services. These include:

- *Knowledge sharing and communication:* Extension officers are expected to “provide advice and information and transfer relevant technologies using public facilities” (Doc 3). They are also expected to “exchange ideas and information in a clear and concise manner” (Doc 1)
- *Provide practical problem solving support to farmers:* Extension officers are expected to “provide and facilitate access to advice on sustainable farming practices” (Doc 2), and to engage in “building capacity of farmers towards problem solving, opportunities and potential solutions”.
- *Provide access to resources and technologies:* Extension officers are expected to “explore and implement new ways of delivering services that contribute to the improvement of productivity of the farmers” (Doc 3), and help with “improving access to agricultural support services” (Doc 1).

These were the three main roles that I was able to identify from the document analysis. Interview data showed a similar set of roles, as can be seen in these data extracts:

- *Knowledge sharing and communication:* Extension officers are expected to “advise farmers depending on what the farmers are doing ... so my main job is to advise farmers” (IEO2). Extension officers are seen as bridge builders between farmers and researchers: “their main role is the link between the farmers and research, so the research work is communicated by the extension officers to the farmers and also takes the information from farmers to the research” (IEO1).
- *Practical problem solving support to farmers:* Extension officers are expected to work with farmers to provide solutions to “the problems of the farmers and find out what they want, what do they want to get a breakthrough on”, and then they are expected to “communicate that with research services, then also share the solutions after the research”. It was also noted that it is expected that the research services also need “take the information to the farmers”. (IEO3). The same respondent said that one of the key dimensions of the contracts of extension officers is that they “provide capacity building for farmers and also assist them” (IEO3). They are also expected to support farmers by linking them with various stakeholders, as stated by one of the extension officer

respondents: “the farmers are looking at us so that they get information; so that was my role, being a linkage between research and farmers” (IEO1).

- *Provide access to resources and technical support:* Extension officers are expected to “work with officers as they are assisting farmers in terms of giving support, a support is a person technical support, whereby the officers they give advice and technical support to what the farmers are doing” (IEO3). Another extension officer said: “the work of an extension officer is to work directly with the farmers” (IEO1).

In addition, the interview data also seemed to point to other roles of extension services:

- *Improving access to agricultural support services:* This role was reflected by two interview respondents who said, “Because during the time of vegetables if they have orders or we have supplied them with seedlings and seeds the extension officers do demonstrations showing the farmers how to go about planting, and they go and do regular checks to see if there is any progress” (IEO1). The support is also in the form of human capital support whereby “every financial year we sort of develop an employment contract, one of the key things is that extension officers provide capacity building to farmers and also assist them” (IEO3).
- *Provide advice, information and transfer of relevant technologies using public facilities:* Here an extension director noted that that extension officers are “**advising farmers** whether it be delivering materials, production materials or anything is done whether it involves **demonstration**, or whether it is an agricultural show. All of those are done with accordance with the norms and standards” (IDRDAR1).

Interestingly, from interviews and observations, it was clear that the technological or top-down transfer model is still the dominant approach in the extension services, as can be seen in the following citation from an extension director which reflects on the way in which a top-down political culture influences and shapes what they are told to do:

And we are in such a thing, it is unfortunate you know ... on Friday the president is going to deliver his speech. From that speech, our Premier is going to deliver a speech that is linked to that. And then things are going to go down [the hierarchy, and we get] instructions on things for us to do some of the things. Politicians see things in specific ways, especially now it's local government elections. We are even likely to do things that are contrary to sustainable development ... [laughs ironically] ... but we are employed, so what we can do? (IDRDAR1)

This citation also shows an influential level of political dominance and political expediency that shapes the technological transfer model and the work and roles of the extension officers.

The technology transfer role of the extension officers is also held in place by inadequate social facilitation skills, and the co-learning and co-engagement amongst farmers and extension officers is still weak due to inadequate social facilitation competences, as stated by the same extension director who said,

You see – and that is one of our weaknesses – this is our weakness, I must acknowledge it, we are very poor in social facilitation. You are aware that one of the first steps towards development is social facilitation, such as facilitation using Participatory Rural Appraisal. (IDRDAR1)

In the Amanzi for Food programme, I was able to further interpret the roles of the extension officers by developing a deeper understanding of the farming practices of rural smallholder farmers, and their rainwater harvesting and conservation practices, which I discuss next.

4.2.2. Farming practices of rural smallholder farmers in the Nkonkobe area

This section provides a narrative account of farming practices of rural smallholder farmers as it provides more insight into how the extension officers are supporting or could support the farmers. In my observations in the Nkonkobe Municipality I noticed that large areas of previously cultivated land had been abandoned. Many of the cultivated fields showed evidence of small-scale farming practices that are dominated by vegetable and livestock production, the most common practices of the smallholder farmers.

The Alice and Sheshegu units are characterised by low rainfall and poor quality soils and are thus used almost exclusively for extensive grazing. The Amatola unit has significant cropping potential, but is a small isolated unit surrounded by steep mountains. The landscape is very dry, there has been decline in agricultural productivity, particularly homestead food gardening, due to prolonged dry periods.

The typical farming practices are predominantly at household level, where there is clear indication that farmers are mainly involved in subsistence farming and smallholder farming. There is high intensity grazing where grazing is viewed as a public good and commonly

accessible. This is visible on the landscape as semi-natural vegetation with alien invasive species which is partly a result of overgrazing. The intensive agricultural landscape is beneficial to the people as it is a main source of income and livelihood for the majority of the population. The farmers described some of the crops they are producing:

We are currently producing vegetables such as cabbage, spinach beetroot, onions, green pepper tomatoes, peas, potatoes, cattle maize, and chicken, ... [we also have] fruits trees such as oranges, peaches apples, lemons and bananas. (FGD2F1)

However, the majority of the population are elderly people involved in smallholder and homestead farming using low intensive agricultural inputs and they are mainly dependent on the state for financial support via meagre pensions. These farmers have organised themselves according to various farmers' associations for easy access to extension and farmer support services. What was also observed was the rural development taking place in the form of infrastructural development (RDP houses, universities and colleges, government department, etc.), particularly construction of main roads for easy access to villages within the municipality.

Below are some pictures showing some of the current farming practices of smallholder farmers and infrastructural development which I observed (see Figures 4.1, 4.2 and 4.3).



Figure 4.1: An example of smallholder farming practices (crop production) observed in the Nkonkobe Municipality



Figure 4.2: An example of smallholder farming practices (poultry) observed in the Nkonkobe Municipality



Figure 4.3: An example of an observed programme aimed at infrastructural development of the Nkonkobe Municipality

4.2.3. Rainwater harvesting and conservation practices

The farmers are the rainwater harvesters and food gardeners either as individual or collectives who are involved in learning about rainwater harvesting and conservation practices. The farmers have a clear purpose as to why they are learning rainwater harvesting and conservation – to have water for homestead food production/gardening to meet household food security. Farmers participate in training programmes, workshops, and productive demonstration site interventions in order to sustain water for growing their food. Figures 4.4, 4.5. and 4.6 below show some pictures of farmers participating in training, workshops and productive demonstration site interventions that are facilitating learning around rainwater harvesting and conservation for household crop production and smallholder farming practices.



Figure 4.4: Farmer sharing her knowledge and experiences of rainwater harvesting with other farmers during a workshop in Lloyd Village in the Nkonkobe municipality



Figure 4.5: Farmers learning together about rainwater harvesting practices and challenges they are facing with regard to water in Lloyd Village in Nkonkobe Municipality



Figure 4.6: Farmers participating in productive demonstration site: Demonstration of implementing mulching as one of water conservation practice which involves covering the soil with leaves to maintain soil moisture in Gwali Village

Rain water harvesting and conservation practices are themselves diverse and I observed farmers in the Nkonkobe districts implementing a range of different RWH&C practices. The practices also involved a number of work practices such as maintaining the productive demonstration sites, harvesting water and growing vegetables, engaging in various types of training and co-learning activities, and participating in workshops. The list below shows those RWH&C practices that were implemented by the farmers in the Amanzi for Food project, and which I observed:

- *Roof water harvesting*: collecting water from roof for garden use, I observed that most farmers were harvesting roof water.
- *Grey water harvesting*: using household waste water (bathing, cooking, cleaning water) for gardens.
- *Fertility pits*: pits that are filled with organic matter such as compost or manure and enables runoff to be captured and absorbed.
- *Gelesha*: turning the ground ready to receive rain before planting
- *Diversion furrows*: direct rainwater runoff to a crop area or storage tank.
- *Trench bed*: trenches dug and packed with dry grass and leaves, compost manure and soil used in food gardens, creates highly fertile soil which can absorb and store water.
- *Mulching*: spreading organic material like compost, dry grass and leaves onto the surface of the soil to reduce evaporation.
- *Homestead ponds*: small scale storage ponds to catch and store surface runoff.

The practices were mainly implemented by the farmers because they involve little technology, requiring only basic equipment that farmers have access to. They also require low skills and understanding, low cost and low maintenance and are therefore easily implemented. Figure 4.6 is a collage of photos showing some RWH&C that were implemented by the farmers.



Farmers and extension officers digging homestead ponds.



Farmers creating diversion furrows to redirect water to their gardens.



An example of a completed homestead pond for storing rainwater from crop production.



An example of mulching, implemented by the farmers by covering soil with grass/plant matter to reduce water evaporation and maintain soil moisture.



An example of a trench bed packed with dry grass and leaves, compost manure and soil used in food gardens – creates highly fertile soil which can absorb and store water.



An example of fertility pit filled with organic matter.

Figure 4.7: Photo collage of observed RWH&C practices implemented by farmers in the Nkonkobe Municipality

In developing a deeper understanding of the farming practices of rural smallholder farmers, and their rainwater harvesting and conservation practices, I also observed dissonance amongst the farmers and extension officers which posed both challenges and opportunities for social learning to take place. I discuss these next.

4.3 Dissonance and conflict as a challenge / opportunity for social learning

Learning processes in this research are drawn mainly from observations amongst other data collection methods used in this study. The conflicts and dissonances were viewed as an opportunity for social learning around rainwater harvesting and conservation practices. During the time that I was doing the research, farmers were facing water shortages and were therefore struggling to produce food as shown in this evidence from focus group discussions extracts below.

The drought destroyed us ... we have no maize, our chickens are hungry ... we didn't produce ... if we had water we would have ploughed ... we wouldn't be in this situation, we didn't grow anything at all. (FGD2:F4)

You can tell even by looking in our field that no work has been done here ... we didn't work our land at all ... by this time we should be harvesting. (FGD1:F2)

The citations show that the farmers were not able to produce enough food for household consumption, which is attributed to prolonged dry periods. It also shows a need for adaptation interventions such as use of rainwater harvesting and conservation techniques which can help to minimise the impacts of uncertainties such as drought on homestead food gardening.

The farmers expected the extension officers to bring about solutions to their water challenges. However, this was not always the case, hence I found some evidence of conflict and dissonance between these two groups as stated by the extension officer and farmer in the citations below.

At times there are problems like drought, like the previous drought ... all the money for the programmes ... was redirected for the drought so we have nothing to offer for some of the programmes. That will mean that people will not grow their vegetables because they are expecting something from the department. Those are some sort of challenges that we have. (IE01)

We haven't received anything because of drought, we have rain shortage, our officer assists us, it not easy but he does try, he works with us, I don't want to lie, it's been two year since we have produced because of drought. We don't have water, here we grow the mealies only, we grow in our gardens. There is no crop rotation because we don't have water in the fields. We try to grow food but drought is preventing us and we have nothing and we starve ... we only grow mealies and nothing else because we don't have water. We thought by this time of the year we will have water in our gardens so that we grow vegetables, beetroot, spinach and feed the children, but because we lack water we can't grow the food. (FGD1F2)

This dissonance and conflict was not entirely negative, however, as it enabled a learning space where extension officers and farmers came together to learn about alternative ways of getting water for food production, as shown by this evidence from the data extract below:

... water here is a very scarce resource and it is important in agriculture for food production, so it is important that the farmers learn how conserve water because during the times of rain there is lot of water that goes to waste. There are techniques through the Amanzi for Food and our learning network – a lot of techniques – that are there and we are transferring those techniques to the farmers that this is what could be done during the time of rain falling so that we prepare for the times of rain scarcity. (IE01)

The farmers take this office – the extension office – as their home because in each and every problem that they have, they know that that is related to agriculture. You know they have to come here, this is where they have to get many of the solutions to their problems. (IE02)

The data extract shows that due to water scarcity, the extension officers and farmers had little choice but to connect with the Amanzi for Food programme to learn together about rainwater harvesting practices. It also shows that the extension services had to take a leading role in enabling a learning space for farmers.

The rainwater harvesting practices introduced via the Amanzi for Food programme challenged current farming practices and extended farmers' ability to bring about collective reasoning and practices with extension services and other stakeholders which were agreed upon and then

tested as reported on below in section 4.5. The dissonance and conflict provided much opportunity for social learning processes to take place. These are discussed further in section 4.5. What stood out was the importance of use of mediation artifacts and facilitation processes to help enable the social learning processes, which I discuss next.

4.4 Mediation tools and facilitation as an opportunity for social learning processes

Mediating tools include the history and culture of the farmers, which influenced the introduction of rainwater harvesting and conservation practices. In the study site, I found the following dimensions of the history and culture of the farmers' connections to and experiences with crop production, influencing the introduction of RWH&C. Farmers indicated their interest in growing maize (mealies), and indicated that they worked with the extension services and also had experience of co-operative farming, as noted in the citations below:

We work with crop production, we grow mealies, these mealies we get from the extension officer. Our work started as a co-op, and then our officer intervened, we have been assisted but this year we haven't received anything because of drought, we have rain shortage. (FGD1F2)

We love mealies, we just harvested mealies, we want water so that we can also grow vegetables, and producing food is our livelihood. If we don't produce, we suffer because we grow crops in the gardens, and we keep chickens and goats. But if we don't grow mealies they go hungry. We receive food in the form of the mealies because the vegetables we grow in the gardens are not enough for us to eat with our children. We want water, the assistance we need here is water. (FGD2F4)

The data extracts above highlight that at household and smallholder farming level, farmers participate in varying degrees of food production activity. Land for each farmer varies, they have crop production potential, and they are dependent on agriculture for their livelihood. Despite this, it seems that their food production has gradually declined over the years with a contributing factor being water challenges for crop production.

Another tool which mediates the learning of rainwater harvesting and conservation practices is the literacy/education, experience and expertise levels of extension officers and farmers and how this impacts upon their learning of the practices. Language is an important tool which

mediates learning and practices. In this study, I found the following influences of these factors being noted:

People are diverse in nature, you find others are committed in their work while others need to be spoon fed information. They need to be looked after and they need to be chased. Others are having their family problems ... so now I need to control myself to harmonize the situation to make sure that what is required is done, and not to be influenced by those behaviours ... (IEO2)

Yeah now I want to upgrade, but we are forced, you see in the Eastern Cape entry level is Level 6. Here in the Eastern Cape we are inferior, in other provinces entry level is Level 7. So now there is that pressure, now we entered in that level ... here in the Eastern Cape we need to upgrade to qualify ... they say we don't deserve this level. According to our qualification NQF Level 6 is Diploma, if you have B Tech you have Level seven so we need to be at Level 7 [referring to the extension Diploma]. (IEO)

The available information especially the one being informed about what the farmer wants to know then it is the duty of the extension officer to look for that information. And get the answer so that the farmer's problem is resolved. So, at times it is demand driven, what the farmer wants and you as the extension officer you have the responsibility to seek the information so that you can help him resolve his problem. So without that really there is not much interaction ... Because they respond to the demand if there is information that we want from them, then it is easy to come with us or get engaged in sorting out that problem. (IEO1)

The data extracts above highlight that the capacity, skills, knowledge and competency of extension officers impact on farmers' learning. It also highlights the skills needed to translate research knowledge into suitable forms, and to judge the suitability of information, knowledge, and materials for both extension officers and farmers to learn. This suggests a mediation and knowledge translation role. This is related to the complex mediation role that extension officers play. They require the ability to interpret new scientific knowledge, bridge the technical divide, and identify knowledge and skills gaps of farmers. They also have to know how to present new knowledge to farmers, and how best to share knowledge in appropriate ways so that farmers can translate this information into applicable solutions on their farms.

The involvement of and ethos of the Amanzi for Food programme also influenced the mediation as is shown by this data extract:

... as a network, we had a slot at Fort Hare FM [radio station] between six and seven where we talk about water harvesting and Amanzi for Food. As the Amanzi for Food team, we get a radio programme slot. There we have a panel, the farmers, the extension side, the research side, and also then our guys from Rhodes University. We get a slot there and farmers get to phone in and ask questions and we give them responses. (IE01)

As stated in Chapter 1, the *Amanzi for Food* programme is an action-oriented project, which aims to support the dissemination and uptake of research-based information on rainwater harvesting practices (RWH&C), and to encourage RWH&C as a mainstream activity across small-scale and household farming scales.

Additionally, the extension services and farmers' associations all introduced tools which mediated learning and performance of rainwater harvesting and conservation practices. These tools included:

- *WRC learning materials (see Chapter 1),*
- *Prior and indigenous knowledge, skills and capacity of farmers and extension officers,*
- *Training of Trainers Programme involving facilitation of workshops,*
- *Resources from extension services (farming implements),*
- *Farming inputs (gardening tools),*
- *Land for productive demonstration sites,*
- *Labour for implementing the practices, and*
- *Participation in radio broadcasts.*

The tools mentioned above such as facilitation of workshops, productive demonstration sites, training programme, use of indigenous knowledge and prior experiences, use of WRC materials, follow-up support and radio broadcasts played an important mediating role and will be discussed further in section 4.5. The actual RWH&C practices such as building small ponds, dams, and mulching as well as additional gardening implements/tools were also mediating tools which people had to learn to maintain on their own, as described in section 4.2.

I also noted that ecological factors such as land and rain affect the ability to harvest rainwater for food production. These are also tools to consider in facilitation of rainwater harvesting practices. This was mentioned in the study interviews, for example:

... here we grow the mealies only, we grow in our gardens, there is no crop rotation because we don't have water in the fields, we try to grow food but drought is preventing us and we have nothing and we starve, we only grow mealies and nothing else because we don't have water, we thought by this time of the year we will have water in our gardens so that we grow vegetables, beetroot, spinach and feed the children, but because we lack water we can't grow the food. (FGD1F2)

The extract also highlights that the rainfall and soil are very important for terrestrial and aquatic ecosystems that provide goods and services for farmers, as availability and quality of water is a key determinant in agricultural and natural productivity systems. Natural and agricultural systems suffer the most when water becomes scarce and soils become degraded due to changes in climatic conditions, such as the seasonal drought the farmers experienced in the past years. When facilitating rainwater harvesting practices, it is important to take into consideration the ecological factors since they determine the success of these practices.

4.5 Facilitation and mediation of social learning processes associated with rainwater harvesting practices

To help me understand and interpret the facilitation and mediation of social learning processes I used the Wals et. al (2009) six social learning contours as an analysis tool as explained in Chapters 2 and 3. Applied to this chapter, these are:

- *Orientation and exploration:* learning together through identification of key actors and exploring water and food security issues in a way that connects prior farming practices to learning rainwater harvesting practices, enabling emergence of motivation and shared sense of purpose amongst farmers and extension.
- *Activation, realising energy and creativity:* learning processes where farmers and extension elicit their own social learning processes and nature-culture relations of rainwater harvesting and conservation practices frames of reference relevant to issues and challenges in learning of sustainable farming practices.
- *Selection and designing a solution:* learning through observations and taking notes of farmers and extension articulations and how they challenge each other's frames through

process of exposure to alternative frames about rainwater harvesting practices. Farmers and extension ideas about alternatives or adaptations of RWH&C are constructed and clarified together.

- *Implementation:* farmers and extensions officers are expected to learn through collaborative action using newly co-created frames for RWH&C practices for food production.
- *Reviewing:* farmers and extension will learn by assessing the degree to which water and food security challenges in their learning of RWH&C have been addressed, and also review changes that have occurred through their learning of RWH&C.

I discuss each of these processes in more detail below, in order to also explicate and show the role and contribution of the extension officers to the social learning process, in response to the research questions focusing on *farmers' experiences in learning about RWH&C with extension officers and how facilitation of rainwater harvesting reflects social learning or not.*

4.5.1 Exploration and orientation

The learning together through identification of key actors and utilisation of dissonance, use of language, cultivation of commitment and involvement and hooking up with existing capacities and exploring water and food security issues in a way that connects prior farming practices to learning rainwater harvesting practices were the main mediation and facilitation processes that were important for the exploration and orientation phase.

4.5.1.1 Identification of key rainwater harvesters and utilising dissonance

The Amanzi for Food team introduced the topic of rainwater harvesting and conservation practices for food gardening in response to a concern amongst the farmers and extension officers with regard to prolonged dry periods and water shortages for food production. The farmers and extension officers acknowledged that water shortages have prevented a number of farmers from producing their own food, as shown by this citation:

It has been two years since we have produced because of drought we don't have water, we try to grow food but drought is preventing us ... we only grow mealies and nothing else because we don't have water. (FGD1F2)

Water shortage for food production was the main problem area for the farmers and extension officers and this common concern or dissonance enabled them to explore rainwater harvesting practices as one of the alternatives for homestead food production, as stated by the extension officer below:

Yeah, the vegetable farmers were hard hit by this dry spell, water here is a very scarce resource and it is important in agriculture for food production water. Times there are problems like drought, like the previous drought all the money for the programs as I have mentioned were redirected for the drought. (IEO1)

The establishment of a core group for interactions and meeting was to ensure that the participants reflect the existing interests and perspectives in which the social learning process could take place. I observed how the group of rainwater harvesters was established; this was through formal and informal meetings, trainings, site visits and productive demonstration visits and other forums as stated in the data extracts below.

... we do have farmers' days, information days, also organise farmers' agricultural shows, even the farm visits, we organise them, we mobilise them to form farmers' associations, village associations where the extension officers will visit and say 'today I want to meet the farmers of this village', at some stage he even goes further and wants [to meet] the different stakeholders because in the communal set-up there are a lot of farmers doing different things, [e.g.] we got livestock farmers. (IEO1)

These meetings were the most common way of sharing experiences and new farming practices such as rainwater harvesting practices. The meetings, trainings and productive demonstration occurred when farmers, extension officers, agricultural lectures met together. Meetings were also enriched by research as shown in the citation below:

The farmers take this office, the extension office, as their home because in each and every problem that they have, they know is related to agriculture. You know they have to come here, this is where they have to get many of their solutions to their problems. Then with research ... it is only on demand if I can put it that way, the research people link with us and the farmers if us and the farmers – when I say us I mean farmers and the office – request their intervention. (IEO2)

The extension officers, researchers and academic institutions have many more opportunities than the farmers in the municipality. They have qualifications in agriculture, work experience

and learning materials as their main source of information and learning. As shown by the citations above, the extension officers and researchers provided advice and guidance to the farmers they worked with, and they therefore have capacity to provide orientation for social learning, and to help organise the learning group in response to the dissonances observed in the field.

4.5.1.2 Language

Linked to educational levels and literacy of the group, is the mediating factor of language, as stated by the extension officer in the data extract below. The farmers were predominantly isiXhosa speakers and hence the language used during rainwater harvesting workshops and learning materials had the ability to engage and alienate the farmers from the learning practices. In this case, the extension officers were also isiXhosa speakers, the WRC materials were both in English and isiXhosa. In cases where the facilitator could not speak isiXhosa, there were translators who could assist during the workshops, meetings and trainings. Language was the main mechanism influencing participation and learning and was therefore critical to provide orientation as well as for exploring the issue. The farmers could easily participate during the workshops as they were speaking in their mother tongue. I observed in some workshops how some trainers struggled to speak in isiXhosa and this may have hindered some teaching and learning. The extension officers were sensitive to the importance of accessibility of information via appropriate language as noted below:

We make it simple for the farmers to understand, we make it and we take the suitable one to the suitable farmer because you will find that there is a lot that comes from research but you know the lack of operation of the farmers and level of understanding of the farmers, then it is a duty of the extension officers to make sure that he explains it in a manner and the language that the farmer would understand. (IE01)

4.5.1.3. Cultivating commitment and involvement

The formal and informal meetings amongst the farmers, extension officers, Amanzi for Food team members, provided founding interactions for the core group to emerge. Through wanting to find solutions for water shortages, relationship between the farmers and extension officers, agricultural colleges and other stakeholders was strengthened. This strengthening took place during workshops, trainings and meetings and productive demonstration sites as well as via radio broadcasts, as stated by the extension officer in the citation above. Through these practices, the farmers and extension officers started identifying themselves as a group with a

common interest in rainwater harvesting and conservation. The farmers and extension officers wanted to learn about RWH&C and to incorporate it into their individual mediation and farming practices as shown in the data extracts below:

... so also to invest more in these tanks for rainwater harvesting ... You know our households don't have the infrastructure to harvest water, they are having houses most of the households ... so if we can invest more in that infrastructure in the Department we can also ease the pressure of water infrastructure in taps. (IEO3)

... the officer is amongst us, we go to him he comes to us with resources but the problem is water when drought approaches – we can't produce food ..., if we were to get solutions to speed up process of water that would be better. (FGD1F4)

This shows motivation to learn about the RWH&C practices.

4.5.1.4. Hooking up with existing initiatives and capacities

As noted in Chapter 1, the aim of the Amanzi for Food project is to disseminate WRC materials on RWH&C practices more widely in the agricultural landscape. This was done through the networking course, site visits, productive demonstration and radio broadcasts. Where various people from the agricultural sector (farmers, extension officers, institutions) could support one another in the adoption and implementation of the practices in their farming and work practices (as stated by the extension officer in the data extract below), they then had opportunity to share their knowledge, resources, and to link up with academic institutions. The Amanzi for Food team was present throughout this process to facilitate the use of the learning materials. The extension officers, and farmers needed RWH&C knowledge based on experience of how things can be done in a more productive way.

Yes there is, as I have said the Agricultural Research Commission (ARC) they are doing these techniques in a maize cropping field because they have got implements at DOHNE institution [local research institution] where they know the techniques of rainwater harvesting. So they have got implements that are operated by tractors and then those implements can do all those techniques there ... there are not problems ... we support those. Even with the department, the ARC is working closely with the department and national ARC programmes are known. Even FortCox have those implements. (IEO2)

During this phase I observed how the change process and corresponding ‘problem area’ (water for food production) was tentatively explored by a selected group of farmers, extension officers, college lectures and how learning on rainwater harvesting practices started gaining support from other people such as the ARC, where I observed activating of social learning which will be discussed below.

4.5.2 Activating: Releasing energy and creativity

This section describes the main facilitation and mediation processes that were significant to the activating of social learning with the emphasis on the relationship between farmers and the extension officers. Following the exploration and orientation phase, which was started by a relatively small group of farmers, extension officers, lectures and so on, there came a period where other interested parties became involved and the diversity and creativity of the group was utilised. Learning through Amanzi for Food resources, learning through trainers, learning from the group and through mediation tools, helped with the activating of social learning.

4.5.2.1 Learning through Amanzi for Food resources

The farmers and extension officers used the WRC materials to learn about RWH&C practices. These materials supported the farmers in the adoption and implementation of these practices in their farming practices. The materials provided visual aids in giving farmers ideas about various rainwater harvesting practices. The Amanzi for Food team facilitated the use of these learning materials, the extension officers used the WRC materials to guide them in constructing some of the RWH&C structures. Through the use of these materials, the farmers could get ideas of various RWH&C practices they could implement and could also compare various ideas.

While using the Amanzi for Food learning resources, both the farmers and extension officers became aware of their ways of farming when they were exposed to new ideas of rainwater harvesting practices as stated in the data extract below. Their ways of knowing and doing were also challenged by the knowledge of rainwater harvesting. Self-awareness was expressed when farmers were challenged by the ideas of rainwater harvesting and ideally they wanted to learn and implement some of the practices and also see how they were different from their current farming practices. As stated by an extension officer,

... water here is a very scarce resource and it is important in agriculture for food production water, so it is important that the farmers learn how conserve water because during the times of rain there is lot of water that goes to waste so there are techniques through the Amanzi for Food and our learning network ... there are lot of techniques that are there and we are transferring those techniques to the farmers that this is what could be done during the time of rain falling so that we prepare for the times of rain scarcity. (IE01)



Figure 4.8: Farmers using the WRC learning material during training in Gwali village

4.5.2.2. Learning from experienced others

Learning from trainers is one of the important ways to facilitate activation of social learning. It was also one of the important ways the farmers learnt the rainwater harvesting practices. The Fort Cox and Amanzi for Food trainers shared examples of the practices through training workshops and sessions, to which the extension officers contributed. Learning rainwater harvesting methods in an abstract way took place in a community halls and this involved used of WRC materials, groups discussions and graphics as can be seen in the picture below.



Figure 4.9: College lecturer demonstrating various rainwater harvesting practices during training in Gwali village

The trainers also taught practical rainwater harvesting techniques such as constructing small ponds, productive demonstration sites, diversion furrows, mulching. As part of the learning the farmers could compare and contrast between these practices and make decisions as to which one was applicable to them:

There are many services we transfer skills to them, farming skills, like you know with cropping now these days we usually have these unexpected drought, you see, so we have to at least try to teach them how to adapt to these situation like using these rainwater harvesting techniques, there are many of them so we demonstrate if we coming with new technique we have to demonstrate how it is done and they can continue doing it on their own. (IEO2)



Figure 4.10: College lecturers, farmers, extension officers in practical demonstration of mulching during training in Gwali Village

During these workshops the farmers also articulated their expectations and motives for being part of learning about rainwater harvesting and conservation. They mentioned how this might help them with growing their food, how they might get farming implements and inputs.

Our knowledge is local, people who have been farming here previously had dams, now we don't have dams, there were furrows and pipes to help irrigate the fields, there is no maintenance of the dams, if that happened maybe we would have been assisted with regards to drought, if we had dams and water we would have been able to grow food and drain water from dam. (FGD1F6)

I also observed how farmers from various villages, farmers' associations and extension service officers assisted these farmers coming together in the villages for workshops, meetings, and productive demonstrations. Learning from experienced others also enabled a learning environment where farmers' creativity was unlocked; for example, a farmer from a nearby village had to visit farmers at Lloyd village to share her permaculture practices and also learn about rainwater harvesting practices as can be seen in the picture below.



Figure 4.11: Farmer sharing her permaculture farming practices with farmers from Lloyd village

4.5.2.3. Learning from the group

Learning from the group was also an important mediation process in activating social learning amongst the rainwater harvesters. It was generally informal, these farmers interacted within their social networks and from one another to change their understanding of rainwater harvesting. What I observed was an increasing number of farmers who were becoming actively involved in learning of RWH&C practices, as farmers invited other farmers and shared the knowledge with them.

I realised that I missed many of these informal interactions as I was not part of the group. However, there were monthly meetings to discuss challenges and successes. During the focus group discussions, the farmers mentioned how they visited each other's gardens to share their knowledge on sustainable farming practices, such as permaculture and rainwater harvesting practices, as stated by the farmer below:

Depends on the problems you have because you can't always run to extension officers, where the association can be able to assist you, maybe it is just a minor problem, that does not require extension, you can meet with other farmers to help you with the problems, because they might have experienced the same problem before and then know how to assist you can do 1,2, 3, to solve their problem. (FGD2F7)



Figure 4.12 : Farmers learning from each other during their informal meetings in Gwali Village

4.5.2.3. Learning through mediating tools

Linked to learning through experienced others is the observation that the farmers learnt through the use of explicit mediating tools such as posters, drawings, diagrams, etc. I observed how the introduction of rainwater harvesting introduced learning that leads to a new kind of thinking, alternative values and co-created creative solutions amongst the farmers and extension officers. One of the main mediating tools was the navigation tool developed by the Amanzi for Food which includes various rainwater harvesting practices (see Appendix C). A workshop was held on how to use the navigation tool and how it could assist farmers for using the WRC learning material. Learning through pamphlets, books, meetings and training created different social experiences rather than only having extension officers visiting the farmer's gardens. These mediating tools also catered for individual learning needs of each farmer and they could use them in a way to suit their particular needs.



Figure 4.13: Workshop participants using navigation tool to learn about RHW&C practices (see the full navigation tool in Appendix 3)

4.5.2.4. Learning through hands on practice and site visits to support practice

I also observed how, after the workshop, training and meetings, the farmers would go to their homestead gardens to implement some of the practices and come back to later meetings to share their experiences with regard to the practices. The practical demonstration of rainwater harvesting practices in the farmers' gardens was one of the key mediums to facilitate and encourage self-awareness amongst the farmers and extension as stated below:

... we demonstrate, if we coming with a new technique we have to demonstrate how it is done, and they can continue doing it on their own. (IEO2)



Figure 4.14: Farmers digging small ponds to capture rainwater in Lloyd village

What also emerged from the data was the importance of motivation of people to be creative when doing rainwater harvesting practices in their gardens. What is seen in the citation below is an extension officer visiting different farmers to see how they are implementing the rainwater harvesting practices in their homestead gardens, indicating also the importance of good relations with the farmers and their role in bringing stakeholders together with farmers to support these practices.

I think we have a healthy relationship, especially with the farmers because they are our primary stakeholders, time and again we meet, time and again we are with them in their work places in their projects, we are in their gardens, you see then with other stakeholders, anything that is agricultural related they know that we are entry point, because we work with NGOs and private sector, NGOs such as World Vision. So it is strategically situated that these officers are there for easy access to the farmers, they have a very good and healthy relationship with the farmers, and also with fellow stakeholders, yeah. (IEO1)

4.5.2.5. Orientation through increased self-awareness

I observed self-awareness amongst the farmers through their interactions when they became aware of their current farming practices. It was also through becoming aware of their reality with regard to water shortages that these rainwater harvesting practices were applicable to their local situation and lived reality. With water challenges, the farmers were asked about what they could do about their situation and what other sustainable alternative methods could be used to improve productivity of their gardens. They were not aware of other rainwater harvesting practices or that they could improve food production. After this critical realisation, farmers and extension officers saw the need to come and engage and learn about these alternative practices, which in itself is a process of self-awareness as shown below.

They know about RWH, it just that they need training, so for them alternative is Jojo tanks and in fact that she says their gardens are small, they can't make farm ponds. She doesn't know that there are other practices that can be done, so training is needed on rainwater harvesting. (FGD2F5)

This phase unveiled a spectrum of possibilities for rainwater harvesting and diversity was important for activating social learning; the next phase was about choosing solutions that rainwater harvesters can actually realise in practice.

4.5.3 Selecting and designing solutions

This process was difficult to capture. It is evident in the end products such as practices implemented in the gardens. 'Lead up' social learning processes can be considered: farmers implementing the rainwater harvesting and conservation practices attended the training workshops and meetings to discuss the rainwater harvesting practices as noted above before trying them out in their sites. The selection and designing of solutions took place when lecturers from the University of Fort Hare (Agriculture, Engineering and the Agricultural Rural Development Institute), the Extension Office, Nkonkobe Economic Development Agency (NEDA), and local garden farmers worked together to design and implement rainwater harvesting and conservation demonstration sites in their villages. This process involved the following processes discussed in the sections below.

4.5.3.1 Workshops and meetings to discuss possible solutions

A number of meetings and workshops took place to discuss rainwater harvesting practices. Here farmers would discuss rainwater harvesting practices applicable to them using the navigation tool to decide which would be suitable, and which tools and materials were needed to implement these. They also discussed which ones they required assistance with, which were feasible, and which they had tried before and whether they had worked or not. Figure 4.15 below shows such a discussion.



Figure 4.15: Farmers participating in a workshop on rainwater harvesting and conservation in Gwali Village

4.5.3.2 Observing possible solutions through performing practical activities

The farmers had to observe possible solutions through performing practical activities. It was through these observations that the farmers could see the shortfall of each rainwater harvesting practice. What could be observed in the actions of the farmers is evidence that there was a process of deframing taking place. Farmers generally learned through experiencing and doing. They learned from observations by performing practical activities, they also learned from experienced others such as fellow farmers and extension officers. Practical training methods such as productive demonstration sites were suitable as many of the farmers were not highly literate which made informal instruction more practical. Engaging hands-on practical activities enabled farmers to participate and learn by observing and doing. However, they were also an important source of learning for the extension officers. One of the extension officers commented on the effectiveness of the practical session and its influence on his own learning, in the data extract below:

... in most cases that is happening because during the demonstrations the farmers will tell you this is how I do it and it is working for me, then by so doing you will be learning

something new, even during project if I can go to Mrs Peter place she teaches me everything about the ecosystems, permaculture, you name it, you see things that I have forgotten about she refreshes me. No lie, this is the way to go, this is how we do it, that is how we learn new things, because it a two-way process you come with something to them but they will show like no I hear what you are saying but this is working for me, this is how I do it. (IEO2)

4.5.3.3. Identifying solutions via probing problems and weaknesses

When identifying solutions, the farmers and extension officers had to reflect on their current practices. In this phase it was important to note processes of deframing/deconstruction, which happened when the farmers and extension officers acknowledged that their current irrigation system was not efficient nor effective due to lack of maintenance. They were also willing to reconsider indigenous knowledge, and also acknowledged weaknesses of some of their current farming practices as well as some of the extension programmes (such as the top down and input driven approach) and were ready to take on new ways of thinking and doing as stated by the extension officer in the data extract below:

My view on that is that it is helpful, if it is practised extensively, it can have a lot of impact because food security is important and food security cannot prosper without having access to water so the RWH is one of the solutions that can help meet the problem of food security. Because we are faced with issue of water scarcity and people have to make means of saving the little water that we have, then the experiences the lot of farmers had, have interest in this. In fact, the water harvesting is not a new thing in people but because of modern times people have forgotten those conventional ways of doing this. But with this water harvesting now we are taking them back. What we are saying it was you used to do, and it is still helpful now – it is still relevant because people use to make means and it is low in cost. Today if you want things for producing food, the things involve irrigation but where is he going to get water? Many people are not staying near to a perennial river or the big dams where they can all irrigate so one has to make use of the little water that he can preserve. (IEO1)

4.5.4.3 Investigating solutions by asking questions around practices and how they work

What I also observed in the process of deframing/deconstruction is that the farmers question these practices. Farmers were asking questions about RWH&C during the sites visits,

workshops and demonstrations, and during the informal meetings amongst the farmers or groups in which they deliberated on the rainwater harvesting practices. For instance, the formal gathering amongst the farmers created an opportunity for the deframing process. *“He doesn’t only come and talk he works with us in our gardens and we talk and advise each other he then leaves and we continue with our work, he works with us (FGD1F1).* It also promoted deliberation amongst extension officers and farmers when they questioned the practices and talked about what was working and not working for them. I observed that such deliberation enabled the deframing process and is important to social learning. During the workshops and meetings I observed how farmers were asking:

- Which practice brings the most results?
- How do we maintain soil moisture?
- Why is it dry for prolonged periods of time?
- Who is already implementing the practices and are they are working?

This shows farmers’ practical interest in the RWH&C practices but also how they question which solutions might be best, and why things were the way they were. People were also given the chance to share other ideas with the group on what worked for them. This can also be seen where extension officers, farmers, and college lectures were visiting various farmers gardens to learn about the rainwater harvesting and how the farmers are implementing the approaches. What they learned they also shared with a wider audience of farmers with regard to what they are doing as can be seen in the picture below where a farmer was sharing her practices with the wider audience of farmers during a workshop in Gwali Village.



Figure 4.16: Farmer drawing graphic representation of her rainwater harvesting practice during workshop in Gwali village

4.5.4.4 Investigating solutions via collective engagement and dialogue

I observed the appreciation of rainwater harvesting practices as one of the solutions and alternatives to water problems, and there seemed to be a collective understanding of the challenge. There were various rainwater harvesting practices demonstrated, however it was up to each individual farmer to choose which one was most suitable for them. Choice of implementing the practice was based on the available resources and also capacity of the individual farmer and extension officer. I also observed conflict as an importance source of collective learning, for example when a farmer was reluctant to practice some of the RWH&C, the extension officer proposed that the farmer continue with his current farming practices and then request a plot near his garden to demonstrate and over time to compare and contrast what is working and not working between the new knowledge of rainwater harvesting and the farmer's current farming practices, as described by the extension officer below,

... no there won't be any conflict because it good to convince her and persuade her to do it the right way. However, if what she or he believes is wrong, then as an officer you have been trained to be able to communicate to convince him or her that there is another way to do it. There are demonstration plots that you can do in such a case, if one believes that the practice is the best then you can organise that he or she keeps on doing their practice and you can ask for a piece land next to his or her land, and then

show the new practice and see the results. That is one way to convince him or her of the demonstration plot. (IEO2)

4.5.4.5 Investigating solutions by what works and what does not work

People were also given chance to share other ideas with the group, on what works for them what does not work for them as can be seen from Figure 4.17 below where farmers were co-learning how to use an A-frame to set levels and mark out contours across slope or hillside .



Figure 4.17: Farmers and extension officer discussing use of an A frame for implementing RWH&C practices in Lloyd village

This phase was about collectively choosing solutions that can actually be realised in practice by farmers and led to various implementation of rainwater harvesting practices.

4.5.4 Implementation

The practising of the rainwater harvesting practices is a key outcome of the above mentioned interconnected processes of social learning. It shows the learning via application of knowledge in practice. The knowledge around the rainwater harvesting practices was mainly practical and thus lent itself to be implemented, applied and experimented. The experimentation and application of these practices was an important source of learning for extension officers and farmers alike. During the focus group discussion, one farmer confirmed that they prefer doing things with their hands rather than sit in workshops.: *“I prefer to learn by doing rather than sitting and listening, we prefer hands on learning”* (FGD2F6). As can be seen from the

processes from orientation through to deliberating possible solutions outlined above, there was a strong support for practice-based learning, although there was also time given to learning about the practices through deliberations, questioning, observing others' practices and learning from materials as discussed above. This, however, did not replace the importance of the practical 'doing' or 'implementing' of the RWH&C practices as an important dimension of the social learning process.

The mediation and facilitation processes listed below were important for the implementation phase of the social learning process:

- *Identifying sites to implement the practices,*
- *Identifying practices to be implemented,*
- *Identifying equipment and materials to be used,*
- *Roles and responsibilities of individuals during implementation of the practices,*
- *Agreeing on a means of communication, and*
- *Identifying limitations to each practice.*

4.5.4.1 Experimentation via productive demonstration sites

Through deliberations, a demonstration site was established at Lloyd Village in Alice, where all agricultural actors shared knowledge and material resources. The Lloyd Village site was seen as an important site for local food production from the RWH&C perspective and was therefore identified a potential demonstration site as it was a communal garden where elderly women were producing food to supplement household livelihood strategies and feed their grandchildren.

Water scarcity was a major challenge to local food production in this site. Besides the dry conditions, farmers were also struggling with the capacity to farm, as they were mainly elderly women and they needed support to establish RWH&C they could easily use. They were struggling to carry water from a dam far away to their gardens.

In response to the issues as expressed by the elderly women, lecturers from the University of Fort Hare (Agriculture, Engineering and the Agricultural Rural Development Institute), the Extension Office, Nkonkobe Economic Development Agency (NEDA), and local garden farmers worked together to design and implement a rainwater harvesting and conservation demonstration site in the Lloyd Village garden, which included building a number of small

ponds (lined with plastic) and putting in gulleys to lead water to the small ponds. At first these small ponds worked well; however, the elderly women later found it difficult to maintain and use them. While they initially had a lot of support to build the small ponds and the gulleys, they had little ongoing support from their extension officer with regards to maintaining these productive demonstration sites as can be seen on the picture below. The ponds, after a while had holes in the plastic, and the old women struggled to get support to maintain them.



Figure 4.18: Small pond (practical demonstration site) that has dried up due to no rainfall in Lloyd village

4.5.4.2 Bucket and drum approach

During the field visits I observed that there were some tensions with regard to pumping water from the river to the Lloyd Village garden where previously the farmers had dams near the fields that were filled by the municipal pumps that were maintained by the municipality. They also appeared to have had other support for water management such as furrows and pipes that carried water to their fields. The pumps, however, have not been maintained and hence were no longer working, leaving the farmers with no choice but to use bucket and drums to harvest rainwater for their crops as stated by the farmer below.

... our knowledge is local, people who have been farming here previously had dams, now we don't have dams, there were furrows and pipes to help irrigate the fields, there is no maintenance of the dams, if that happened maybe we would have been assisted with regards to drought, if we had dams and water we would have been able to grow food and drain water from dam. (FGD1F6)



Figure 4.19: An example of the bucket and drum approach used by the farmers.

This problem of using buckets and drums was one of the main motivating factors for trying out the small ponds and diversion furrows in Lloyd Village, described above. Other techniques were also tried out in other sites such as mulching and tied ridges.

4.5.4.3. Small ponds and diversion furrows, mulching, tied ridges

The RWH&C practices demonstrated on the productive demonstration sites were an effective learning and knowledge dissemination center for farmers, extension officers, colleges, NEDA and colleges. This is evidence by others who visited the productive demonstration site to change their own farming practices. For example some farmers who had been part of the building of the small ponds and diversion furrows in Lloyd Village also tried this out at their own gardens.

Other techniques that were tried out and found to be successful were mulching and tied ridges, which some farmers also combined with the building of ponds and furrows. The mulching techniques helped to keep moisture in the soil, while the tied ridges helped to direct the flow of water to where it was needed. Figure 4.20 shows these practices.



Figure 4.20: Tides, ridges, furrows and mulching practices that were implemented

A farmer reflected on learning these practices within a more holistic agro-ecological approach to farming, and also on how she learned about using RWH&C practices via participating in the development of the demonstration site in Lloyd Village.

We get feed for cattle and medicine for the cattle and ways of farming, what to do during periods of drought. We learnt a new practice that we didn't know called mulching. We learned that we need to do mulching when we plant, so that it not dry. There are lot of things we learnt. Use of organic manure [is also important], we used to use fertilizers, and found out that these fertilisers are killing people, and we were advised to use organic manure, that why we have what is called organic manure as Iliziwi Lama Fama. I don't even have to use chemicals to get rid of insects as I have been introduced to biological control. (FGD2F4)

During implementation phase I also observed some conflicts with regard to the actual building of the rainwater harvesting structures. The farmers were saying that they are labour intensive and time consuming and as the majority of them are old, this was not easy to do. During the practical demonstration of diversion furrows, one farmer reflected on her experience in making

diversion furrows. *“Diversion furrows are hard and labour intensive but if you do them well first time round it will be easier to maintain them”* (OB3F4).

I also observed how others were feeling that their current ways of knowing and doing were being challenged. For example, some farmers expected to get Jojo tanks rather than building the rainwater harvesting structures themselves, as reflected in these citations:

What we also need the most as other we don't have tanks, as farmers when rains comes we capture and store the water, and put the water in the drums for cattle and also assist us (FGD2F6).

So it shows that they know about RWH, it's just that they need training, so for them the alternative is JOJO tanks (FGD2F5).

4.5.4.4. Group dynamics shaping implementation of the RWH&C practices

Another mediating factor that shaped implementation of the RWH&C was the group dynamics of the community. Division of labour played a major role in the actual implementation of the practices. As stated above, the farmers are mainly elderly and the rainwater harvesting practices are labour intensive and hence affected levels of participation in the actual implementation of the practices. What I observed is that application of knowledge of RWH&C was most effective where knowledge sharing took place amongst the farmers and extension officers and also non-farmers (e.g. college and university lecturers and students). I noticed that when these practices were being demonstrated there were some who were watching carefully what was being done, even though they were not farmers. I noticed that people involved in the learning group had different reasons for being there, some to learn, and some to change practice. The involvement of students from the college was also important, as they were both able to learn new practices while also assisting the elderly farmers, and they could also draw on the knowledge and support of the lecturers and the extension services in the process. Figure 4.21 below shows the predominantly young male students from the College assisting farmers in productive demonstration site development as it was labour intensive.



Figure 4.21: College students with workers providing manual labour in the productive demonstration development

4.5.4.5. Farmers' experiences in the implementation of RWH&C practices

It was through the actual implementation process that the farmers were exposed to possibilities and the shortfalls of each rainwater harvesting practice and also they could learn how to adapt and adjust these practices to suit their needs and about how to cope with water issues. During observations farmers acknowledged that some of the practices were not applicable for their gardens and opted to adjust and adapt some of the practices to suit their needs.

For example, I observed that the small ponds and diversion furrows were only applicable when there is rainfall. There were some cases of dissatisfaction with the results of the implemented rainwater harvesting practices as they become dry over period of time due to prolonged dry periods, farmers felt that despite the effort, there was no apparent progress with regard to the practices. This was the case in Llyod village where these small ponds were abandoned and not maintained.

The farmers and extension officers also noted the shorter term results and small scale success of implementation of the practices, as it prolonged the production period of farmers that were implementing these practices, as stated by the extension officer below.

Many people who were involved in this, at least they have something on their gardens because they were, they have some water preserved for at least for a longer period [see

Figure 4.22 below]. For those who don't know anything, who don't practise the water harvesting – they had a total crop failure. At least the ones that have knowledge of rainwater harvesting were not so badly hit but there was still damage [from the drought]. (IEO1)

The picture below shows the garden of the farmer that managed to produce abundant food even during the dry winter period because of rainwater harvesting practices.



Figure 4.22: An example of a food homestead garden that was productive during a dry period because the farmer used mulching and furrows

I observed how both farmers and extension officers realised other results while implementing RWH&C practices, such as co-engagement and co-learning amongst the group.

Observations also showed that farmers that have had training in sustainable farming practices were able to make connections with their prior learning in agro-ecology and thus they made good use of the rainwater harvesting and conservation knowledge and practices to extend their agro-ecology knowledge as illustrated by the farmer below:

... and another thing in this village we have been trained at Ilizwi Lamafama [farmers association], we are mainly Ilizwi Lamafama members and we were trained in Agro-ecology, our farming is pro-climate what you call global warming and climate change so they know, you don't just burn. What you need to do is to save water. (FGD2)

As explained above, the implementation phase involved the actual implementation of the selected rainwater harvesting practices. It entailed physical construction of the rainwater structures and it involved improved social relations and learning amongst the farmers, extension officers, college lecturers, and the Amanzi for Food team. It also involved experimentation and trialling and testing of the practices as explained above with new insights into the suitability of the emerging practices.

4.5.5. Reviewing/evaluating

This section on this phase of the social learning process describes how the farmers and extension officers learned by assessing the degree to which water and food security challenges in their learning of RWH&C have been addressed, and also how they reviewed changes that had occurred through their learning of RWH&C. One can erroneously assume that the social learning was mainly technically focused on the RWH&C practices, but the review process showed the value that was created via the social learning processes in the form of networks and relationships, as well as via a supportive co-learning environment.

4.5.5.1. Cultivation of relationships amongst rainwater harvesters

Through observations and the various discussions I had with the farmers, I found appreciation for and evidence of new relationships that formed during the learning of rainwater harvesting practices. Some key examples of these occurred between the farmers and extension officers, as the extension officers usually visited farmers on their plots to share new knowledge but also to learn about new practices, as stated below.

With my farmer and my own farmers my relationship is good, because I am always bringing something new to them, even when I come with a programme to them they accept it. They question and question but ultimately they accept it because they see that as long as it something that will not disturb them, as long as it is helping them.(IEO1)

There is no problem between us and the extension officer, we work well together. He is a good person, what I can say is that he is under authority, whatever he brings to us he is given by people in charge of him so he can't do as he pleases because he reports to someone, we work well with him. (FGD1F5)

Another productive relationship that was valued was between the college lecturers and farmers; lecturers also visited the farmers' plots and they assisted with training and conceptualisation of practical demonstrations. I observed how these relationships became stronger over time, also as more students became involved. I noticed too that it was easy for the farmers, extension officers, and college lecturers to communicate together and set up meetings. Figure 4.23 is a photo of various people from various institutions who had an opportunity to exchange and share knowledge with each other. The picture shows co-engaged interest in co-learning.



Figure 4.23: Group of farmers, college lecturers, extension officers and Amanzi for Food partners during a workshop in Gwali village

4.5.5.2 Belonging

It was evident that people felt like they belonged in a group, where they participated in formal and informal meetings, trainings, workshops, and practical demonstration and shared their ideas with the wider group. Along with sense of group belonging, the farmers, extension officers, lecturers, belonged to their individual institutions, farmers groups and this strengthened the existing relationships and co-engagement and learning amongst and between these institutions. This was the case throughout this study's fieldwork period where Amanzi for Food, agricultural extension, NGOs, and colleges have been learning together about rainwater harvesting practices throughout. This collective sense of belonging was reflected in the group's identity: they named themselves the Imvothu Bubomi Learning Network. This learning network has had an active What's App group since 2015 and they regularly communicate with each other and share experiences of their RWH&C practices, as well as their farming activities on this site. This learning network has expanded to include other learning activities and events as can be seen in the pictures below.



Figure 4.24 : Imvothu Bubomi Learning Network members from various institutions learning about and sharing their experiences of RWH&C practices during a workshop

4.5.5.3 New ways of knowing and doing

As shown in the narrative above, learning about rainwater harvesting practices is an experience that was shared by all of the participants in the learning group. Although some missed one of the workshops, or training sessions or meetings and not all participated in all of the productive demonstration sites, they were all exposed to new knowledge on rainwater harvesting and conservation during any engagement they attended. There was a sense of common knowledge amongst the group as they had deeper understanding of RWH&C practices and a willingness to try out the different practices as shown by the application descriptions above. Below are examples from an extension officer's reflection with regard to the learning around the rainwater harvesting practices.

... in most cases that is happening because during the demonstrations the farmers will tell you this is how I do it and it is working for me, then by so doing you will be learning something new. (IEO2)

... The Amanzi for Food Project ... I was fortunate to be contacted by the team from Rhodes and they were fortunate to be tipped by the guys from Fort Cox that there is an extension office which is here, so they came and introduced the concept ... I like it ... (IEO1)

4.5.5.3 Engaging in rainwater harvesting practices

As mentioned in this section 4.5, people received various WRC materials relative to their learning needs (see Appendix 3). The materials described many opportunities for rainwater harvesters to engage with one another regarding a practice that is of relevance as stated by the extension officer below. The productive demonstration sites where the implemented RWH&C practices were explored are key examples of rainwater harvesters engaging with the practice.

The active engagement of the practices strengthened collaboration amongst the farmers, extension officers, college lecturers and students. These demonstration sites still continue to be used by people to engage with the practices and learn how to use them themselves, as well as to provide immediate benefits to farmers. The extension officer reflected on the success of this approach to social learning,

Because [referring to the need for this kind of learning]... specially the small scale farmers because they could see that this is a way to go, because it is low in cost, something that is doable, you see the results immediately you then that is something that many of them meant to get information on so that they can practice. (IEO1)

4.6 Conclusion

This chapter presented relevant data gathered from the study to explore the research questions. It has provided evidence from the data to provide insight into the research questions and thus has helped to achieve the purpose of the study. The chapter reduced data into sensible information which is a foundation for Chapter 5. The essence of Chapter 5 will be to reflect on Chapter 4 and Chapter 2 to present an argument. Therefore Chapter 5 discusses and interprets the presented data in Chapter 4 and synthesises the study findings relating to the research questions and purpose of the study.

CHAPTER 5

DISCUSSION AND RECOMMENDATIONS

5.1 Introduction

To facilitate the discussion in this chapter, I start with a short summary of the study. The discussion addresses the research question, which focusses on how extension officers facilitate and support social learning of rainwater harvesting and conservation practices amongst rural smallholder farmers. This chapter summarises the main findings that are related to each research question/goal. The data generated and presented in Chapter 4 will be reconciled to the ideas shared in the literature review in Chapter 2 where the conceptual and theoretical framework was presented.

5.2 Short summary of the study

As explained in Chapters 1 and 2, the role of extension is to be active within the farming community, to facilitate social interactions and collaborative processes that often focus on activities that are intended to find, assess, interpret and adapt information, knowledge and evidence that are suitable for farmers' needs. Extension should also be available to identify arising issues that the farmers experience that can be solved by the use of research knowledge. Recent extension policy also indicates that extension services need to take up social learning approaches to their extension practice, as explained in Chapter 2. However, little is known with regard to if extension officers are taking up this role effectively.

Using a case study of learning in the context of the Nkonkhobe municipality with specific focus on the Amanzi for Food project, where I used document analysis, semi-structured interviews, field-based observations and focus group discussions to probe the role of learning of extension officers and farmers, the research demonstrates and reflects on the role of extension services in facilitating and supporting social learning processes of RWH&C practices amongst rural smallholder farmers for improved food security.

5.3 Main findings

5.3.1 Research question 1: Role of extension officers in the Amanzi for Food Project context

5.3.1.1 Extension officers are a bridge between farmers and research based knowledge

As shown in Chapter 4, the extension services are mainly involved in farmer support services, their main role being to assist farmers with accessing agricultural services. The extension officers see themselves as bridge builders between farmers, research and innovation. They facilitate and mediate research based knowledge to the farmers and they see themselves as the main link between farmers and research. They also communicate farmers' issues and challenges to the researchers. As shown in Chapter 4, the extension services are an important institution, as they also link stakeholders for mediating cutting edge research based knowledge to farmers, as they have a close relationship with farmers (see section 4.2.1.).

The literature review in Chapter 2 also emphasised the importance of the extension services, indicating the important role they play in providing one of the main means of communication between research based knowledge and farmers. As shown in this study, the extension officers work with farmers to help them acquire relevant and useful knowledge such as knowledge on RWH&C to improve their food production. According to Islam et al. (2011), the extension services are an important bridge 'builder', as they link the researchers with the farmers. In the case of the Amanzi for Food project, this was also found to be the case, as the extension officers played an important role in linking the Rhodes University and Fort Hare University researchers with the farmers and other stakeholders, so that practitioners (the farmers) who were in need of knowledge of rainwater harvesting and conservation practices could be linked with the research based knowledge that was being provided by the Water Research Commission. They also helped spread awareness and adoption of rainwater harvesting practices in the form of practice and mediation support.

As found in this case study, researchers and farmers were separated by distance as discussed in Chapter 4. The Amanzi for Food project team is located at Rhodes University in Grahamstown and the project site was located in the Nkonkobe Municipality. Initially farmers did not have access to technological communication on RWH&C, as they had limited access to and few knowledge resources on RWH&C practices as these were not accessible to the farmers. However, the extension officers in the project had direct access to the farmers and as

they are located closer to the villages and could more easily be reached by the farmers. Their role in supporting the researchers to connect with the farmers and other stakeholders in the learning group was crucial, especially because the extension services remain active in the community even after the Amanzi for Food Phase 1 project came to an end.

Being bridge builders also had implications for the extension officers as mediators. As mentioned in Chapter One, the WRC materials were available but not being used. In the case study – as reported in Chapter 4 – the extension officers helped to mediate the materials, and to package information and knowledge that might have presented some difficulties from the view point of the farmers. One of the challenges identified in the field, was bridging the technical divide of the learning materials and farmers' knowledge, and it is here that the extension officers played an important role, as they were able to present this knowledge in farmers' localised language (isiXhosa) and advise on using practical examples so that farmers were able to translate this knowledge into practice on their farms (see section 4.5.1).

5.3.1.2. Extension officers are important facilitators of knowledge and resources

As shown in Chapter 4, the extension services provide and facilitate access to agricultural services, knowledge and respond to farmers' needs. They also contribute to capacity building of farmers. However, as also shown in Chapter 4, the facilitation of knowledge and research to the farmers is limited by the capacity and resources of extension services themselves. Without extension services, the farmers cannot access agricultural services from the government (see section 4.2.1). This also implies a need to develop the capacity of extension services as they are crucial in development of rural smallholder farmers. In the case of the Amanzi for Food project, there were clear indications of the extension officers both contributing knowledge and resources on RWH&C, while also learning more about these and farmers' practices through interactions in the multi-stakeholder learning group, and via use of the WRC materials, the navigation tool, and the co-engagement with college lecturers, farmers association members and farmers around the development of the productive demonstration sites.

Even though extension officers were not necessarily the source of all the information, Chapter 4 showed that extension officers were an important mechanism in sharing information, knowledge and innovation between farmers and researchers as noted above via their 'bridge building' role. Very limited knowledge /resources are accessible to these villages – this has

resulted in inadequate dissemination of resources, information knowledge and literacy levels of the communities. This study showed that working closely with extension officers in a multi-stakeholder learning group was one of the best ways to make the RWH&C knowledge of the WRC (that was previously not being used) accessible to the farmers because they have such direct access to the farmers and work with them on regular basis (see sections 4.5.1- 4.5.4).

As shown in Chapter 4, the extension officers facilitated social interactions between outsiders (researchers) and farmers. The chapter also showed that the skills, capacity and willingness to provide facilitation and support by the extension officer is critical in fostering these relationships. In the Amanzi for Food case, the extension officers appreciated access to the WRC materials, the navigation tool, and the training provided to the learning group (which they both contributed to, and benefitted from). This allowed them greater access to a wider range of effective means and tools to facilitate this process as their willingness and knowledge can hinder or foster success of social interactions and farmers learning. Chapter 4 showed too that they also have to deal with conflict that might arise during the social interactions and this requires certain types of skills and capacity, therefore extension officers need to be team players, reflexive and critical thinkers, who can think ‘outside the box’ and make the best use of opportunities to support the farmers they are working with (see section 4.5.5). Chapter 4 showed that the extension officers’ disposition and willingness to engage with new knowledge resources was important for farmers’ social learning and their own reflexive learning.

Chapter 4 also indicated that extension services allow for knowledge and information to be shared across range of different farmers, and therefore they need to be aware of the learning needs of the farmers. They also need to know how to share the knowledge in an acceptable manner with the farmers and need to give attention to language use during the sharing of information and knowledge. As indicated in Chapter 4, the extension service is where farmers can go and seek for information and advice if they have problems in their farming practices. Knowledge sharing therefore also involves a trusting relationship between farmers and extension services. Such a trusting relationship allows farmers and extension services to come together and learn from each other. As shown in Chapter 4, this was supported by a wider co-learning process involving college lecturers from Fort Cox College, local municipality officers as well as university researchers from both Rhodes University and Fort Hare University (see section 4.5.3). As noted by Islam et al. (2007), and as discussed in Chapter Two, there is a

growing need for agricultural, rural and sustainable practices as knowledge is intensifying and as the field of agriculture is facing challenges in keeping up with increasing population, water shortages, food security, and environmental degradation. Islam et al. (2007) noted the importance of supporting farmers to become more knowledgeable on these emerging issues (Islam et al., 2007), hence emphasising the role of the extension services in this process. There also continues to be a pressing need for changes in agricultural extension and training systems in order to fully integrate sustainable agricultural and environmental concerns (Hagman et al., 1998; Islam et al., 2011) indicating that this is an ongoing challenge for extension services to provide updated knowledge and tools, as circumstances change.

5.3.1.2 While extension officers play a significant role, they lack support for social learning and mediation skills due to heavy emphasis on technological approaches

As reported on in Chapter 4, research respondents from the Department of Agriculture and Rural Development noted that one of the major challenges facing the extension services is lack of social facilitation skills and participatory rural appraisal tools. This is because the tradition in agricultural extension is technological and input driven and more emphasis is placed on technical knowledge transfer than social learning and social facilitation (see section 4.2.1.).

In general, the history and tradition of extension services are mainly on transferring technologies and farming inputs developed by researchers, and farmers are not often seen as active partners in innovation but are viewed more as recipients of knowledge within a technology transfer approach. The general tendency is also to only provide extension services and support to farmers on request or demand-only basis. These two tendencies from past extension practice tend to limit engagement between farmers and researchers. Extension is weakened as the focus in this paradigm (i.e. technology driven paradigm) is mainly on end or final products rather than stakeholders engaging together to develop and discuss farming inputs and technologies and how these can actually be used by farmers. Chapter 4 indicated that while there initially seemed to be limited evidence of extension officers taking active steps to build capacity amongst the farmers on RWH&C, and also in promoting participatory learning processes where farmers and extension collectively engage in the learning process, this was expanded as the Amanzi for Food programme and the learning group interactions emerged over time. This allowed the extension officers to more proactively engage in social learning and participatory processes for mediating RWH&C knowledge (see sections 4.5.2, 4.5.3, 4.5.4, 4.5.5). It should be noted that there is nothing wrong with a technological-driven input

approach; what is important, as shown in this case study, is for extension officers to recognise other extension approaches and not only focus on one approach, as farmers are dealing with complex dynamic issues and hence require different approaches, a finding also reported on by Mukute (2010). What is important is the ability to be reflexive and co-engage with farmers and know which approaches are important for the farmers with who they are engaging (Mukute, 2010). The choice of an extension approach should be based on the position of the farmers rather than what extension wants (ibid.). As shown in Chapter 4, the collaborative social learning approach using training, dialogue with farmers, and productive demonstration sites in the Amanzi for Food project, allowed for a broadening of the extension officers roles to be more inclusive of participatory approaches and social learning involving multi stakeholders in the local agricultural learning system. Importantly, this approach allowed extension officers to develop their social learning and participatory approaches to providing extension support.

5.3.2 Research question 2: Farmers' experiences in learning about rainwater harvesting and conservation practices from extension officers

5.3.2.1 Farmers appreciate support for learning by 'doing' provided by extension officers in their gardens

As shown in Chapter 4, extension officers were visiting farmers, holding workshops, and facilitating the development of productive demonstration sites to discuss and learn about rainwater harvesting and conservation practices. Facilitation of these rainwater harvesting practices took place in the farmers' gardens and also in their local language. These practices were facilitated by using locally available resources and were also mainly participatory as they did not position the extension officer as the expert but created space for everyone to participate and contribute. As shown in Chapter 4, this excited the farmers and they expressed how they valued these practices as one of the solutions to their water shortages (see section 4.5.1. & 4.2.5).

Chapter 4 also showed that farmers have a long existing relationship with the extension officers, and hence if they have challenges in their farms they would approach and seek help from the extension services. Chapter 4 shows that their involvement also played a major role in changing farmer's attitudes towards rainwater harvesting practices. Chapter 4 further showed that it was important for farmers to participate in the co-learning process, as those farmers that did not apply the RWH&C practices were not able to adapt to changes and were

not able to produce food, while those that did, were more able to extend the growing period, and grow food, despite the water shortages.

Thus, from this, it can be seen that the learning environment was of great importance as it framed the context in which the learning took place, and allowed the farmers to adopt a carefully deliberated and practical approach to implementing possible options for RWH&C that were relevant in their contexts. The physical (farms) and intellectual (extension) environment facilitating the learning processes, enabled the farmers to appreciate the support and learning. The learning was also enabled by the pre-conditions of learning as described in sections 4.5.2-4.5.3.

As discussed in Chapter 2, Wals et al., (2009) stated that social learning is a learning system in which people learn from and with one another. As shown in this study, RWH&C knowledge is successful when mediated by local individual (extension) and other stakeholders as they work together with the farmers. The extension officers in particular were very focused on supporting the farmers directly, as it is their role to support farmers on a daily basis and they have built trusting and close relationships over the years as reported on above. As described above, the extension officers played an important role in re-interpreting the knowledge that is relevant to the farmers to a particular RWH&C practice. Here the use of a local language that could be understood by the farmers also showed itself to be important for farmers' learning and the building of a trusting relationship with the extension officers. In this study it was shown that it was those farmers that were willing to take up the new knowledge of RWH&C that were the ones that worked closely with the extension officers (see section 4.5.1- 4.5.4).

5.3.2.2 Extension officers are not always present to provide follow up support which affects continuity of the practices

While the extension officers play an important role in supporting farmers' knowledge and practice, as described above, and in general in the case study area, there were good relationships between the extension officers and the farmers as discussed in Chapter 4. However, the existing relationships amongst some of the farmers in the group and the extension services also hindered the process of continuity of practices. This was observed when a process facilitator was not always present to support farmers, which I observed in a village during one site visit, where there was workshop on RWH&C practices and the extension officer was not present. It was also observed during sites visits to the Lloyd Village after the ponds and furrows were put in

where some of the farmers had abandoned these RWH&C structures due to a supportive system for maintenance of the structures not being present and supporting farmers (see section 4.5.4). Here it seemed that the extension support services should have provided for continuity and maintenance support after the productive demonstration sites were set up.

This lack of support for continuity and maintenance from the extension officers in the Lloyd Village setting seemed to be problematic and resulted in limited appreciation or potential of rainwater harvesting for the farmers to tackle food insecurity. Understanding learning processes associated with adoption and *ongoing utilisation and maintenance* of alternative agricultural practice's such as RWH&C is crucial. For farmers to adopt these alternative practices they need motivation and support of social networks and extension services, not only during the establishment phase, but also during the ongoing utilisation and maintenance phases of developing a practice.

5.3.3 Research question 3: Facilitation of RWH&C reflects social learning

5.3.3.1 New knowledge of RWH&C practices is important for social learning and challenges farmers practices

As reported in Chapter 4, what I observed in the process of deframing/deconstruction in the social learning process is the importance of farmers' questioning of the RWH&C practices. For instance, farmers were asking questions about RWH&C during the sites visits, workshops and demonstrations. I also observed that the informal meetings amongst the farmers or groups in which they deliberate the RWH&C practices were an important forum for such questioning to emerge, for instance the formal gathering amongst the farmers created opportunity for the deframing process. It also promoted deliberation amongst extension officers and farmers where they questioned the practices and talked about what was working and not working for them, and what alternatives they could try out (using the navigation tool). As shown in Chapter 4, such deliberation enables a deframing and reframing process and is important to social learning as explained by Wals et al. (2009) (see section 4.5.2-4.5.3).

Chapter 4 also reported that the prior knowledge of farmers and extension officers affected how they perceived new information and knowledge of RWH&C practices. Farmers and extension officers had a little prior knowledge with regard to rainwater harvesting and this enabled the farmers and extension officers to accept and understand RWH&C practices. The prior knowledge affected how they organised the new information and knowledge; in this case

they had to incorporate the new knowledge into existing prior knowledge and used existing structures to assimilate the new rainwater harvesting and conservation practices (see section 4.5.2.).

Prior knowledge also affected how farmers made connections to the new information. One of the keys to learning is the richness of the connections related to information. The more connections, the easier it is for farmers and extension officers to engage with RWH&C. As shown in Chapter 4, to begin with it was useful to know the current farming practices of farmers, as this facilitated making the connections to new practices, and facilitated reflections on the practices and which ones could be tried out where and by whom.

Chapter 4 also showed that new knowledge from the WRC materials, introduced via the navigation tool and handouts as well as training workshops and lectures in both English and isiXhosa supported the learning process. Through exposure to the new RWH&C practices, farmers were empowered to understand their farming practices from the new perspective and were able to envision better water ways of improving food security. The new knowledge stimulated deeper thinking and farmers' questioning of current ways of knowing and doing. Farmers were encouraged to weigh their current practices and knowledge against the new knowledge and question the practices. As shown in Chapter 4, the farmers' prior knowledge was valued and used in the learning of new RWH&C practices. They accepted this knowledge because they were able to debate and question and also adapt according to their local conditions (see section 4.5.3-5-4.5.4).

The new knowledge enabled the farmers to understand, intervene and resolve problems with regard to food production in their gardens. The knowledge varied from various artefacts used to communicate the RWH&C. For the farmers, the new knowledge was not merely in a set of books; it was in the ability of extension officers, researchers and farmers to contribute to the vitality, application and evolution of RWH&C practices, and hence to the farmers the RWH&C knowledge was irrelevant without application, and the new knowledge was the driver of learning new practices as shown in Chapter 4 (see section 4.5.1-4.5.2).

5.3.3.2 Co-engagement between farmers and extension officers is essential for social learning

What was observed in the Nkonkobe case study was different levels of involvement and commitment amongst farmers and extension officers in learning about rainwater harvesting

practices. As reported in Chapter 4, involvement was mainly *problem-based involvement*, and had a very high connection with water shortage problems as this deeply touched their livelihoods. They had little alternative but to come together and co-engage with each other with regard to alternative solutions for water for food production (4.5.5).

As discussed in Chapter Two, there have been changes and shifts in extension approaches, and many extension approaches now emphasise co-engagement, and co learning or social learning involving problem solving between the farmers and extension officers, including the draft extension policy. In the case of the Nkonkobe district, this co-learning also involved the Amanzi for Food team members as well as lecturers, researchers and students from local learning institutions. It recognised different kinds of knowledge based between the farmers, researchers and extension officers. As explained by Wals et al. (2009) and Mukute (2010), social learning takes place through deliberative processes and in the Nkonkobe case, this involved sustained interactions between the farmers, extension officers and other stakeholders in an evolving learning group that was built around sharing of knowledge and perspectives in the farmers' communities and in service of their practices to produce food (see section 4.5.5).

The interactive and ongoing nature of the learning interactions in the Amanzi for Food programme enabled farmers and extension officers to engage with one another with regard to RWH&C practices and other sustainable farming practices. It also promoted continuous dialogue and deliberation amongst the farmers and officers, and this could be seen by extension officers visiting the farmers' gardens to learn about RWH&C practices. It was also observed when extension officers engaged with other stakeholders such as agricultural college lecturers. It is to be noted that deliberative processes did not always lead to shared understanding and agreement amongst extension, as levels of literacy, time constraints, and power relations were some of the factors that influenced the extension and farmers' learning experiences as also reported on in sections 4.5.1-4.5.3.

Chapter 4 reported that the introduction of localised RWH&C practices has seen shifts in the learning processes of farmers as members of the learning group, including the extension officers, sought to support farmers to develop capacity to improve their food production. It also supported positive attitudes and values within the locality for farmer's sustainable farming practices. Localised learning included increased relevance of education local meaning making.

Wals et al. (2009) and Mukute (2010) argued that people need to engage with such social learning processes if we are to enable farmers and extension to engage with complexity and the changing nature of food security impacted on by issues such as climate change (as discussed in Chapter 2).

In the Nkonkobe case study context, extension officers and farmers were learning from one another and not only viewing extension officers as the 'external expert' and there was a recognition that individual farmers too were experts of their local conditions as also reported on by the extension officer in Chapter 4. As reported on in Chapter 4, the farmers in the Nkonkobe District were faced with water shortages, and were compelled by this crisis to take action by building social cohesion and trust between those involved in learning and making collective meaning and sense. As reported on in Chapter 2, one critique of government institutions is the failure to co-engage and this results in failure of knowledge dissemination and learning. However, in this case context, there were high levels of co-engagement between extension and farmers which enabled an opportunity for social learning processes to take place (see section 4.5).

5.3.3.3 Dissonance and conflict provided an opportunity for social learning

As discussed in Chapter Two, the social learning model of Wals et al. (2009), developed in an education and sustainability context, noted that dissonance around sustainability concerns can be a source of learning. Mukute (2010) also reported that contradictions can be a source of learning. As reported in Chapter 4, at the time of this research there was an existing relationship between the farmers and extension officers. The water shortage issue at stake was experienced by both as creating dissonance and conflict amongst the farmers and extension officers as the farmers wanted solutions to their water problem and wanted government to intervene and support them to resolve it. This then seemed to create or enable space for the farmers and extension officers to come together and learn about rainwater harvesting practices as one of the means for food production (see section 4.2.1).

As reported in Chapter 4 there was also conflict with regard to the introduction of new knowledge of rainwater harvesting, as the farmers said they were labour intensive and time consuming and the majority of the farmers were elderly. The feeling that their current ways of knowing and doing was being undermined was also noted as they had various expectations

such as receiving Jojo tanks rather than building the rainwater harvesting structures themselves. There were also cases of always expecting farming inputs from the extension officers when they visited the gardens; however in this case there were no farming inputs and they had to use the locally available resources to implement these practices.

In this case, the extension officers saw this conflict as an important source of collective learning, where they proposed that the farmer continues with his current farming practices and then requested a plot near his garden to demonstrate and over time to compare and contrast what is working and not working between the new knowledge of rainwater harvesting and the farmers' current farming practices (see section 4.2.1-4.2.4).

The water shortage was noted in the case study context to be crucial in triggering dissonance amongst the farmers and extension officers and these two processes were critical in facilitating social learning processes. Farmers and extension officers were exposed to threats of shortage water for food production, and when they were exposed to new ways of knowing and doing with regard to RWH&C practices, they felt they could address this dissonance, but it also led to dissonance and conflict as they were learning to deal with their water challenges, showing that not only one type of dissonance can be involved in social learning processes.

In this case study, it was clear that the social learning that emerged in response to the dissonance was also dependent on a great deal of collaboration and shared goals held by the farmers and extension officers. The case study also shows that the shared collaboration and goals could also be strengthened and deepened over time around the dissonance, contradictions and conflicts that were experienced and openly engaged with through the regular interactions. Hence, in this case study context, the conflicts and dissonance brought about meaningful social learning processes. It is to be noted that there are limitations of conflict and dissonance in enabling social learning as Wals et al. (2009) point out that too much dissonance can also create a breakdown in the social learning process.

5.3.3.4 Social learning approach in Amanzi for Food challenged current extension practice and strengthened relationships with farmers

At the start of the Amanzi for Food project, current practice in the extension services did not include much of a focus on rainwater harvesting and conservation in the extension programmes. The programme's focus on RWH&C and its connections to the farmers and extension officers

around the shared challenges and dissonance helped to challenge the extension officers to rethink ways of integrating this into their existing extension programmes and also look beyond and fully integrate sustainable agricultural and environmental concerns into their practices, as explained in Chapter 4 (see section 4.2).

Chapter 4 also showed that in the case study context, coping with water shortages for food production required people from various backgrounds such as Amanzi for Food (education) extension (agriculture), college lecturers and farmers to work together and learn about RWH&C in order to deal with risks and challenges faced by the farmers. It also enabled the extension officers to extend their existing extension practices and critically review their predominantly top-down technological input-driven approaches and correct themselves as explained in section 4.2.1 & 4.5.1.

Social learning in the case study context was very much experienced as a matter of survival considering the threats of water shortages to farmers' livelihoods, and therefore called for re-examination of assumptions and values in the extension services, as well as critical thinking and new creativity and shifts in meaning making on the part of both the extension officers and farmers. In learning experiences such as those experienced by the learning group in the case study, it is possible for groups to collectively reframe their assumptions as described in section 4.5.3. This collective meaning making and reframing is an important feature of social learning in sustainability contexts as explained by Wals et al. (2009), Mukute (2010) and other social learning researchers working in southern Africa such as Kachilonda (2013) and Lotz-Sisitka et al. (2016). This is important for the recommendation of the National Climate Change Response White Paper (RSA, 2011) which suggests that, in order to expedite adaptation to the added uncertainties of climate change, subsistence smallholder farmers need efficient and informative agricultural extension services to provide advanced and state of the art research based knowledge on climate change adaptation. However, the National Climate Change Response White Paper does not give advice on how such processes are to be learned which this study thus provides some insight into.

Importantly, in this case study, social learning was centred on farmer learning and allowed for farmers to learn and investigate RWH&C practices with the support of others who were prepared to share knowledge and co-learn with them. This offered an alternative to traditional

extension approaches where farmers tend to be seen as passive recipients of farming inputs. In this setting, farmers were not simply presented with new knowledge and techniques, but were also supported to conceptualise and implement new sustainable farming practices of RWH&C through use of new ideas, new ways of knowing and doing on how they can respond to water shortages, a process of collective social learning (see sections 4.5.2-4.5.3). This also provides insights that can be useful for the implementation of the National Framework for Extension Recovery Plan (ERP) (DAFF, 2011) which, as discussed in Chapter 2, has as its fourth pillar, a focus on re-skilling and re-orientation of extension services. As noted in Chapter 2, this plan does not give attention to the re-orientation and re-skilling of extension services under complex conditions such as climate change (DAFF, 2011), and hence the insights found in this study could help to provide approaches for such re-skilling of extension services.

5.4 Recommendations

5.4.1 *Recommendations to extension services on ways to strengthen social learning approaches*

As shown in this case study, social learning platforms or discussion forums for agricultural extension can be beneficial as they allow people to come together to learn and develop their knowledge from others in the field in ways that are both sustainably and socially aligned to the particular contexts in which they work. As shown in this case study, the extension officers require complex technical and social competencies as they deal with more than technical aspects but also humans (farmers). As noted above, under conditions of complexity and climate change, they also need to be able to be reflexive and co-learn with farmers and other stakeholders how to respond to dissonances such as water scarcity. This study has shown that agricultural extension training systems and departments could consider supporting development of social competency training using social learning approaches such as that demonstrated and reflected on in this case study.

This case study has also shown the value of promoting formal and infield learning experiences needs and drawing on public media and information from various institutions for informing both farmers and extension services of new practices. This case study has shown that there is value in exploring the possibilities provided by opportunities created for co-learning in learning forums, communities of practice or learning networks for learning how to apply general and specialist forms of knowledge into practice in farmer-centred ways, as the knowledge that can

be acquired is dynamic and complex, and so such forums need to be responsive and dynamic. For extension services training, this indicates the need to develop an understanding of such processes amongst extension services and others in the agricultural learning system who can also provide contextually relevant knowledge and support in such learning forums or networks.

In the Nkonkobe case, the regularity of the meetings was important. This indicates that there is need to look at possibilities of knowledge hubs, where agricultural knowledge and learning can take place on a regular basis, as these are more likely to be a potential conduit for new knowledge into the local agricultural learning system. Such knowledge hubs have the potential to provide ongoing renewal of knowledge for extension services and can also provide support to extension officers in the form of locally accessible learning forums as was shown to be the case in Nkonkobe.

The case study has also shown that implementation of practices should not just focus on the technical side, but also look at learning processes during the implementation of agricultural practices. Thus, broader recognition of non-technical issues should be taken into consideration and processes of using farmers' experiences in the extension programmes should be recognised as being important. This requires recognising that communities and farmers are heterogeneous; what works in one village might not work in other villages or context and hence extension officers also need to learn to be reflexive and have willing dispositions that will allow them to flexibly address different farmers' needs as was shown to be important in this case study.

This case study has also shown that investing in social skills and capacity support of extension officers can have major impacts on the success of facilitating social processes in the agricultural sector. This shows that extension services also need to be reflexive on how they may hinder or contribute to success of farmers' learning, and hence the need to also invest in social facilitation processes. Importantly, the study has shown that extension officers also need to develop an appreciation for conflict and dissonance as a possible source of social learning. But they must also give enough time and ongoing support to the processes, beyond the initiation stage, to further include the use and maintenance stages.

As shown in this case study, knowledge produced by scientific institutions such as the Water Research Commission can be used to guide practical implementation of policy processes such

as the National Climate Change Response policy. The actual implementation of such policy will depend on circumstances. In the case of the Nkonkobe municipality, the extension services, working with other stakeholders and knowledge partners were able to use knowledge on RWH&C practices to inform policy processes of the Eastern Cape extension services. Through this, climate change policy, water policy and extension service policy was implemented. This shows potential for such processes to be more widely implemented across the province by extension officers in different municipalities. However, as this was only one case context, wider research on this can provide more adequate information of how the province could benefit by including RWH&C in their policies, especially for smallholder farming contexts in dry areas, and in the increasingly uncertain conditions of climate change.

5.4.2 Recommendations for future research

5.4.2.1 Roles of extension services in ensuring sustainability of RWH&C practices

As discussed in Chapter 2, project sustainability is a major challenge in the country. Projects implemented by outside researchers often tend to experience difficulties with sustainability. The implementation of RWH&C practices in this case study context showed a significant improvement as engagement with the farmers was ongoing in the learning group. However, as shown in Chapter 4, the emphasis was more on initiation of RWH&C practices; it is crucial to look at the post implementation of the RWH&C practices as well. This requires further research into the full value chain of RWH&C practices and how they are to be supported by extension officers and others in the learning groups.

As discussed, one of the major roles of extension officers is to link farmers with research based knowledge and to support farmer learning. Research on how they ensure sustainability of RWH&C without external support from the researchers is important as this will reveal how extension encourages local ownership and uptake of these practices and mobilises the department to support continuity of the RWH&C practices in local contexts.

5.4.2.2 Wider range of sites and extension officers

Extension officers work with various villages, in the case of this research, I found that each individual officer works with ten villages. I was not able to follow their practice in all of the villages and hence further research is needed to look at the potential and possibility of

expanding or scaling the knowledge of RWH&C practices to other villages and to establish demonstration sites and work with other extension officers in the province.

5.4.2.3 Importance of social learning for extension in relation to new agricultural extension policy

As discussed in Chapter 2, the policy and history and traditional practices of extension services have created some constraints to change and learning, as the emphasis has mainly been on technological transfer. The new extension policy and Strategic Plan of DAFF (2015), however, recommends social learning approaches. The DAFF (2015) Strategic Plan also notes that the momentum for supporting smallholder farming in South Africa must be increased and other forms of support must improve as well. The DAFF (2015) Strategic Plan for 2015-2020 reaffirms the mandate of the agricultural extension services to foster development of smallholder farmers through improved agricultural production compatible with natural and other resources available to them. It suggests that climate smart and conservation farming approaches need to be expanded, and this implies the need to mainstream RWH&C in extension services systems, and extension approaches. In this case study, I was able to study only the practices of a few extension officers in one learning group or network that made use of social learning approaches, farmers' knowledge, and informal learning platforms and forums amongst extension services, farmers and other stakeholders in ways that was able to enable/trigger institutional change within the extension services showing that both farmers and extension officers can learn through participation and interaction. It will therefore be important to see how social learning can inform policy development and joint practices and collective action on a wider scale in response to these policy shifts being inaugurated by DAFF (2015).

5.5 Critical review of the research process

This small scale case study research journey has been exciting, challenging and iterative. As an Amanzi for Food project team member, my knowledge of agricultural extension characterised with RWH&C for food security, was improved by engaging with literature on the subject and investigation of the case through workshops, field visit observations, interviews and group discussions and analysis thereof using social learning theory. It helped to sensitise me to the phases and processes of social learning, and to appreciate the importance of relationality and dissonance in such social learning processes.

Through the Amanzi for Food initiative I was able to build relationships with the research participants and stakeholders involved in the learning group. This relationship also gave me a chance to view what was actually taking place on the ground and through this, I was able to develop insight into agricultural extension services and how they facilitate service delivery amongst smallholder farmers. My visibility in the community created trust between myself and research participants and hence I did not find any difficulties in acquiring access to research sites and participants.

The document analysis provided rich information on the roles and practices of extension officers and also enabled me to observe and see if these were actually taking place on the ground. Insights into how the social interactions between the farmers and extension officers took place and on the predominant extension approaches being used, were generated using observations. These observations were done during workshops and field visits. This could have been done over a longer period of time, but due to time limitations and budget constraints it was not possible to extend the time on the observations. Upon reflection, it would have been beneficial to have observed other villages to see how extension officers were supporting and facilitating RWHC practices in more villages, but as mentioned above, I have proposed this as a recommendation for further research as I was also not able to do this within the scope of this small scale half-thesis study.

The semi-structured interviews provided rich information on how the extension officers were facilitating and mediating the RWH&C practices with the farmers and also provided good insight into their experiences of being involved in this process. It was encouraging to see how willing the extension officers were to be interviewed and share their work. The focus group discussions enabled me to gather information about the farmers' experiences in learning about RWH&C and how they were working with their extension officers. As mentioned in Chapter 3, the farmers I was engaging with were predominantly isiXhosa speakers and I am an IsiZulu speaker. Fortunately, I could communicate with them in their local language as our languages are similar. They could express themselves in their language and it eased the communication and group discussion between myself as researcher and the farmers.

One of the most challenging parts for me was working out a way of making sense of all the data that I collected and writing it down in an academic format. The writing was the most

challenging phase in my research process. None the less I am satisfied that I collected enough data to meet the requirements of a master's half-thesis. It would have been interesting to spend time observing sustainability of the RWH&C practices and also work with the extension officers to further promote social facilitation processes within the farming communities, but this was beyond the scope of this study which focused on one case study context only.

5.6 Conclusion

As shown in this small scale case study, agricultural extension services can be effective in supporting and facilitating uptake of RWH&C knowledge across farming communities. Extension services can potentially make a contribution towards farmer learning on RWH&C for improved food production, especially if they engage in contextually situated social learning processes as shown in this case study. This study has shown that agricultural extension services can provide learning platforms where farmers are exposed to new ways on knowing and doing, and where extension officers themselves can also be part of the co-learning process, thus also reflexively developing their social facilitation and mediation competences. Such processes can allow them to nurture social learning processes with positive benefits to farmers and agriculture. Overall, this study has shown that supporting and facilitating RWH&C practices using social learning approaches that allow for deframing and reframing around dissonances and shared collective goals could be one of the effective ways for improving household food production and extension officers could consider uptake of the practices. Such a process is aligned with policy recommendations, most of which don't provide good process guidelines. This study has helped to provide insight into the processes that can be followed to establish and understand the social learning approaches that are recommended for working with smallholder farmers in agricultural and extension policy, and that can help with adaptation to climate change and water scarcity. As shown in this study, there are valuable sources of knowledge and information being produced by research institutions such as the WRC. The study has shown the central role that the extension services play in the agricultural social learning system, also showing an approach that can be followed (co-learning in learning groups or networks) to also support the extension services to update their knowledge and develop social facilitation competences while supporting farmers to practically address their needs via productive demonstration sites and the pre-conditions for learning.

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Appendices

Appendix 1: Research access request letter

5 February 2016

TO WHOM IT MAY CONCERN

Dear Sir / Madam

RESEARCH ACCESS REQUEST

Miss Phindile Sithole is a Master of Education student registered with Rhodes University in South Africa, Student Number 15S4678. We kindly request that you grant her access to conduct her research in your area/institution.

Her research seeks to understand the role of extension officers in disseminating information, with specific focus on knowledge of Rain Water Harvesting and Conservation (RWH&C) amongst rural smallholder farmers. She hopes to capture experiences of farmers in the RWH&C learning process and examine if and how these might be constituted as social learning processes.

The research design Ms Sithole intends to use is qualitative, and will allow farmers and extension agents to share their learning experiences via interviews and focus groups. All participants will be requested to give their individual consent to participate in the research.

I therefore kindly ask you to allow Ms Sithole access to conduct her research.

Please do not hesitate to contact me should you require any further information.

Yours sincerely,



Professor Heila Lotz-Sisitka

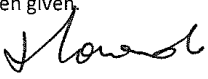
SARChI Chair: Global Change and Social Learning Systems Research

Supervisor

Appendix 2: Informed consent form

INFORMED CONSENT FORM

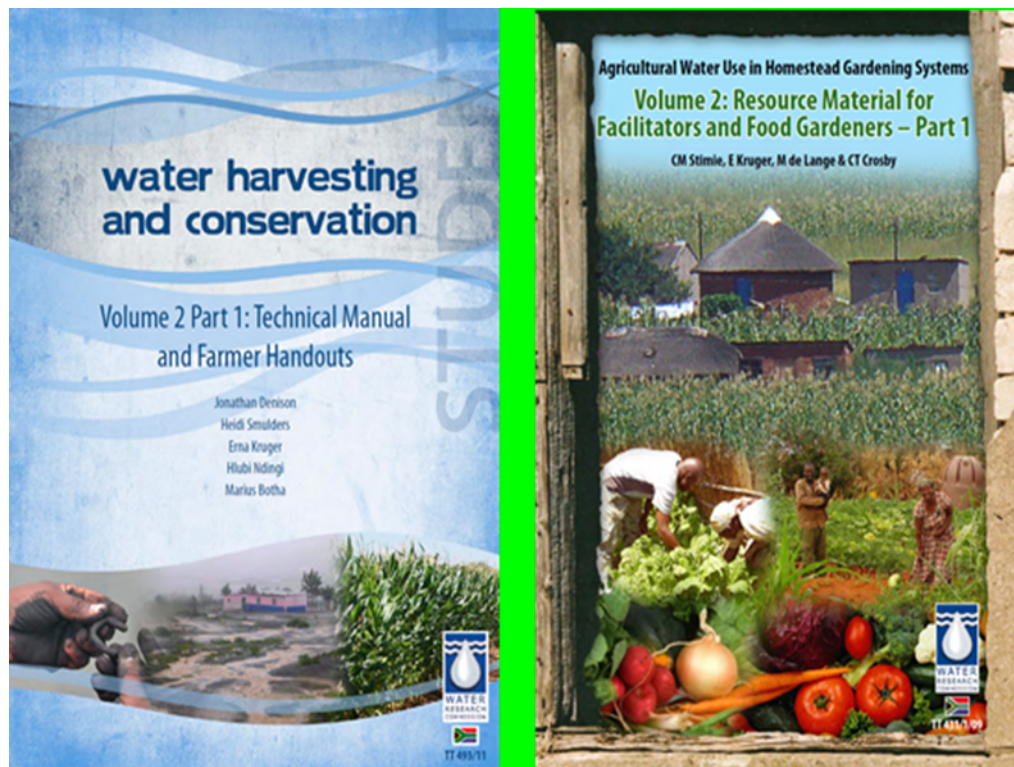
1. Awonke Sonandi (name and surname), understand that I am being asked to participate in a research study conducted by Phindile Sithole of Rhodes University in South Africa. This research study will follow a process that has been described to you in the interview you will or have taken part in. The study is looking at the role of extension officers in disseminating information, with specific focus on knowledge of Rain Water Harvesting and Conservation (RWH&C) amongst rural smallholder farmers. Focus is on capturing experiences of farmers in the RWH&C learning process and examine if and how these might be constituted as social learning processes. The study is made of interviews, focus group interviews and discussions, and will allow farmers and extension agents to share their learning experiences. I will be sharing back the information from the interview through a feedback session where you will check the interview transcription of our interview and validate that it correctly and accurately represents what we discussed and what you shared.
2. I am aware of the benefits of this study, such as providing an opportunity for smallholder rural farmers and extension agents to learn together with the researcher and to share experiences on learning with specific focus on rainwater harvesting and conservation.
3. I also understand that my participation in this study is entirely voluntary, that I may withdraw from this study at any time should I wish to do so.
4. I authorise the researcher to use any professional photographs that include me in her research reports.
5. Please select one: I would like my specific input to
- A. Remain anonymous, in which case the researcher will ensure anonymity following research ethics procedures at Rhodes University, _____ or
 - B. I do not mind if my identity is explicitly revealed in the study as long as it is in line with the research ethics procedures at Rhodes University. X
6. The study has been explained to me. I have read and understood the consent form, all my questions have been answered and I agree to participate. I understand that the research process will continuously provide opportunities for research findings to be shared with the farming and extension support community in Eastern Cape, Nkonkobe local municipality and its environs.
7. By agreeing to participate in the study, I also participate in the feedback workshop process which will be arranged for the farming and extension support community of practice. I am free to ask any questions about the study or about my participation in the research by Ms P Sithole via email, mobile phone or office number which I have been given.

Signature of interviewee: 

Date: 08/02/16

Place: K.V.T.

Appendix 3: WRC materials (including navigation tool mentioned in Fig 4.13)



‘Navigation Tool’ to access information in the Water Research Commission (WRC) Materials

Introduction

This ‘tool’ is designed to help access the critical information relating to Rainwater Harvesting and Conservation (RWH&C) in the 2 key materials:

WH&C – Water Harvesting and Conservation (Volume 2, part 1)

AWHGS – Agricultural Water Use in Homestead Gardening Systems (Volume 2, Parts 1, 2 and 3)

3 Forms of Information

This information can be found in three (3) forms in the materials:

- As Handouts (H)
- As Case Studies or Stories (CS)
- As information in the Text (T)

4 Kinds of Activity or Practice

The Tool is arranged around four (4) different kinds of Activity or Practice associated with RWH&C:

1. General Activities Applicable to and Underpinning Many of the Key Practices
2. Collecting, Reducing Loss and Holding Rainwater
3. Storing Rainwater
4. Using Rainwater for Irrigating Crops

Definition of levels ascribed to the other factors

*Low:

- Technologies – basic gardening equipment;
- Skills and understandings – as required for basic gardening;
- Cost R0 – R1000;
- Maintenance – none or one or two days a year, simple repairs

**Medium:

- Technologies – simple testing or measuring kits, tanks, pipes;
- Skills and understandings – as required for small-scale business;
- Cost R1000 – R10,000;
- Maintenance – regular but infrequent checking/repair, 7 – 10 days/year, technical repairs.

***High:

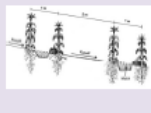
- Technologies – specialised equipment (tractors, mechanical pumps, laboratories etc.);
- Skills and understandings – as required for professional specialists;
- Cost >R10, 000;
- Maintenance – essential regular and frequent checking and repair, up to 50 days/year, complex technical repairs

Much of the information in this Tool is adapted from the Overview of WHC Methods (pages 13 – 18) in Water Harvesting and Conservation, Volume 2 Part 1, Technical Manual and Farmer Handouts

General Activities Applicable to and Underpinning Many of the Key Practices				
Practice (and other names)	Type and Scale (1,2 or 3)	Main Purpose and Description	Other Factors	WRC Materials: Text (T), Case Studies (CS), Handouts (H)
Constructing and using 'A-frame'	Preparatory Activity 1 and 2	To set levels and help mark out contours Constructing a simple tool for assessing levels	*Low technology, local materials, low level skills and understandings, low cost, low maintenance	WH&C (T: Pp115-121 & H), AWHGS (CS: Vol.2, Part1, P2-83 and H: Vol.2, Part2, Chap.5,H1, P5)
Constructing and using a 'line-level'	Preparatory Activity 1 and 2	To set levels and help mark out contours Constructing a simple tool for assessing levels	*Low technology, local materials, low level skills and understandings, low cost, low maintenance	WH&C (T: Pp116,122-123 & H), AWHGS (CS: Vol.2, Part1, P2-83)
Identifying soil types	Preparatory Activity, All	To identify soils appropriate for different RWH&C practices Fairly simple methods for assessing soil types	Low to **medium technology, some specialised materials/equipment, low to medium skills and understandings	WH&C (T: Pp79-108 & H), AWHGS (T: Vol.2,Part3, Pp.6-3 to 6-10),
Calculating slope	Preparatory Activity, All	To calculate the slope of the land Simple method for calculation of slopes	Low to medium technology, some specialised materials/equipment, medium skills and understandings	WH&C (T: Pp113-118 & H), AWHGS (T: Vol.2,Part2, Pp5-38 to 5-42),
Establishing precipitation (rainfall) amounts	Preparatory Activity, All	To calculate the amount of rain falling on the land. Fairly simple methods for rainfall calculations	Low to medium technology, some specialised materials/equipment, medium skills and understandings	WH&C (T: Pp31-33), AWHGS (T: Vol2.Part1, P1-23),
Calculating storage requirements	Preparatory Activity, All	To estimate how much rainwater storage is needed. Quite detailed calculations of storage volume needs	Medium skills and understandings	WH&C (T: Pp158-160 & 163), AWHGS (T: Vol 2 Part 2, Pp 5-80 & 5-81)
Calculating irrigation (watering) requirements	Preparatory Activity, All	Estimation of crop water needs Quite complex calculations for estimating water needs	Medium to ***high skills and understandings	WH&C (T: Pp161-162), AWHGS (T: Vol.2,Part2, Pp 5-70 to 5-79)

Collecting, Reducing Loss and Holding Rainwater				
Practice (and other names)	Type and Scale (1,2 or 3)	Main Purpose and Description	Other Factors	WRC Materials: Text (T), Case Studies (CS), Handouts (H)
Saaidamme (Wadi floodwater system, flood spate) 	Harvest, conserve and use. Floodwater harvesting. (3)	Involves the diversion of floodwater from non-permanent rivers into a series of flat basins which are used for cropping. Diverted water from the flooding river is channelled into the fields and completely submerges the land for 1 to 3 days, where it fully saturates the soil.	Medium to high technology, medium skills and understandings, medium to high cost (depending on scale), medium maintenance	WH&C (T: Pp 169-170, CS: P7)
Dome Water Harvesting (Rock Catchment) 	Harvest, on a large (macro) scale for diversion to where the water is needed (3, possibly 2)	Used to intercept and direct rainwater runoff from impermeable rock domes into a reservoir, or directly to a field where the water is stored in the soil. The method provides valuable drinking water in arid areas. Can be very effective for agricultural use where rock surfaces are located close to agricultural lands.	Low to medium technology, low to medium skills and understandings, low to medium cost, medium maintenance	WH&C (T: Pp167-168)
Ploegvoren (pitting) 	Harvest, conserve and use. Can be done by hand on a small scale for crops. (1 and 2)	Involves creating numerous small, well-formed pits or "imprints" in the soil that collect rainwater runoff, seed, sediment and plant litter. This provides a relatively sheltered microclimate in which seed and seedlings can grow.	Medium to high technology, medium skills and understandings, medium to high cost, low maintenance	WH&C (T: P166)

	Roofwater Harvesting Harvest Mainly used for domestic supply. Surplus can be used in home gardens. (1)	Collecting water from roofs for household and garden use is widely practiced across South Africa. Tanks and containers of all types – from brick reservoirs to makeshift drums and buckets – are a common sight in urban and rural areas.	Low to medium technology, low to medium skills and understandings, medium cost, medium maintenance	WH&C (T: Pp156-165), AWHGS (T: Vol.2, Part2, Pp5-83 to 5-90 and H: Vol.2, Part2, Chap.5, H1, Pp9-11),
	Greywater Harvesting (Recycling, re-use) Harvest Includes the water used for bathing, washing, cleaning, cooking and rinsing. Used in home gardens. (1)	The practice of using non-toilet wastewater produced in a household to water the root zone of the soil. Usually requires some kind of filtering process.	Low technology, low to medium skills and understandings, low cost, low maintenance	WH&C (T: Pp154-155 & H, CS: Pp2-6), AWHGS (T: Vol2, Part1, Pp4-60 & 4-61)
	Fertility pits (banana circles, circular swale) Harvest, conserve and use. Micro-system which can be a soakaway around buildings – to absorb greywater or surface rainwater. (1)	Enables runoff water to be captured and conserved in 1m deep pits that are filled with organic matter such as compost or manure. The organic matter increases the fertility of the soil and minimises the loss of water from evaporation.	Low technology, low skills and understandings, low cost, low maintenance	WH&C (T: Pp124, 151-152 & H), AWHGS (CS: Vol2, Part2, P5-22),
	Terraces (Benches) Harvest, conserve and use. Micro-system used on steeper slopes (1 and 2)	Used in home gardens and smallholder fields. Mainly used in steeper-sloping areas for cropping and orchards. A level strip of soil built along the contour of a slope and supported by an earth or stone bund, or rows of old tyres filled with soil. Terraces create flat planting areas and stabilize slopes which would otherwise be too steep for crop production.	Low to medium technology, medium skills and understandings, low to medium cost (mostly labour), medium maintenance	WH&C (T: Pp148-150 & H, CS: Pp2-6), AWHGS (CS: Vol2, Part2, P5-22)

	Stone Bunds (stone lines, stone banks, contour banks) Harvest, conserve and use. The contour ridges collect water from adjacent slopes. (2, possibly 3)	Rows of tightly packed stones built along contour lines. Used to improve grazing land. Slow down, filter and spread out runoff water. Increase infiltration and reduce soil erosion. Sediment is slowly captured on the upper sides, forming natural terraces.	Low to medium technology, medium skills and understandings, low to medium cost (mostly labour), medium maintenance	WH&C (T: Pp 140-142 & H)
	Swales (Bunds, contour ridges, berm 'n basin, contour ditches) Harvest, conserve and use. Often used with diversion furrows and mulching. (1 and 2)	An earth bank constructed along the contour with a furrow on the up-slope side – this is filled with dry leaves, compost and soil. The top of the earth bank is levelled off to allow planting. The swale intercepts runoff, spreads it out and helps it infiltrate deep into the ground. Used in home-gardens and smallholder fields. Widely used within permaculture systems. Good groundwater recharge.	Low to medium technology, medium skills and understandings, low to medium cost (mostly labour), medium maintenance	WH&C (T: Pp145-146 & H), AWHGS (CS: Vol2, Part2, P5-25 and H: Vol.2, Part2, Chap.5, H1, Pp6-7),
	Tied Ridges (In-field RWH, cross-ridges) Harvest, conserve and use. Can be used with diversion furrows and mulching. (1 and 2, possibly 3)	Built along the contour at 3 m spacings. Crops are planted on either side of the ridge. Runoff from the unplanted area is caught in the furrow and infiltrates into the root zone. Used in home gardens and on smallholder fields; when mechanised, used on a large commercial scale. The system has been fine-tuned to South African conditions, and is called "in-field RWH" in local publications.	Low to medium technology, medium skills and understandings, low to medium cost (mostly labour), medium maintenance	WH&C (T: Pp 143-144 & H),

Gelesha / Infiltration (Ripping)	Harvest, conserve and use. Preparing the ground (All)	Practice of turning the ground ready to receive the rain before planting.	Low to medium technology, low skills and understandings, low to medium cost (depending on scale), low maintenance	WH&C (T: P18)
Diversion Furrows (run-on ditches, run-on or ex field RWH) 	Harvest. Diversion of runoff water onto cropland. Brings water from an external catchment to the field. (All)	Directs rainwater runoff from gullies, grasslands or hard surfaces (such as paths or roads) to a cropped area or to a storage tank. This increases the water available to the plants. Used for fieldcrops and in gardens. Additional water diverted directly to soils and crops. Additional water stored in underground tanks for later watering.	Low to medium technology, medium skills and understandings, low to medium cost (mostly labour), medium maintenance	WH&C (T: Pp 132-133 &H),
Trench Beds (Deep trenching, fertility trenches) 	Harvest, conserve and use. Trench beds are usually connected to diversion furrows, which collect water from adjacent areas and direct it to the trenches. (1)	Trench beds are 1 m wide and 2 m long. They are dug to 1 m deep then packed with dry grass/leaves, compost, manure and soil. Used in food-gardens. Create highly fertile soils which can absorb and store water. Provide an immediately usable planting bed even on shallow or poor soils. Often used with diversion furrows and mulching.	Low technology, low skills and understandings, low cost, low maintenance	WH&C (T: Pp124, 134-139 &H), AWHGS (CS:Vol.2, Part1,Pp28&29, 2-80 and T:Vol.2.Part3, Pp6-59 to 6-63)
Mulching 	Conserve and use, Water conservation method. (1 and 2)	The practice of spreading organic material like compost, straw, manure, dry leaves, grass clippings or wood chips onto the surface of the soil. Can be used on all crops and orchards, not pastures Improves plant growth. Reduces evaporation from the soil surface. Improves soil temperature. Limits weed growth and makes watering easier by protecting the soil.	Low technology (unless plastic sheet mulching), low to medium skills and understanding, low cost, low maintenance	WH&C (T: Pp124, 137-138 & H), AWHGS (T: Vol.2,Part3, Pp6-34 & 6-35),

Storing Rainwater				
Practice (and other names)	Type and Scale (1,2 or 3)	Main Purpose and Description	Other Factors	WRC Materials: Text (T), Case Studies (CS), Handouts (H)
Dams	Harvest and store Simple storage of runoff in purpose-built ponds. (3 and 2)	Generally fairly large-scale storage ponds from which water can be taken for either crops irrigation or used directly for livestock	Medium technology, specialised equipment, medium skills and understandings, medium to high cost (depending on scale)	WH&C (T: P18), AWHGS (Vol.2,Part2, CS: P5-85 and H: Vol.2, Part2, Chap.5,H1, P11)
Matamo/ipitsi (homestead ponds)	Harvest and store. Simple ponds for homestead gardens (1, possibly 2)	Small-scale storage ponds to catch and store surface run-off. Water used for irrigation or livestock.	Low technology, basic equipment, low skills and understandings, low cost, low maintenance	WH&C (T: P18, CS: Pp2-6), AWHGS (H: Vol.2, Part2, Chap.5,H1, P11)
Underground tanks	Store. Tanks located underground to store surface run-off (1, possibly 2)	Relatively small-scale water storage for irrigating small to medium cropping areas.	Medium technology, specialised materials and equipment, medium skills and understandings, medium cost, medium maintenance	AWHGS (T: Vol.2,Part2, Pp5-84 and H: Vol.2, Part2, Chap.5,H1, Pp11-12),
Roof Tanks	Store. Tanks usually above ground to store roof run-off.	Relatively small-scale water storage for domestic use or irrigating small to medium cropping areas.	Medium technology, medium skills and understandings, medium cost	WH&C (T: P158), AWHGS(T: Vol.2,Part2, P5-84 and H: Vol.2, Part2, Chap.5,H1, Pp9-11), V: DVD1

Irrigation Practices				
Practice (and other names)	Type and Scale (1, 2 and 3)	Main Purpose and Description	Other Factors	WRC Materials: Text (T), Case Studies (CS), Handouts (H)
Drip/trickle Irrigation	Low water-use, highly focussed irrigation (All)	Water-saving. Delivers water directly to the plants, most useful for orchards and other long-term crops, but can be used for vegetables.	Low to medium technology, medium skills and understandings, medium cost, medium to high maintenance	AWHGS (Vol.2,Part2, T: P5-95, CS:Pp5-97 to 5-102 and H: Chap.5, H2,Pp3-5)
Buried pipes	Low water-use, reduced evaporation (1 and 2)	Water saving. Delivers water to crop roots. Mainly used in small-medium scale vegetable production	Low to medium technology, medium skills and understandings, medium cost, medium to high maintenance	AWHGS(T&H: Vol.2,Part2, Chap.5, H2,P6)
'Spaghetti lines'	Low water-use. (1 and 2)	Water-saving. Small pipes taking the water from a central pipe to the plants. For orchards or vegetables	Low to medium technology, medium skills and understandings, medium cost, medium maintenance	AWHGS(T&H: Vol.2,Part2, Chap.5, H2,P7)
Sponge lines and string lines	Low water-use. (1 and 2)	Water-saving. A trickle irrigation system, using sponge or sting in the holes in the pipes to reduce water flow.	Low to medium technology, medium skills and understandings, medium cost, medium maintenance	AWHGS(T&H: Vol.2,Part2, Chap.5, H2,Pp7-8)

Appendix 4: Example of Amanzi for Food Project Documents, Agricultural Extension Documents

Example of Amanzi for food project document: K5-2277 Deliverable 2 and Agricultural Extension recovery plan

1 CONTEXT OF EXTENSION ACTIVITIES & TRAINING RELATING TO IRRIGATION WATER MANAGEMENT

1.1 Introduction and overview of this section

As indicated above in Section 1, an important part of any curriculum analysis is to understand who the learners might be, and who the training is to be targetted at, and the context in which such trainees work / find themselves when being sent out to apply / practice their knowledge, as this tends to shape the purpose of a curriculum intervention, especially if the curriculum intends to be 'labour market relevant'. This is an important factor to consider in agricultural curriculum development, as the graduates need to be 'labour market ready' and have the capabilities necessary for practicing effectively following their graduation.

While the agricultural colleges train both practicing farmers and extension officers, we found it useful to begin the curriculum 'learner' focus on contexts of **irrigation extension**, as it is such trainees that would have a strong impact on small holder farmers and their knowledge use in the near future, given the national initiatives to revitalise extension services (draft policy produced by DAF 2013), and also the emphasis on support for small holder farming expansion in the National Development Plan of 2013 which will rely on irrigation expansion approaches at small holder farmer level, and will require inclusion of rainwater harvesting approaches (see Deliverable 2, policy analysis).

Very useful to the development of this section of the Deliverable, was analysis and insights derived from another WRC research report on irrigation extension. The project team were provided by the WRC with the outputs from another WRC project: '*Development of training material for extension in irrigation water management*' (WRC Project no: WRC REPORT NO. TT539/12 (Stevens et al. 2012)) as part of the extended WRC knowledge resource dissemination initiative. This was completed and the outputs developed towards the end of 2012. Volume 1, the Main Report (TT 539/12), contains considerable detail on the context in which extension support for irrigation water management is provided.

As both the WHC and AWUHGS materials are concerned with the use of rainwater for crop production, essentially low-input irrigation, the contextual picture painted by this report is of great value to this project. Although the report: WRC REPORT NO. TT539/12 (Stevens et al.

National framework FOR Extension Recovery Plan



agriculture,
forestry & fisheries

Department:
Agriculture, Forestry and Fisheries
REPUBLIC OF SOUTH AFRICA

Appendix 5: Example of field observation notes

May support visit to Anatole Ben
showcasing of RWHEC practices

arrive @ 8:30/9 am where farmers, extension officers (ORDAE), college lecturers and students arrive with their tools such as cameras, note books and learning materials. The plan for the day is the demonstration of RWHEC techniques implemented by one of the farmers in her homestead garden.

This farmer has been implementing the RWHEC Practices and is now sharing her knowledge and learning with a group of extension officers, college staff, students and NEDA staff.

She takes this group in to her garden. She firstly demonstrate practice called "mulching". She explaining how she collects dead plant matter and uses it to cover her soil and this helps contain soil moisture. She explaining to the group that it one of the practices that is not labour intensive. She then shows them how she mulches her plants and soil.

Appendix 6: Interview instrument to guide semi-structured interviews with participants

Research question: What is role of extension officers in facilitating social learning of RWH&C with rural smallholder farmers in the Eastern Cape?

Sub questions 1: What is the role of extension officers in ensuring knowledge and information is shared between farmers and researchers?

How did you learn about the Amanzi for Food project?

How many years have you been working in the extension services?

What is your educational background?

What are the most important skills, knowledge, competencies required for extension?

What are your daily work activities?

What has been your experience for being part of the Amanzi for Food programme?

What are your experiences in working /bringing together and farmers and researchers?

How is information, knowledge and learning shared between the farmers, researchers and extension?

What are your experiences in working with farmers and researchers mainly on RWH&C?

What is your role in assisting farmers in problem solving particularly water related problems?

How is the relationships facilitated between farmers and researchers.

How do you facilitate process of social interactions and knowledge exchange?

What difficulties and challenges do you encounter with regards to facilitation?

Sub questions 2: What are the farmer's experiences in learning about RWH&C with extension officers?

Sub questions 3: does the information and knowledge sharing reflect social learning processes, and if so how?

What information do you seek from extension officers?

How do you access knowledge and information from extension officers?

How is the relationship between farmers and extension officers?

What have you learnt from extension officers and how do you learn together?

What tensions, conflicts exists between the farmers and extension officers.

How does extension share knowledge, information and engage with farmers?

What have been your experience regarding knowledge and information on RWH&C and how have you engaged with the learning.

Appendix 7: Example of focus group discussions notes

Date: 08 June 2016

Venue: Gwali Village

Focus Group Discussion with farmers.

interviewee7: Morning there are lot of things that we know, in the field we fence for ourselves, we do things on our own we don't hire because we don't have money, this drought is killing us, if there is drought we don't know what to do in our fields, land is hard we don't even have our own tractor we wait for the officers and it also takes once if it hard we can't we struggle there. We don't get supported with inputs and hence we struggle, and we asked them for assistance such as mealies it still hasn't arrived, I am Simon

Interviewer: owk how often do you meet and engage with the extension officer? If you want to meet him is he easily accessible what happens?

Interviewee 7; he does come, in a month he comes usually three times, but most of the time he is busy he is not only responsible for us, he goes to all the places where they need him

Interviewer: as farmers do you get together to learn from each other? Share knowledge and information as farmers or you just have meetings and go? Or you visit each other's garden and fields.

Interviewee: when we got to the gardens we work together, if there are alien invasive we remove them, the people work together, and in the gardens we assist each other and learn from each other.

Interviewer: others how do you learn from each other as farmers, this side is quite

Interviewees: laughs

interviewee 8: here is my hand let me start by greeting you farmers and our visitors , we have been growing food in our local way, nothing has changed too much except officer advising us to remove the weed and also applying fertilizers in our gardens to make our land more productive and produce more mealies and bigger, that what we saw it the only change from our conventional way of farming, the issue of harvesting you asking the correct question with regards to us coming together and learning from each other and help each other, that the only thing lacking, where if one has bigger field being left behind when it comes to harvesting, it still an obstacle , we need to meet and assist each other when it comes to harvesting mealies and also sorting of maize because our hands will be very sore , each person does their own thing and they struggle these are the things are lacking I am Mama Jaunties.

Interviewer: others are there anything you learning with your extension officer? Do you learn from each other or does he come and tell you what needs to be done

Interviewee 6: he doesn't only come and talk he works with us in our gardens and we talk and advice each other he then leaves and we continue with our work, he works with us

Interviewer: others when he comes for examples and tell you to use this type of fertilizer do you take it and use it or you ask him questions regarding those fertilizers.

Interviewee 6: yes we'd ask him, he even knows and tells us how it done, that is why we guarantee him he is always with us he can't go anywhere,

Interviewer: owk others how do you work with your extension officer?

Interviewee 6: as we here we have a committee that goes to meet with him and come here and he also comes and we work together

Interviewer: owk can I make an example here, if you are an individual farmer and you have a problem, so you have to consult the committee before going to the officer or you directly go to the officer? What happens?