The food-energy-water-land-biodiversity (FEWLB) nexus through the lens of the local level: An agricultural case study

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Dissertation presented for the degree of Masters of Philosophy in the Department of Environmental and Geographical Science

University of Cape Town

April 2015

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Abstract

There is a recognised need to turn the abstract concept of resilience thinking into practical action for resource management. This is often difficult as resource management is complex and multifaceted. Nexus thinking attempts to address this by promoting a framework that integrates and coordinates resource management across many different but interlinked resource pillars and sectors. This research focuses on the local level implementation of the food, energy, water, land and biodiversity (FEWLB) nexus framework, and assesses farmers' understanding and implementation of nexus thinking in relation to the support of the Bergrivier Municipality. Agriculturalists (farmers) have been described as significant custodians of natural resources, as they sit in a key position when it comes to implementing and practising sustainable development. There has been little research into the relationship between farmers and local municipalities, or into the role that local government can play in supporting holistic resource management through agriculture. While there are many different actors contributing towards resource management, this research focuses on the agricultural sector within the municipality. Qualitative research methods, including semi-structured interviews, participant observation and surveys, were used to undertake a case study of the agricultural sector within the Bergrivier Municipality. In a context where local government struggles to find its role in supporting socio-ecological resilience, the FEWLB nexus framework offers an opportunity to implement effective planning and policies that could enable more efficient resource use.

Acknowledgements

I would like to acknowledge the people who contributed their time and energy in different ways so that I could complete and submit my thesis.

First of all, I would like to thank my primary supervisor, Dr Gina Ziervogel, for being a strong role model and inspiration. Alongside her own work, she has been able to give consistent support to my project. I have appreciated her advice and guidance throughout the year. Secondly, I would like to thank Dr. Mark New for his time and energy he put into the project and gave me the opportunity to contribute to nexus thinking.

This project would not have been possible without the contributions from the agricultural community, and others within the Bergrivier region. I am appreciative of the time that was given and the kindness I encountered, and am especially grateful to the Wilsnagh and Bryant families for their hospitality.

A special thank you must go out to Jim and Liz Taylor for their enthusiasm and love of helping others. Their advice and contributions were essential for breaking ground and for giving me the confidence to succeed.

To the friends who have stood by me, and who have supported, read and corrected my work, I am always thankful.

The last and biggest thank you needs to go to my parents and family back home, for enabling me to take this opportunity to do my Masters' degree and enjoy Cape Town. Their enthusiasm and support has been endless throughout the years, and I appreciate their eagerness to hear about my work. Home has been a grounding space which I have needed, and I am so appreciative for the sacrifices that my family has made.

Thank you

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List of Abbreviations

FEWLB- Food, Energy, Water, Land and Biodiversity

ACDI- African Climate Development Initiative

BM- Bergrivier Municipality

CSIR- Council for Science and Industrial Research

NDP- National Development Plan

NIP- National Integrated Plan

SIP- Strategic Integrated Projects

SA- South Africa

IPM- Integrated Pest Management

CSA- Climate Smart Agriculture

IWRM- Integrated Water Resource Management

Chapter 1: Introduction

1.1 Calling for resource management

Sustainability is defined as providing services for basic human needs in a way that can continue over time, resulting in less impact on the environment (Winkler et al. 2007). With this in mind, sustainable development has proven to be a complex concept as it deals with multiple stakeholders and a number of different temporal and spatial scales (Zeijl-rozema and Martens, 2008). Sustainability is governed by three main dimensions, namely, economic, social and environmental, therefore highlighting the need for a holistic approach to resource management.

Balancing these three pillars of sustainability, and the complexity of resource management, has long been acknowledged, as indicated below in the quote from John Muir, a naturalist from the 19th century. He described the difficulty of trying to pick out anything by itself, as we find it to be part of a complex system, connected to everything else in the universe (Von Bormann and Gulati, 2014).

> "When one tugs at a single thing in nature, he finds it attached to the rest of the world." – John Muir (1914)

An example of this interconnectedness is the relationship between the world's food, energy, water, land and ecological systems. Energy is needed to treat and transport water and to grow and process food. Water is needed during energy generation and to support both ecological and agricultural systems, while land is required to grow food and accommodate alternative energy developments (Midgley, 2014). Resource management cannot be one dimensional, and there is a need to incorporate the complexity of many interlinked resources into one management framework if we are to achieve sustainability and ensure the natural wealth of the resource base is maintained.

A holistic framework, known as nexus thinking, has evolved in an attempt to integrate and coordinate resource management across many different, but interlinked resource pillars and sectors (Hoff, 2011; Von Bormann and Gulati, 2014). Nexus thinking does not aim to undermine the resource management already in place, but rather looks to strengthen and support existing management through a holistic approach (Ringler et al. 2013).

1.2 Background – Framing the nexus

Nexus thinking has undergone many changes and it is adaptable to different areas (Giampietro et al, 2013). The first nexus frameworks were centred on water resources, and branched off Integrated

Water Resource Management (IWRM) (Midgley, 2014). The application of nexus thinking was expanded by the Stockholm Environment Institute (SEI) to include food, energy and the environment, which were then connected to land and water resources (Midgley, 2014).

Focusing on the Berg River catchment, the African Climate and Development Initiative (ACDI) - through research by Hoff (2011) and the SEI - recognised that land use change and the resulting loss of biodiversity needed representation within the resource management system. Subsequently food, energy, water, land and biodiversity (FEWLB) were identified as being strongly interconnected critical resources (Midgley, 2014). These fall within a natural resource base which is described as being the natural wealth of a country. The interconnection between these nexus resources has led to the development of the FEWLB nexus framework within the Berg River (Figure 1). This conceptual figure has been developed for use in the region to think about the nexus and this study will make use of it to assess the understanding and implementation of nexus thinking at the municipality scale.

Within the Bergrivier Municipality, resources such as water are expected to become more limited due to growing demand and a changing climate (Methner, 2014). Many of these resources are being pushed to their capacity as a result of population growth, urbanisation, globalisation, economic development, politics and human-induced climate change (Midgley, 2014). This increasing pressure highlights the need to understand and deal with the interdependence and co-ordination between natural and human systems, and the need to develop a sustainable management system.

The introduction of the nexus framework within the Bergrivier Municipality does not seek to undermine other mechanisms such as the IWRM, but aims to enhance this integration and make it stronger. The nexus achieves this by using an inclusive and holistic vision in order to allow for sustainable planning and management of the region's resources. These five resources, of food, energy, water, land and biodiversity, are considered to be of equal importance and require equal attention to ensure holistic resource management. Applying the FEWLB nexus strives for greater coordination and integration in the management of resources. The FEWLB nexus will be used as a framework for this study as it enables a vision for integrated resource management, and contributes to system sustainability.

1.3 A Farmer's influential position

Agriculturalists (farmers) are significant custodians of natural resources as they are very influential when it comes to implementing sustainable development (Brown et al., 2010; Källström and Ljung, 2005). This is supported by Council for Science and Industrial Research (CSIR) report which recognised the sheer size and importance of the agricultural sector in South Africa with regard to the

land area that it uses, its use of resources such as water, its impact on the environment and its direct contribution to human well-being (Hancock, 2015).

The agricultural sector is recognised as being a key role player in the development of a green economy, which needs to be in tune with the social, economic and environmental conditions in order to be sustainable (Hancock, 2015).Achieving sustainability is not easy, especially in the agricultural sector which is susceptible to multiple influences which impact on the capability of farmers and other land managers to adopt sustainable farming practices (Brown et al., 2010). Sustainable farming depends on the farmers' skill and ingenuity as managers, on the resources they have access to and on the institutional and policy environment in which they operate (Brown et al., 2010). The challenge faced by farmers is to build the productivity and profitability of their agricultural enterprises without depleting the natural resources, such as soils and water, on which they depend (Brown et al., 2010).

The adoption of sustainable farming practices takes place against a backdrop of uncertainty in markets, climate and resource access, where farmers are constantly adapting to global change(Brown et al., 2010). The capacity of farmers to adopt sustainable farming practices and adapt to this global change will influence the success of the nexus framework(Brown et al., 2010). As stated by Källström and Ljung (2005), "If farmers are not satisfied with their situation or motivated to continue farming, many of today's environmental goals will be impossible to achieve"(p. 376). This highlights the need for a supportive system that can incorporate the agricultural sector into sustainable resource management.

1.4 Holistic resource management within a government structure

The South African government is in charge of establishing long term policies and plans for the sustainable use of resources and for enabling the implementation of legislative frameworks that allow for social and environmental safety nets (Bach et al. 2012). Local governance systems are often the closest entities for planning and implementing management strategies which should consider the particular geographic and social context of the area (Pasquini et al. 2013). This is further acknowledged by Ziervogel and Parnell (2014), as they recognise that municipalities play an important role in multi-level governance because of their link to the local and national scale. There are opportunities in which municipalities are able to support farmers and enable better resource management. It is for this reason that this research is applying the FEWLB nexus at the local government scale for the Bergrivier Municipality.

The FEWLB nexus opens the door to significant opportunities in achieving the national goals, as there is strong evidence for the need to protect ecosystem services with the recognition of ecological infrastructure in the 19th Integrated Strategic Project (SIP 19), and to work towards a green economy. The importance of this ecological infrastructure has recently been recognised by the National Development Plan (NDP) for South Africa, which called for a 19th Strategic Integrated Project (SIP 19) for investment in ecological infrastructure for water security (Republic of South Africa, 2014). SIPs originally focused on the built environment, but in fact it is biodiversity and ecosystems that allow for the resources to be drawn on, and that gives development stability (J. Taylor, personal communication, January 2015). This shows the importance of ecological infrastructure for the development and progression of South Africa. If South Africa can look after its ecological infrastructure, then a sustainable future could be possible (J. Taylor, personal communication, January 2015). Although South Africa has extensive resource management in place, such as the National Water Resource Strategy (NWRS), there is a need to reach deeper, and realise the interconnectivity of many resources in a management scheme (Hoff, 2011).

This need to generate better planning and implementation of supporting policy is also motivated by climate change. The National Climate Change Response Strategy supports both top down and bottom up approaches, which must both be adopted and informed by local government and their communities (Bergrivier Municipality, 2015). The 2015 Bergrivier Municipality IDP recognises that the municipality's local economy is driven largely by agriculture, and recognises the potential impact that climate change may have on the agricultural sector in the region. This illustrates the municipality's vested interest in collaborating with farmers for better resilience.

Land managers' inclusion in resource management is seen as fundamental, as they play a pivotal role in connecting policies to implementation on the ground, and it is essential that adequate support is available. Municipalities have been identified as being best placed to facilitate this support, and are therefore responsible for ensuring that, with growing pressures on natural resources, agricultural management is effective, efficient, inclusive and collaborative.

1.5 Aim and objectives

In light of the South African National Development Plan (NDP) and the 19th Strategic Integrated Project (SIP 19), the following research question and affiliated objectives are examined in order to better understand (from an agriculturalist perspective) the potential for the FEWLB framework to promote effective, efficient, inclusive and collaborative resource management within the Bergrivier Municipality.

Aim: To assess farmers' understanding and implementation of nexus thinking in relation to resource management in the context of the Bergrivier Municipality.

In order to achieve this aim the following objectives were established:

1. To investigate how farmers engage with water, energy, food, land and biodiversity within the nexus framework in the Bergrivier Municipality.
2. To investigate farmers' understanding of how resources are governed in the Bergrivier Municipality
3. To identify the barriers farmers face in accessing support for resource management from the Bergrivier municipality
4. To identify the external drivers that impact on farmers' holistic resource management

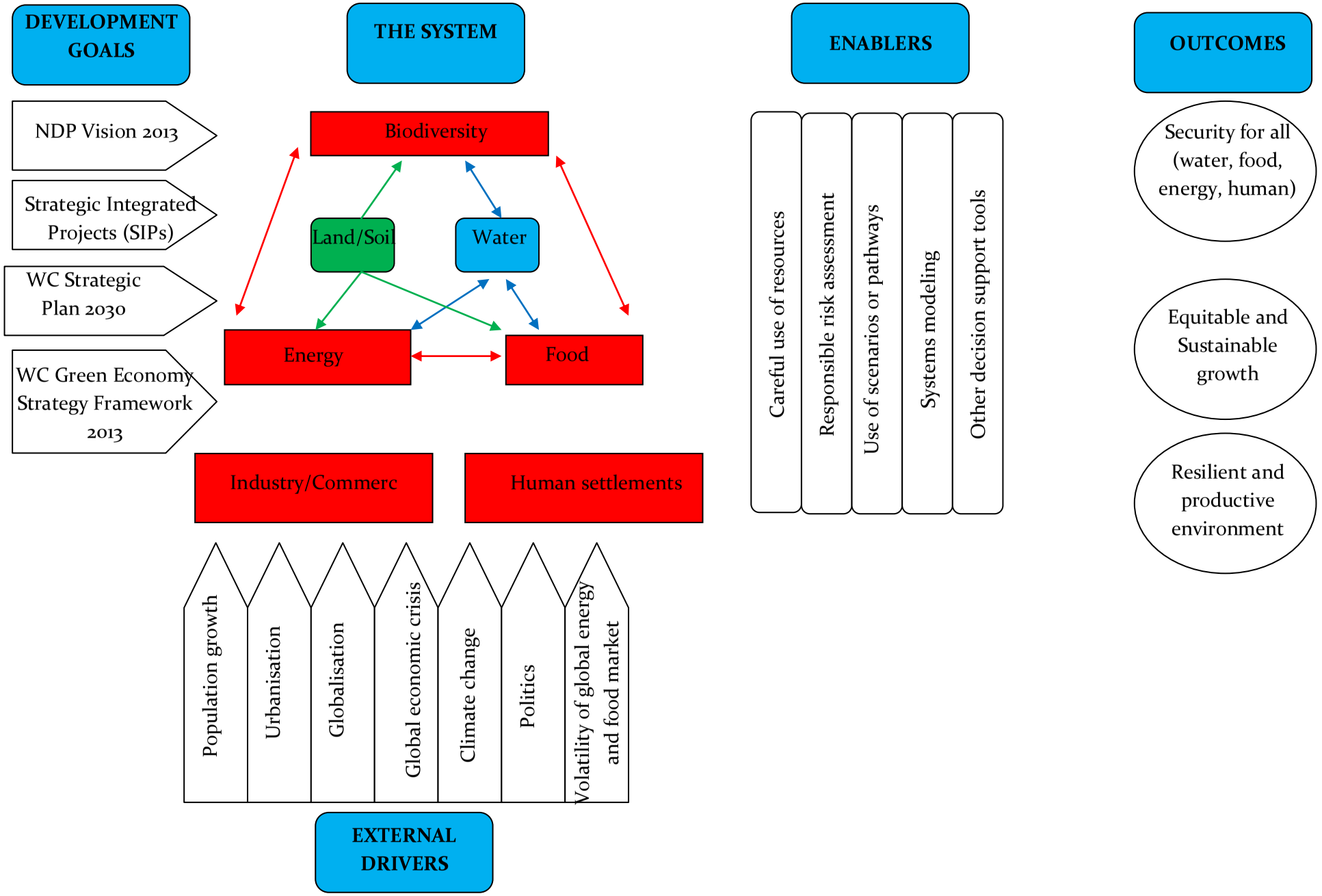

Figure 1: Diagrammatic representation of the broader FEWLB nexus framework (Midgley, 2014)

Chapter 2: Literature review

This literature review is comprised of seven sections which look at resilience thinking; applying resilience thinking; the nexus contribution to sustainability and resilience; the role of local governance in supporting resource management; the municipal mandate; governance of the nexus scale; and building resilience at the local level. Through this literature review, this study hopes to ground the farmers' understanding and implementation of nexus thinking in relation to the support of the Bergrivier Municipality in the literature surrounding resilience thinking.

2.1 Resilience thinking

There are growing concerns about the sustainability of the current global socio-ecological system, given the increasing pressure of a growing population and climate change (Biggs and Schoon, 2014). This creates substantial uncertainties that have given rise to a variety of new perspectives, such as the resilience approach, which falls within the broad category of sustainability science (Biggs and Schoon, 2014; Folke et al. 2010; Funtowicz and Ravetz, 1999). The Stockholm Resilience Centre has completed numerous studies related to social-ecological system resilience, and the definition they give is: "A coupled system of humans and nature that constitutes a complex adaptive system with ecological and social components that interact dynamically through various feedbacks" (Simonsen, et al. 2013). The resilience approach recognises that humans are no longer seen as the external drivers, but are deeply integrated within complex interactions among actors, institutions and ecosystems across multiple scales (Biggs and Schoon, 2014; De Villiers et al. 2014; Ostrom, 2009; Simonsen, 2013; Walker and Salt, 2012).Because human society is dependent on the environment for a variety of ecological services, the resilience approach is directed at the management of social-ecological systems (Biggs and Schoon, 2014). As found by Folke et al. (2010), the resilience approach focuses particularly on the capacity to deal with change, and may seek to fundamentally transform social-ecological systems in a proactive way (Biggs and Schoon, 2014; Folke et al., 2010).

Resilience thinking offers a shift away from negative perceptions of change. This is highlighted by Holling (2001), who offers a way of identifying the points at which a system is capable of accepting change. In this view, change is an inherent characteristic of social-ecological systems and it should not be seen as something negative that has to be avoided (Biggs and Schoon, 2014; Holling, 2001). These changes offer opportunities for renewal and improvement. Hagmann (2002) recognised that sustainability involves change, and we have to enable flexibility across a diverse range of sectors in order to achieve this. Resilience thinking has emerged as one conceptual framework through which

to understand change and multiple cross-scale interactions in social-ecological systems (Plummer and Armitage, 2007).

Research into social-ecological resilience has seen rapid growth in the last two decades (Berkes and Folke 2000; Berkes et al. 2002; Bodin et al. 2011; Boydand Folke 2011; Walker and Salt 2012; Norberg and Cumming 2013; Galaz 2014; Biggs and Schoon 2014). This literature has focused on developing a greater understanding of social-ecological systems; although in the past it leaned more towards ecological systems than social ones (Biggs and Schoon, 2014). This fast growth in the field of social-ecological resilience has sought to provide practical guidance to decision makers and practitioners, where there is clearly still a gap between resilience theory and action. Although there is a lot of literature on the topic, there are still limited practical solutions for increasing resilience. This is as a result of a heavy reliance on theories and little practical research (Biggs and Schoon, 2014). One reason for this is the diversity of the factors involved, as social-ecological systems cover an immense area of potential research. The integration of the social with the ecological introduces complexities of its own, as humans have been described by Ritchey (2013) as "the most complex adaptive systems that we know of". This means that anything that interacts within the social sphere will become complex, giving rise to issues that we can regard as 'wicked problems'. Wicked problems are ill-defined and ambiguous, and are associated with moral, political and professional questions (Ritchey, 2013).

2.2 Applying resilience thinking

Applying resilience thinking in an effective manner has been a challenge, due to the complexity of the concept, as well as the difficulty in putting it into practice (Schwarz et al. 2011; de Villiers et al. 2014). Creating resilience relies on an adaptive capacity to enable fluent and constant change. Holistic management is an example of how capacity building and resilience thinking can be used as tools to allow social-ecological infrastructure to reach its full potential in a sustainable manner. This is opposed to traditional management concepts, also known as command and control approaches, which have been criticised for increasing social-ecological systems' vulnerability to shocks and stresses (Gunderson, 2000; Berkeset al. 2002; Walker and Salt, 2012). These traditional management techniques, also called single state management, have been said to exacerbate degradation by impacting on the elasticity of social-ecological systems (de Villiers et al., 2014; Gunderson, 2000).

De Villiers (2014) gives holistic management as an example for generating action from theory. Holistic management is a decision making framework which emphasises the integrated nature of social-ecological systems, and establishes key principles that seek to build resilience (de Villiers et al.,

2014; Savory, 1999). Past holistic management research has been limited, but there has been a recent surge of interest with regards to controversial grazing principles put forward by Allan Savory and the Savory Institute (Holechek et al., 2000; O'Connor et al. 2010). Briske et al. (2014) recognise the lack of research on holistic management beyond grazing principles, and emphasise the need for more research.

The application of resilience thinking has been broadened, for example by Climate Smart Agriculture (CSA), where researchers recognise the significant transformation that agriculture must undergo in order to meet the related challenges of achieving food security and responding to climate change (FAO, 2010). Climate Smart Agriculture is situated in holistic management, as it involves managing and combining variables such as soil and nutrient management, water harvesting and use, pest and disease control, improving ecosystem management and biodiversity, and the preservation of genetic resources. Conservation agriculture is also a form of climate smart production, and is a term used to include farming practices such as: minimal mechanical soil disturbance, maintenance of mulch and rotations of crops. Integrated Pest Management (IPM) is a school of thought that has been used to contribute to Climate Smart Agriculture and to the application of resilience thinking. IPM is based on a natural farming process, where natural predators are used to reduce pests, organic matter levels are managed to retain nutrients, and the farm system is designed to reduce waste (Risser, 2014).

Through this, it is clear that holistic management has not been limited, and can be found in new areas of application. Holistic management is a core foundation for nexus thinking, contributing to a range of management techniques. As stipulated by Risser (2014), a key factor determining these management techniques is the current economic situation, which allows for two options. The first management option would be for farmers to become more intensive, with large-scale agricultural systems where natural processes are minimized. The second is to use more gentle approaches, such as those involving IPM, and to retain many natural control processes. The more intensive approach has been favoured in light of feeding our growing population, but it involves undoing the natural stability of the environment.

2.3 The nexus contribution to sustainability and resilience

Nexus thinking has emerged in the last five years out of a need to combine all scales of management across multiple resources, and thus it embraces holistic management (Ringler et al. 2013). Nexus thinking requires a shift away from single channel forms of thinking, as the nexus is about relationships across resources. Much of the literature calls for cooperative governance, unique partnerships and new forms of dialogue for effective management of resources (Von Bormann and

Gulati, 2014; International Conference: Sustainability in the water-energy-food nexus, 2014; Hoff, 2011; Granit et al., 2012; Lawford et al., 2013). However, there is seemingly limited literature addressing the local level management of resources. Furthermore, the literature that does exist, focuses more on the top-down approach, rather than bottom-up.

The nexus approach calls for governance which is reliant on an integrated approach to policy, planning, management and development, as well as institutional capacity (Von Bormann and Gulati, 2014). The linkage between policy and science communities has been known to be difficult, as policies may hinder the development of solutions for global environmental change (Van Kerkhoff, 2014). As an alternative, a range of diverse knowledge needs to be brought together to address complex sustainability challenges, including contributions from local stakeholders (Van Kerkhoff, 2014). As Holgate (2007) argues, this will ensure that the required material and intellectual resources are available to deal with the problem.

2.4 Role of local governance in supporting resource management

In South Africa the national government departments exercising functions that involve the management of the environment are: the Department of Environmental Affairs and Tourism, the Department of Water Affairs and Forestry, the Department of Minerals and Energy, the Department of Land Affairs, the Department of Health and the Department of Labour. Water resource planning is an example of a national competence, and municipalities are tasked only with service delivery and infrastructural issues. The Water User Associations are the critical local forums for participation by agriculture. Similarly, agriculture and environment are joint national and provincial competences, but with a recent growing trend towards the devolution of some responsibilities to the local level – for example through the Western Cape Land Use Planning Act 2014. An examination of the municipal planning documents (Integrated Development Plan (IDP), Strategic Development Framework (SDF) and Local Economic Development (LED) is useful for assessing the level of planning and action (and where the mandates/priorities lie) with respect to the Agricultural, forestry and fishing sector.

The Bergrivier Municipality IDP recognises that agriculture, forestry and fisheries were the municipality's biggest employment sector until 2009, when wholesales and trade and catering and accommodation took over. Both the IDP and SDF recognise the large number of jobs lost (11277) in agriculture, forestry and fisheries. Yet the LED recognises the large responsibility of agriculture for supplying secondary employment opportunities, such as packing, bottling and processing jobs. The IDP, SDP and the LED all identify the importance of agriculture as an economic driver within the

Bergrivier Municipality's economy. It was recognised that the Bergrivier Municipality should focus on ways in which to support this sector (Bergrivier Municipality, 2014b).

2.5 The municipal mandate

The environment is both a national and provincial competency in terms of Part A of Schedule 4 of the Constitution. Section 23 of the Municipal Systems Act (2000) requires that municipalities work together with other organs of state to contribute to the protection of the environment. The Bill of rights (Section 24) states that:

"Everyone has the right-

a) To an environment that is not harmful to their health or well-being; and,
b) To have the environment protected, for the benefit of present and future generations through reasonable legislative and other measures that;
    i. Prevent pollution and ecological degradation
    ii. Promote conservation
    iii. Secure ecologically sustainable development and use of natural resources while
c) Promoting justifiable economic and social development."

One of the key roles of government in driving social-ecological resilience is establishing long term policies and plans for the sustainable use of resources. Through this, the government lays the foundation for the implementation of legislative frameworks that allow for development of social and environmental safeguards with which to protect long term sustainability (Bach et al., 2012). Resource management has been dependant on the Conservation of Agriculture resource Act no. 43 of 1983 (CARA) (Hancock, 2015). CARA has enabled the foundation for other legislation such as the Western Cape Land Use Planning Act 3 of 2014, the National Environmental Management Act (NEMA), the Environmental Impact Assessment (EIA) Legislation and regulations as well as the National Water Act and the National Water Resource Strategy (NWRS). Resource management at the local level has relied on the local government's initiative through plans and policies. The South African Constitution and government policy give local government the mandate to provide services and infrastructure that are necessary to meet the basic needs of poor communities and to connect community-led development to national development objectives (Department for Cooperative Governance and Traditional Affairs, 2009). Local governments also carry the responsibility of planning and implementing adaptation strategies in the face of a changing climate (Pasquini and Shearing, 2014). Pasquini et al. (2013) recognise how local governance systems are often the most appropriate entities for planning and implementing adaptation strategies. Ziervogel and Parnell

(2014) found that many municipalities do not see adaptation to climate change as a local government mandate, as there is no budget allocated for this. But rather municipality works in partnership with various organs of state and private institutions to ensure that it gives effect to its environmental obligations.

With regard to climate change, the South African government has acknowledged the evidence that climate change is a reality, and it supports a coordinated response by all spheres of the government, the private sector and the broader public. The National Climate Change Response Strategy includes not only a top-down approach, but also a bottom-up approach that is informed by local government and their communities (Bergrivier Municipality, 2015). As the Bergrivier Municipality's local economy is driven by agriculture, and by a concern about the impact of climate change on farming, the municipality has an vested interest in collaborating with farmers for better resilience. Ziervogel and Parnell (2014) recognise municipalities as playing an important role in the micro scale as well as in multi-level governance. This is as a result of the municipalise link to the local and national scale working with, for example the Department of Agriculture to achieve the goals of the IDP, LED and SDF. The Land Tax of 1998 gave Local Government a new revenue source that could enhance accountability and good governance at the local level, and allows for revenue transfer from central government to the municipality allowing for greater independence at the local level (KATZ Commission, 1998).

2.6 Governance of the nexus scale

Within a holistic nexus approach to social-ecological systems there are different perspectives on governance. Conservation biology encourages the management of landscapes at a large scale, while, in contrast to this, sociological approaches to conservation emphasise the importance of ownership, collaboration and stewardship at scales relevant to the individual or local community (Wyborn and Bixler, 2013). The appropriate scale for governance is not self-evident, but is rather socially and politically constructed (Brenner, 2001; Bulkeley, 2005). This introduces the debate of whether to apply the nexus framework to the catchment ecological scale, or to the municipal social scale.

There is a tension between these scales of operation, and the success of large scale conservation often depends on the individual actions at a smaller scale (Saunders and Briggs, 2002; Wyborn and Bixler, 2013). As stipulated by Berkes (2004), cross-scale conservation has to be planned bottom-up rather than top-down, because it makes sense to start solutions at the lowest organisational level possible (Berkes, 2004; Ostrom, 1990). This calls for a governance system which acknowledges both the small and large scales, and that works as an integrating mechanism. The role of municipalities is

vital here, as they have the means to access the lower levels of governance as well as higher government tiers. In the past, the role of the government, in terms of who should undertake what activities and at what level, has been contested (Wyborn and Bixler, 2013). Hoff (2011) acknowledges the lack of strong regional institutions for integrated management and governance across the nexus. A major finding for Lawford et al. (2013) was that issues experienced by the nexus can be strongly influenced by difficulties in governance. Through collaboration between relevant authorities and stakeholders, combining solutions for more efficient resource (Bach et al., 2012).

2.7 Building resilience at the local level

Understanding the relationship between municipality and farmers is essential in order to critically examine the governance of social-ecological resilience. Strong governance of socio-ecological systems is essential for effective resource management and for building resilience (Faysseet al. 2013). Folke et al. (2005) suggest that social-ecological governance has in the past focused only on single issues or resources, and that there is now a need to expand this vision in order to enable integrative resource management, or nexus thinking.

Weak governance occurs when there are weak interactions between the actors who use natural resources, and the actors in charge of managing these resources (Faysse et al., 2013). These weak relations lead to insufficient management of natural resources and often stem from one or more of the following characteristics of the social-ecological system: 1) the actors' limited capacity to interact with others; 2) the actors' limited interest in being involved in the management of the social-ecological system, and limited trust between the actors concerned; and, 3) difficult and costly implementation of direct control of natural resource use (Faysse et al., 2013).

There is little guidance on how to improve weak municipal governance of social-ecological systems. Faysse et al. (2013) propose that this can be achieved through social learning. They define social learning as a process of communicative action, whereby multiple actors collectively learn about and develop an understanding of one another's interests, concerns and preferences through dialogue and deliberation. This can decrease participants' negative assumptions and increase understanding of the issues involved (Muro and Jeffrey, 2012). Social learning can build trust among stakeholders, as well as improve natural resource management.

2.8 Conclusion

The above literature shows that it is very difficult to convert resilience thinking into practical action. Recent research in the nexus field suggests that nexus thinking can help to provide a focus for

holistic management. However, as the review has shown, there is limited evidence of cooperation and collaboration between municipalities and the agricultural sector, in spite of their mutual dependence – as recognised in the IDPs, SDFs and LEDs. There is a gap in the literature as to how municipalities are supporting agriculture, particularly in South Africa. In addition, there is limited focus on how municipalities are supporting policy and practice around nexus thinking. This research aims to speak to this gap, and explores the question of what is the role of municipalities in supporting nexus thinking in the agricultural sector.

Chapter 3: Methodology

Chapter three outlines the methodology used to assess farmers' understanding and implementation of nexus thinking in relation to the support they receive from the Bergrivier Municipality. The chapter begins with a description of the study site i.e. the Bergrivier Municipality, the geography of the area and the type of farming which occurs in the region. The research approach, research design and data collection methods are then discussed. This chapter concludes by looking at the methods of data analysis as well as limitations and biases.

3.1 Study site

3.2.1. Bergrivier Municipality

The Bergrivier Municipality is a Category B (local, non-metropolitan) municipality situated in the West Coast District of the Western Cape Province (Haiden, 2014). The municipality covers an area of 4407 square kilometres, with a population of 56,000 people. It has a high poverty level of 33% which impacts on the well-being of the community and the sustainability of the Municipality (Bergrivier Municipality, 2014a). This poverty line is established through 11 poverty criteria such as access to education, health, sports and recreation, local economic development, safety, financial and government services, communication, transport, basic services and housing. While the agriculture, forestry and fishing sector has always been regarded as the Municipality's dominant employment sector, this changed in 2009 when the wholesale and retail trade, catering and accommodation sector became the largest employer (Bergrivier Municipality, 2014b). Between 2000 and 2011, a total of 11,277 jobs were lost in the agriculture, forestry and fishing sector, which now only employs 2,624 people. Agriculture nevertheless remains an important driver of the Bergrivier economy, and in the Bergrivier Municipality Annual Report (2015) they highlight the need to continue supporting the agricultural sector.

3.2.2. Geography

The Bergrivier municipality falls within the Berg River and Olifants River catchments. Much of the southern border of the municipality follows the Berg River, and to the north it stretches as far as the Olifants River Mountains. The geography of the Bergrivier Municipality is made up of the eastern mountains, the central mountain (Piketberg) with its unique "Inselberg" bioclimatic features with water resources, the dry eastern plain and the western coastal plain (Sandveld). These variations, the diversity of soils, and the altitudinal and rainfall gradients in the region, support strong biodiversity (Haiden, 2014). There is a wide variety of mammal, bird and invertebrate life, and there

are 21 different vegetation types concentrated around the mountains (Haiden, 2014). The Bergrivier municipality is situated at the transition zone between two ecologically highly significant biomes, the Fynbos and Succulent Karoo biomes (Archer et al., 2009). Furthermore, the Verlorenvlei Ramsar wetland is an important site for biodiversity and is a wetland system of international significance.

Figure 2 shows the annual rainfall for the Bergrivier region taken from 2000-2012. As can be seen, the region is semi-arid with a Mediterranean climate, which receives its rainfall in the winter months. The summers are known to be hot and dry, which places stress on the water resources available to the farmers and the town (ICLEI, 2010). The annual average recharge of ground water has been estimated as 233 Mm^3/annum, based on the Groundwater Recharge Assessment of the Department of Water Affairs and Forestry (DWAF) (Archer et al., 2009). Future climate predictions suggest a shorter rainfall period in winter, with an increase in the average temperature (ICLEI, 2010). This is likely to result in a higher level of water stress in an already water-scarce region.

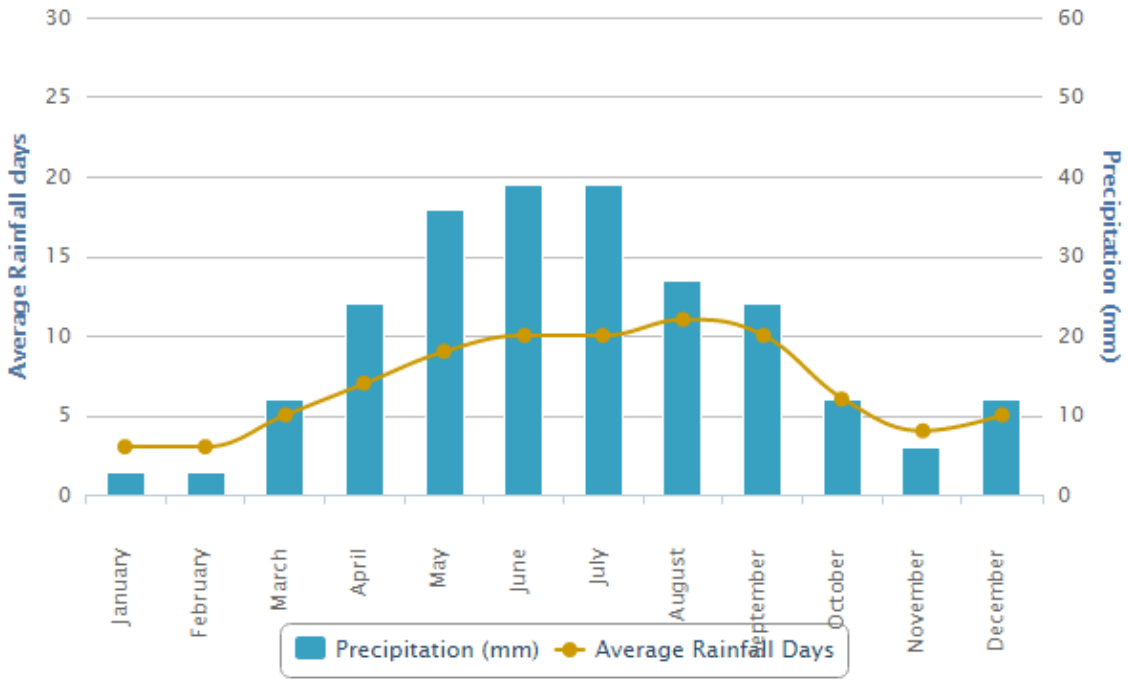

Figure 2: Average annual rainfall for Bergrivier (World Weather, 2012)

3.2.3. Agriculture

Extensive (dryland) farming takes place on the western coastal plains as well as the inland eastern plains where there is wheat and canola cultivation. Extensive agriculture involves small amounts of labour and capital in relation to the area being farmed. The crop yield depends on the natural fertility of the land and the availability of water. Extensive agriculture produces a lower yield per unit

of land compared to intensive agriculture, and its commercial viability requires large quantities of land. This is in contrast with the intensive (irrigated) fruit, flower and vegetable farming on the mountain slopes in the Bergrivier Municipality. Intensive agriculture employs large amounts of labour and capital. It requires the application of fertilizers, insecticides, fungicides and herbicides, as well as mechanised planting, cultivation and harvesting. The optimal use of these materials and machines produce significantly greater crop yields per unit of land than extensive agriculture, and therefore requires smaller land units.

Due to the significantly low rainfall and nutrient-poor soils in the area, commercial scale intensive agriculture requires high volumes of ground water abstraction and the application of fertilizers (Archer et al., 2009). Agriculture is by far the largest water use sector in the Bergrivier (Archer et al., 2009).

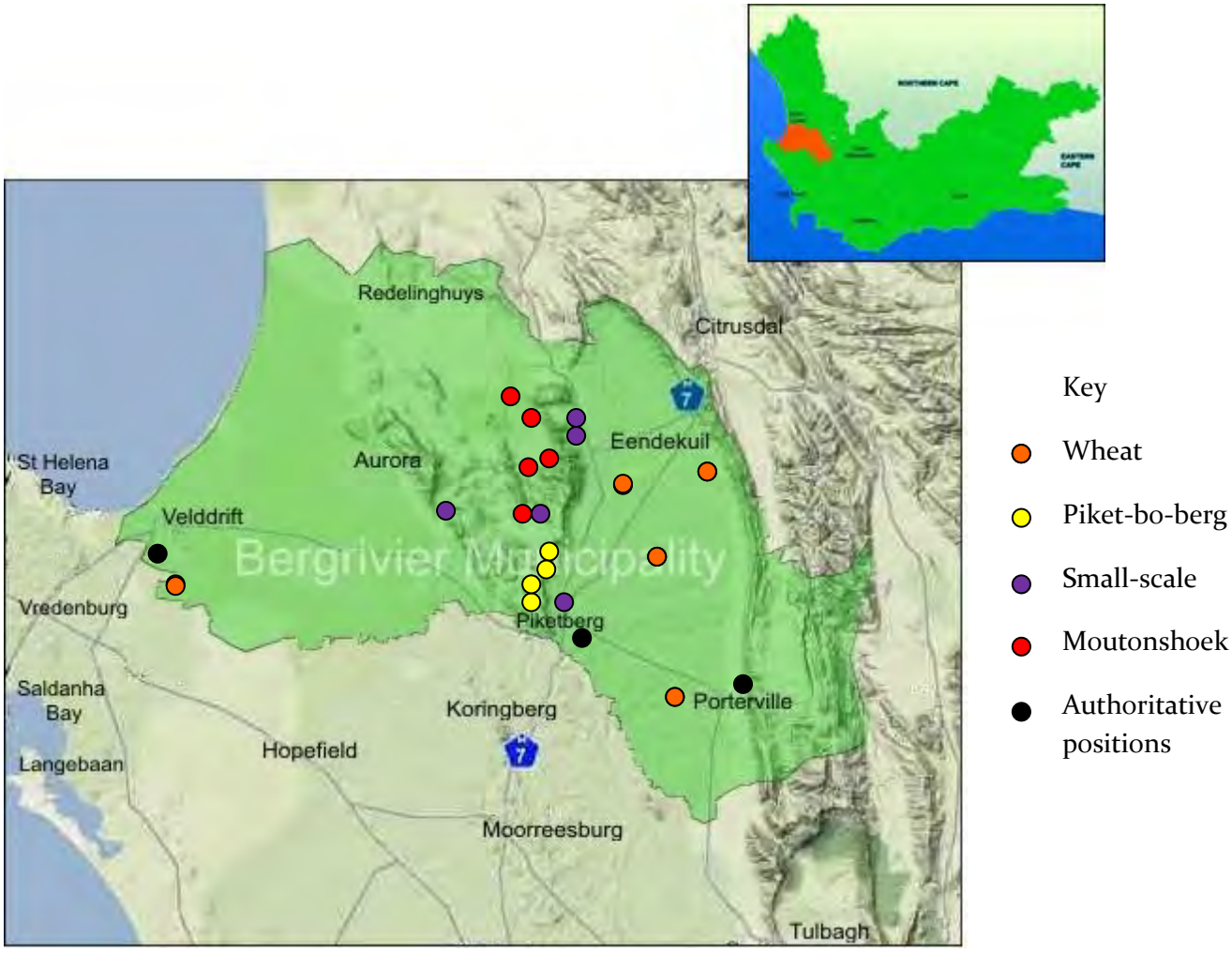

Figure 3: Distribution of the different categories of interviews within the BergrivierMunicipality(Bergrivier Municipality, 2013)

Figure 3 shows the geographical location and extent of the Municipality, and also indicates the distribution of the interviews that were carried out for this study. Through this distribution, it is clear to see the different categories of farmers who were interviewed. Interviewees included a selection of the wheat farmers, the farmers on top of Piket-bo-berg, the small-scale farmers, farmers in Moutonshoek valley and then the people in authoritative positions such as Municipality, Department of Agriculture and Cape Nature.

3.3 Research Approach

In order to allow for the views, experiences and opinions of the interviewees to be explored, the study made use of a qualitative research approach as the context requires interpretation rather than quantification (Creswell, 2003; Kohlbacher, 2006). This allowed for open and flexible answers, and enabled complexity to be captured, as well as the examination of unexpected issues and aspects (Wyborn and Bixler, 2013). Qualitative research does not claim to gain a representative sample or generalized results pertaining to a broader population. Instead, in-depth interviews provide valuable insight into the perceptions and interpretations of selected individuals (Wyborn and Bixler, 2013).

3.4 Research Design

3.4.1. Case study approach

This project followed a single case study design in order to assess the farmers' understanding and implementation of nexus thinking in relation to the support of the Bergrivier Municipality. Case studies allow for in-depth analyses within a real life context which enable the complexity surrounding the context to be captured (Creswell, 2003; Kohlbacher, 2006; Yin, 2013). The advantage of using a single case study is that it allows a thorough and detailed enquiry into the observed phenomenon (Yin, 2013). The single case study makes possible a rich and in-depth assessment, which then contributes towards a holistic account of patterns and interactions between the identified actors. This provides context-specific knowledge which helps to improve the understanding of complex relationships and is therefore an appropriate method for depth analysis. The single case study approach gave insight into the wider context of the farmers' understanding and implementation of the nexus, even though they were not aware of the concept of nexus thinking.

Yin (2013) acknowledges the need to select a representative case study that can either communicate, or challenge existing theories, and that allows for a comparison with other case studies. The relevance of farmers' understanding and implementation of nexus thinking in the

relation to the support of the Bergrivier Municipality is not unique, but represents a question that is applicable to agricultural communities in municipalities throughout South Africa, and across the world. This gives the study an opportunity to be repeated elsewhere and to allow for comparative analysis.

There are two main challenges when dealing with a case study: firstly, it is difficult for the researcher to remain objective as the case requires intensive engagement; and secondly, the amount of data and information received is often overwhelming, which means that careful attention needs to be given to the research objective throughout the study. With regard to the first challenge, it must be recognised that scientific inquiry is never completely neutral. Therefore it was essential to be aware of this and remain transparent and impartial as far as possible (Methner, 2014).

3.4.2. Motivation for the Semi-structured interview

Semi-structured interviews are useful to explore complexity and allow for in-depth understanding of a situation through a conversation (Creswell, 2003). Although the conversation is directed by the interviewer, there is room for the interviewee to talk more freely (Creswell, 2003). Semi-structured interviews were used in this research to explore the opinions, views and experiences of people in the agricultural sector within the Bergrivier Municipality. This is similar to the methods used by De Villiers et al. (2014) and Midgley (2014). These semi-structured interviews were supplemented by contributions from farmers made in the 6 forum meetings attended highlighted in section 3.4. After the first phase of analysing the data, a follow up survey was created to validate the results and findings. The follow up survey targeted past participants as well as the farmers attending the forums.

Initially the interviews were intended to be more structured, but due to the variety of knowledge around the farmers' implementation of an integrated approach to resource use and management, the interviews became semi-structured with the original questions forming a guideline. The interview was made up of four sections. The first section dealt with the farmers' current understanding of nexus thinking and relates largely to the first research objective. These were introductory questions, providing a general overview as well as probed deeper into the farmers understanding of nexus thinking in order to explore how the nexus resources interact and affect the farmer. This was important in order to gain an understanding of the resources in the area and the challenges that the different farmers are facing. Section 2 of the interview entailed establishing a baseline of information indicating the current thinking and practice of farmers in relation to the resource management actor network. Section 3 dealt with the relationship that the farmers have with the municipality regarding resources, and to establish a base understanding of the current nature of these relationships. This section was particularly concerned to assess whether there is

space and opportunity for the municipality to be involved in nexus resource management. Many of these questions explored the barriers that the farmers are facing in terms of resource management within the Bergrivier Municipality, whether these are internal or external challenges. Section 4 dealt with current and emerging pressures that farmers face and how they engage with external drivers. This section gave insight into the farmers' uncertainties about the future, and allowed for an examination of aspects of resource management that the municipality could support. Please refer to section 9.2 for greater detail of the particular questions used in the semi-structured interview. It must be reiterated that farmers had limited knowledge of nexus thinking before the interview, and often confused nexus with the company Nexus dealing in fertilizers.

It was important to keep the questions simple, as it was found that in the pilot study, the farmers kept their answers short if the questions were too complicated. This affected the flow of the interview and the more relaxed semi-structure was adopted with simpler questions.

It must be emphasised that this research does not seek to criticise the municipality, but rather to establish a foundation for building support for nexus thinking, where the municipality could be one of the enablers of more holistic resource management.

3.5 Data Collection

A total of six forums were attended throughout the research process. These forums provided an introduction to the farming context within the municipality as well as a means of meeting many relevant stakeholders.

Date	Forum attended	Location	Reason for attendance
September 2014	Integrated Development Plan (IDP) forum	Bergrivier Municipality offices in Piketberg	Introduction to the Bergrivier Municipality and IDP
November 2014	The Verlorenvlei Estuary Management Forum	Vensterklip	Introduction to key stakeholders in the region and supplement semi-structured interviews
November 2014	Sandveld Bewaringskomitee Vergadering	Goudkop	Introduction to key stakeholders in the region and supplement semi-structured interviews
November 2014	Berg Estuary Management Forum	Velddrif	Introduction to key stakeholders in the region and supplement semi-structured interviews
February 2015	Sandveld Bewaringskomitee Vergadering	Groudkop	Follow up Survey
February 2015	Berg Estuary Management Forum	Velddrif	Follow up survey

Table 1: Forums attended in the Bergrivier Municipality

These forums made it possible to generate group feedback on particular issues. They allowed for networking and identifying significant people to interview within the community. These forums provided an introduction to the interviews which were conducted from November through to December 2014.

The interview process started on 17 November 2014, with four pilot interviews. The first responses from the farmers were short and to the point. Interview questions were then changed to allow for a collaborative dialogue which encouraged a conversational approach rather than a rigid interview approach. The interview questions were structured with the Berg River nexus framework in mind.

Possible interviewees were contacted either through e-mail or a phone call, requesting an interview. The interviews were conducted in person on a particular farm, or at a convenient location within the

Bergrivier Municipality. The purpose of the study was explained at the start of each interview and permission was sought for the interview to be recorded.

In total, 25 interviews were carried out. Each interview lasted from between 30 minutes and two hours. The semi-structured interviews allowed for interviewees to voice their most pressing problems, and through the interviews these issues were discussed further. The semi-structured interviews led to many focused discussions, and granted the interviewee the freedom to talk around the themes. This enabled a discussion which gave interviewees a sense of importance. The semi-structured interviews led to in-depth discussions around many aspects related to resource management that involved the municipality.

Follow up survey

A follow-up survey was undertaken in February 2015, and the preliminary results from the interviews were reviewed and presented as 14 statements (e.g."significant engagement from the Bergrivier Municipality stops at the urban edge"). The participants were asked whether they agreed with each statement, and to give a comment if necessary. This provided triangulation to see how the interpretation of the interviews aligned with a group of respondents. The survey was carried out over two days in the Bergrivier Municipality, where the Sandveld Bewaringskomitee Vergadering and Berg River Estuary Forum were attended in February 2015.

3.5.1. Participants categorization

The participant target group was the farming community within the Bergrivier Municipality. This included large and small-scale farmers, as well as commercial and local market farmers, as well as a range of intensive and extensive farmers. Five groups of interviewees were established (see Figure 3), namely: 1) the Swartland farmers who were mainly wheat farmers around Piketberg. They are large scale, extensive agriculture, targeting a commercial market; 2) The Piket-bo-berg, English speaking farmers who farmed mainly citrus and flowers, these farmers are large scale intensive agriculture, supplying the commercial market; 3) the Moutonshoek Valley farmers who farm potatoes, table grapes, citrus and wheat on a large-scale, as well as stud horses. They are a mix between intensive and extensive agriculture but all supplying the commercial market on a large scale; and 4) the small-scale farmers were the last group which was small scale and looked to supply the local market and home supply. The last group that was interviewed were 5) people in positions of authority who were either involved in the municipality or forums. This last group of interviews was supplemented by work already conducted in the Bergriver Municipality on the mapping of the governance landscape related to ecosystem-based adaptation by Haiden (2014).

3.5.2. Participant profiles

The aim of this section is to provide a profile of the typical person that was interviewed. The following information does not include statistical demographics, but rather aims to provide the reader with some insight into the members of the agricultural community in the Bergrivier Municipality.

The age of the participants was generally above 50 years. There were only four younger interviewees and they were farm managers rather than farm owners. Out of 25 interviews with farmers, there was only one woman interviewed who represented her own farming initiative. Other women who were interviewed were the wives of participating farmers. This correlates with the findings of Källstrom and Ljung (2005) of the farmers in Sweden, where the average age of today's farmers was relatively high, with the vast majority of those working on the farms being men. The Bergrivier Municipality is known to be a predominantly Afrikaans speaking area, and as such the majority of the people's home language is Afrikaans. The Piket-bo-berg Mountain is known to be the English speaking area in the region. Although the greater area was Afrikaans dominated, the people were very willing and accommodating to speak English, or a mixture of the two languages.

Many of the farmers boasted 10 or more years on the farm, and this allowed for a healthy perspective for resource management. Small-scale farmers tended to have the shortest time spent on the farm, generally not over 10 years. In terms of the size of the farm, the Moutonshoek Valley farmers, as well as wheat farmers, had access to the largest areas of land. This often included a number of large farms (>650 ha) in the areas of more extensive agricultural practices. Piket-bo-berg had surprisingly smaller farms, as farm size was limited by the mountain, as well as citrus and flowers being a more intensive crop. The small-scale farmers did not utilise land larger than 10 ha. Many of the people interviewed on farms were farm owners, except for the small-scale farmers, who were either leasing the land or managing it. Everyone interviewed, with the exception of an elderly couple, had a tertiary education up to a university degree.

See Appendix 9.1 for the participant profile summary.

3.6 Data Analysis

Each interview was recorded using audio recordings, photographs and field notes. An analysis was conducted after the completion of 25 interviews in November and December 2014. The recorded interviews were transcribed (and translated where necessary) during December 2014. After transcribing the interviews, the data was analysed with the help of Nvivo 10. Nvivo is a platform for analysing unstructured data and can help to identify recurring themes and create visual maps of the

data. With a large amount of data, it was essential to sort through it and address the recurring themes. It is difficult to cut down on the amount of information, and to determine what to include and exclude, but Nvivo helped tackle some of these challenges. Through analysing the data, it was clear that there were a lot of questions asked, and a lot of data captured. This meant focusing on the more relevant information on the farmer/municipal relationship. Throughout this process, the literature was applied to the emerging themes, which were then confirmed and challenged by the follow-up survey in February 2015.

Through the study the objectives may address different parts of the nexus framework (figure 1). In order to investigate how farmers engage the nexus resources only the system section of the framework will be applied. The development goals and external drivers will be referred to when identifying the current barriers to municipal support and identifying the external drivers for nexus thinking at the local level.

3.6.1 Farmers engagement with nexus framework

The connectivity between nexus resources was explored through the farmers perception allowing an insight into their understanding and implementation of the nexus framework. Farmers are not knowingly aware of nexus, and the research data was assessed based on this. Addressing the connectivity was achieved through the first section of the semi structured interview allowing the farmers to highlight individual connections between each resource. These connections were then used to draw resource flow and connectivity between each of the resources.

To understand the farmers engagement with the nexus resources, Nvivo was used to identify which resources were focused on by which farmer. This made possible an assessment of which resources are at the centre of their thinking, and how broadly they are thinking within the system of the nexus framework.

3.6.2 Farmers' understanding of how resources are governed

A Sociogram was used to depict the connected network of actors involved in resource management from the farmers' perspective. Sociograms (analytical diagrams depicting patterns of social relations) are used to show connectedness or isolation amongst actors (Scott, 2012). They are able to depict the strength of collaboration within networks. This study has made use of a basic sociogram which illustrates interaction between actors perceived by the farmers and perceptions gathered through forums. This study makes use of a qualitative approach due to the small sample of farmers and people in authoritative positions interviewed. Farmers were asked questions related to the influence and interdependencies of departments and organisations, and where the responsibility for resource

management lies. The attendance registers for each forum were also used to establish connections between actors.

3.6.3 Barriers farmers face in accessing support for resource management

The third research objective required an examination of the barriers to municipal engagement in the nexus framework. Through analysing the data, themes started recurring and the follow-up survey provided a means to verify the emerging themes and give validity to the results. The surveys were captured in an Excel spreadsheet and a graph was generated to show the degree of concurrence of the opinions amongst the farmers. The findings of the follow up survey were graphed according to the barriers for the municipality, the barriers for the farmer and the external drivers. To better understand the graphs a rating system was used where 3 is allocated to strongly agreed, 2 allocated to agree, and 1 is for disagree and is subtracted from the total sum of strongly agree and agree.

These results were applied to Faysse et al.'s (2013) three characteristics for weak governance of the socio-ecological system which provided a framework in which to assess the current strength of the relationship between the municipality and the farmers. These characteristics are: 1) the actors' limited capacity to interact with others; 2) the actors' limited interest in being involved in the management of the social-ecological system, and limited trust between the actors concerned; and 3) difficult and costly implementation of direct control of natural resource use (Faysse et al., 2013). Characteristic 2 and 3 were each broken into an (a) and (b) to enable better understanding, and the results are displayed in a summary table with the relevant information under each characteristic. This section covered the first and second characteristic but the third was discussed under the external drivers.

3.6.4 The external drivers of nexus thinking at the local level

External drivers were initially identified through the semi-structured survey and validated through the follow up survey. These differ to the external drivers established by Midgley (2014) and focus on the farmers perceptions at the local scale. The external drivers are viewed against the economic, social and environmental context, drawing on particular development goals in order to capture the holistic perspective. This section will examine how this influences the third characteristic for weak governance, namely, difficult and costly implementation of direct control of resource management (Faysse et al., 2013).

Chapter 4: Farmers engagement with nexus resources

This section is made up of two parts; the first addresses an overview of nexus resources and the farmers' engagement within the nexus system (as shown in Figure 4 and 5). The second part will focus on the interconnections between all the resources and draw out the importance of an integrated system and the need for holistic management.

4.1 An overview of farmers' engagement with nexus resources

Based on farmers' interview responses, the farmers gave insight into the connection between the nexus resources from their perspective. Figure 4 illustrates farmers' understanding of the nexus system at their local scale. The direction of the arrow indicates the direction of the resource flow. It is important to note that nexus thinking was a new term for many of the farmers and often got confused with a fertilizer company called Nexus. Despite this confusion, farmers clearly identified the interconnectivity between the resources. It is evident in figure 4 that all the resources in the nexus framework are dependent on water. Energy and water share an interdependency as access to water stipulates how much energy is being used and the type of agriculture taken up as energy is necessary to pump water for irrigation for intensive agriculture. Food is an exception in terms of resource flow as all the resources in the nexus system flow towards it. This is as a result of food being an output from the farms, where the contribution of the other resources ensure good quality food produce to fetch the best price.

It must be noted that in terms of the farmers' understanding and implementation of nexus thinking in the context of the Bergrivier Municipality, they have always been dependent on natural resources. These resources include water, land, biodiversity and energy.

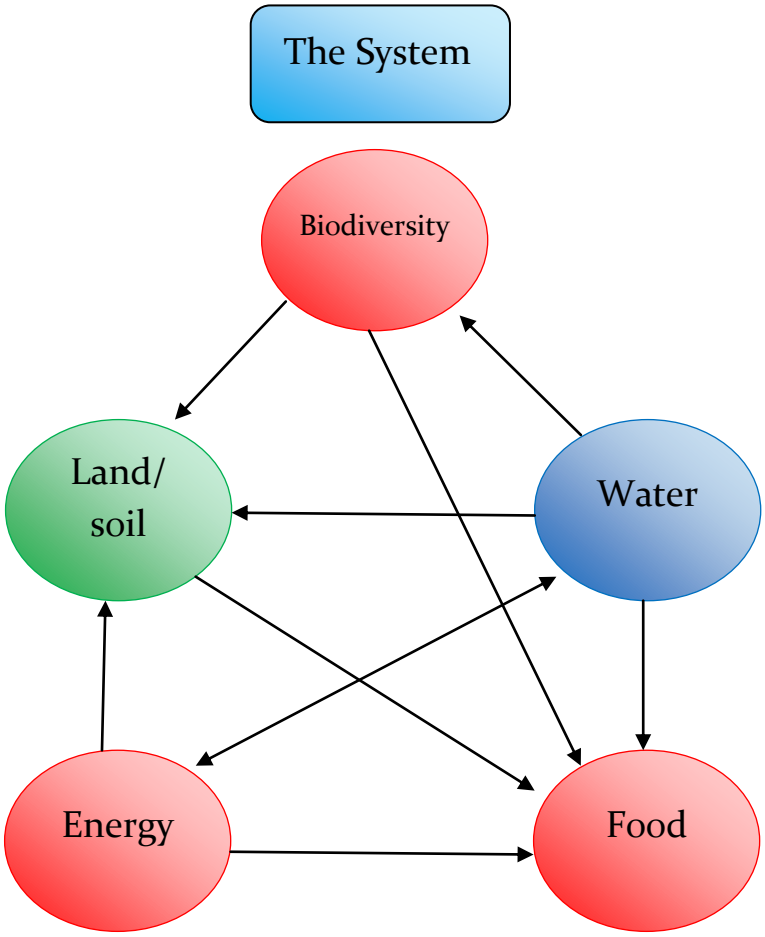

Figure 4: Farmers' understanding of interconnectivity and dependencies within the nexus system

Figure 5 depicts the importance of the different resources for the different farmers. The arrows from each resource point to interviewees who showed a significant engagement with a particular resource as captured through the thematic analysis using Nvivo. The size of the circles captures how frequently the resource was mentioned. This is captured by showing the most-referred-to resource as being the largest, and the least-referred-to resource being the smallest.

Some interviewees did not address some resources explicitly and focused primarily on other issues, such as labour or the economy of scale. Those interviews do not feature in this diagram. In the discussion in 4.2, relevant quotes will be drawn out of the data that depict the interconnection between the resources and the farmers' engagement with the resources.

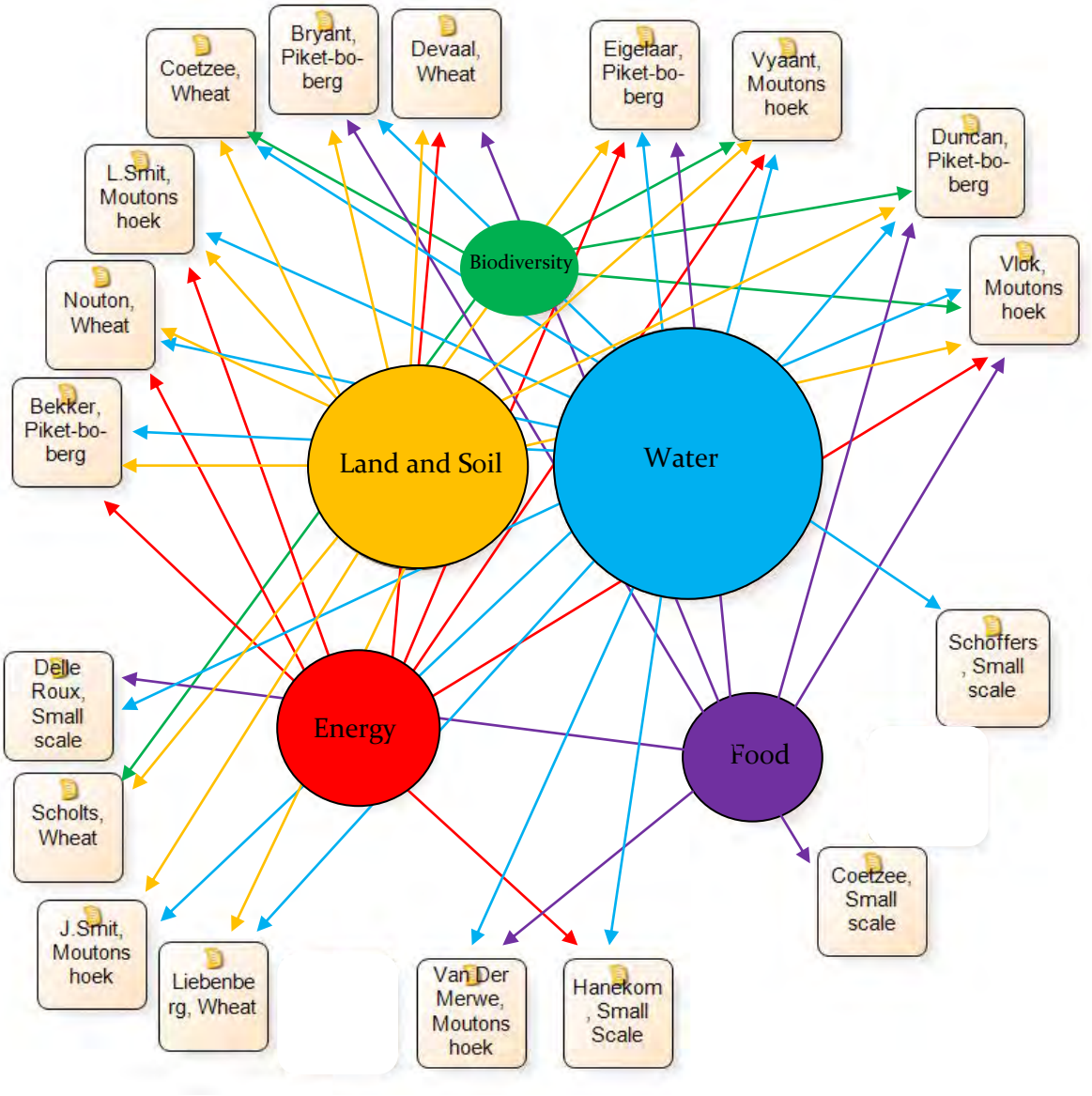

Figure 5: Farmers' engagement with nexus resources

Although many different resources were mentioned in the interviews as seen in Figure 5, it was captured in the follow up survey that the dependency on water is the most critical resource on which farming decisions are made within the Bergrivier Municipality (figure 6). The follow up survey confirmed this with 17 out of 18 participants agreeing with the statement.

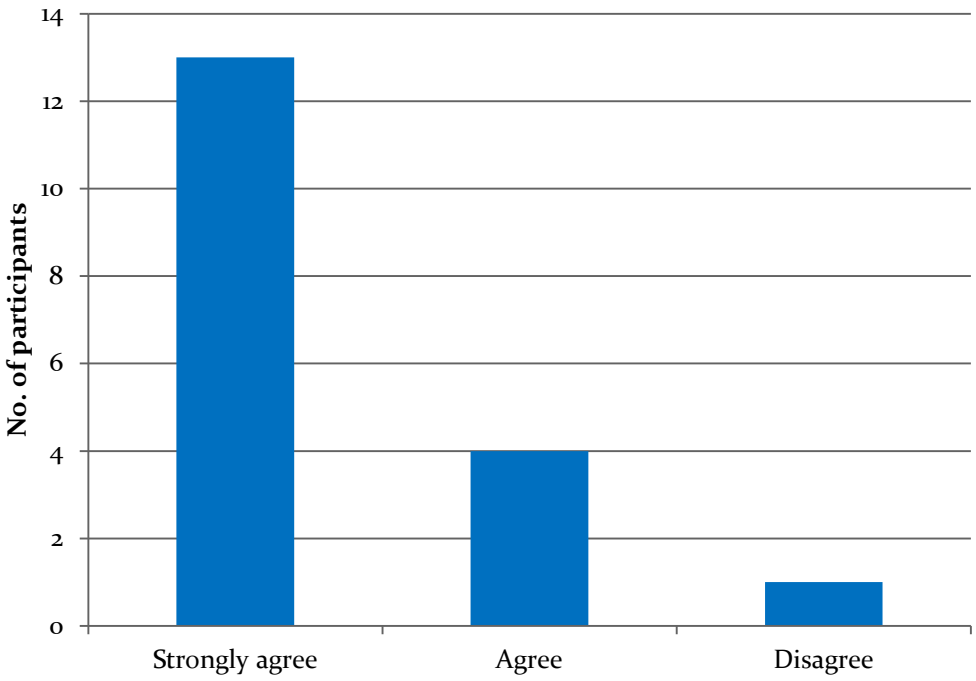

Figure 6: Dependence on water as most critical resource (based on follow up survey with 18 participants)

4.2. Engaging with nexus resources

Through the interviews it was evident that resource management is a priority for farmers. This is illustrated by Devaal who said: "Ninety percent of your job as a farmer is to have all your resources in a straight line, otherwise you can't farm" (De Vaal, Wheat, personal communication, November 2014). Access to resources was recognised as building resilience, and resilience was seen as especially vital within the wheat lands which were described as "an unforgiving landscape" (Scholtz, Wheat, personal communication, November 2014). There was strong recognition of the farmers' dependence on the environment for a variety of ecological services, highlighting the need for the resilience thinking (Biggs and Schoon, 2014).

From Figure 5, it is evident from the large circle that water was the most referred-to resource. The intensity of water dependence was higher for farmers on intensive agricultural land, where they relied on irrigation for citrus, flowers and potatoes. Although the wheat farmers, or extensive farms, are still reliant on rainfall and ground water, water was not the main focus in their interviews. This may have been as a result of the time of year (mid-summer) when it is dry and the wheat fields are barren, meaning that there was no pressure on water resources for irrigation at that time. Small scale farmers also acknowledged the importance of water but not with the same concern as intensive commercial farmers. Despite the fact that the interview process tried to enable equal acknowledgment of each resource, water continuously came out as a dominant aspect (Figure 4 and

5). This was supported by the follow-up survey (Figure 6), where people strongly agreed that water is the most critical resource in relation to which farming decisions are made within the Bergrivier Municipality. This particular focus on water can be understood in terms of the Bergrivier region being a water-scarce area, and because farmers recognise water as the limiting resource for agriculture and affects other resources (figure 4) (Archer et al., 2009).

> It is the water that is stipulating the land use practice, what happens to the biodiversity, how much energy is being used. Water is massive and it will stay like this. (Smit, Moutonshoek, personal communication, November 2014)

What can also be seen in Figure 5 is that soil and land play a particularly important role for wheat and citrus farmers, as well as for the farmers growing potatoes in Moutonshoek valley. There was no significant acknowledgement of soil by small scale farmers or people in authority positions. The energy usage on the farms seemed to be predominantly electricity usage rather than fuel for equipment and was particularly important for the Piket-bo-berg farmers as well as within Moutonshoek – being two areas of intensive agriculture. These two groups of farmers are particularly reliant on energy for irrigation, as well as to run the packing sheds for potatoes and citrus. This is captured by Eigelaar, a Piket-bo-berg citrus farmer, *"*We are driven by electricity, we pump with electricity and we pack with electricity, so it is really a key factor in how this farm operates" (Eigelaar, Piket-bo-berg, personal communication, November 2014). These farmers were found to be very vulnerable to the recent and ongoing load shedding, and were actively looking for alternative energy sources. The interconnection of the nexus system could be seen through the dependence on electricity to pump water for the irrigation on these intensive farms (figure 4).

Food was an outlier in terms of farmers' perceptions of FEWLB nexus resources and as seen in figure 4, the other resources flow towards food. Food as a resource was not well covered in the study. It often led to confusion because it is not a natural resource but rather an output from many of the farms. The reference to food was often linked to the general food market which many of the farmers supplied locally, nationally or internationally. The food market plays a significant role as it ensures a cash turnover. It is a focus of the farmers, as many recognised the volatility of the energy and food markets. Greater reference was made to the food market by the intensive Piket-bo-berg, Moutonshoek and small scale farmers, possibly as a result of their dependence on a good cash turnover. Wheat farmers made little or no reference to the food component of the nexus, possibly as a result of not supplying directly to the food market.

As food is an output of the farms, and ensures the best possible capital turnover, there was concern as to how the other resources influenced the quantity and quality of the produce. To highlight the role of other resources, the example of biodiversity is used (figure 4). To achieve the best price, the farmers need the best quality. Where there is good biodiversity in the soil it ensures the produce will be of a better quality due to the development of natural resilience.

> The biodiversity you get above the soil is the same as what you get beneath the soil, I want to keep that biodiversity and it keeps your soil healthy. Your product has a longer life and the quality is better (Vlok, Moutonshoek, personal communication, November 2014)

There is a high dependence on the nexus resources to produce quality produce. Unfortunately as the input costs increase – without an equal increase in income in the market – the natural resource buffer will be over-exploited. This is reflected in the words of Duncan, "Biodiversity is what will take the knock as the more marginal farmers will not be able to afford it" (Duncan, Bo-piket-berg, personal communication, November 2014). Finances, as an external influence plays a central role in how these nexus resources are managed. According to Smit, "Conservation is a luxury and it only starts after breakfast. If you don't have any money, you won't do any conservation." (Smit, Western Cape Department of Agriculture, personal communication, November 2014). This finding is supported in other research studies where the farmers have recognised that humans interact closely with the biosphere (De Villiers et al., 2014; Simonsen et al. 2013; Walker and Salt, 2012). The interconnection between input costs and resource degradation is impacting on the resilience of the nexus system and the ability to achieve sustainability. This highlights the need to shift away from silo thinking towards a more holistic management approach (Ringler et al., 2013).

The resource that was mentioned and acknowledged the least was biodiversity. Biodiversity was often paired with other resources such as land/soil, and was also referred to with regard to visual aesthetics and the role this plays for tourism. Tourism has been recognised as a growing industry in the Bergrivier Municipality and there is a drive to conserve natural areas (Bergrivier Municipality, 2014b). An example of this is the conservation and management of freshwater aquatic biodiversity in the Berg River Estuary, to ensure river health as well as to promote it as a tourist attraction (Bergrivier Municipality, 2014b).

What is evident in Figure 5 is that, generally speaking, farmers in Moutonshoek and Piket-bo-berg (being the more intensive agricultural areas) consciously engaged with most of the resources and had a fairly holistic view involving three or more resources each (figure 5). They often recognised the interconnections among the various resources, and recognised the connectivity within the nexus

system (Figure 4). This was encouraging, as all the people interviewed had very little knowledge of the FEWLB nexus framework before the interview. The wheat farmers showed good awareness of a selection of resources but did not expand their thinking over the entire range of FEWLB nexus resources. This could be as a result of the farming practice being extensive rather than intensive. In this research it is interesting to note that although the FEWLB nexus is used as a holistic framework that combines food, energy, water, land and biodiversity, it is often difficult to take all these resources into consideration at one time and there will be certain resources that are more dominant than the rest.

Chapter 5: Farmers' understanding of how resources are governed

This chapter looks into the network of actors involved in governing resources. A Sociogram is used to depict the connected network of actors in resource management from the farmers' perspective. This chapter addresses the surrounding support for resource management experienced by the famer.

5.1 Network of actors involved in resource governance in Bergrivier Municipality

A sociogram (figure 7) depicts farmers' understanding of actor networks related to nexus resources, focussing on forums and organisations. Forums provide an important opportunity for local organisations to communicate, learn from one another, identify what projects others are involved in, and, as a result, discover where they can support one another (Waddell and Brown 1997). Forums provide opportunities to combine knowledge and effort, avoid duplication, streamline funding and enable more effective outcomes (Haiden, 2014). There are many forums in the Bergrivier Municipal area and this study focuses on four of those with acknowledgement by the farmers to the Water user association and Working on fire.

The arrows depict interaction between actors and the thickness of the arrow depicts strength of this flow according to the farmers' perceptions. The blue represent different tiers of government actors, from national governance down to local municipality. At each of these levels there are certain departments, organizations and forums. Each level has a different colour code relating to the position they occupy.

- The yellow depict the local level access points such as forums, where farmers are able to voice their opinions and concerns about resource management. These forums are important for holistic resource management as they bring individuals into a group.
- The orange depict the organisations that fall in the Western Cape Provincial Government and Municipal sphere
- The red depict the sphere of the National and Provincial Government.
- The green represents the farmers as they are separate from the tiers of government but are in line as they are the actors situated at the local level and below the municipality.

Figure 7: Sociogram depicting organizations relevant to resource management across scales from local (yellow), provincial (orange) and national (red) with the tiers of government in blue and farmers green

5.2. Resource management network within the Bergrivier Municipality

It is important to take into account that there is no official legal mandate for the involvement of the municipality in resource management. When financial resources are limited, the functions for which the municipality is legally responsible must take priority. The roles and responsibilities of the municipality are allocated by national government. There has been a recent shift towards environmental awareness as the National Development Plan has recently recognised the importance of the ecological infrastructure (Strategic Integrated Project 19), and the mandate for better resource management at the local level should follow suit. The municipality is granted some independence through the Land Tax of 1998 which gave Local Government a new revenue source through the inclusion of land owners outside of the urban edge. The reason for this was to enhance accountability and good governance at the local level of government, and to allow for revenue transfer from central government to municipalities (KATZ Commission, 1998). This was under scrutiny through the court case of JJ Liebenberg and other rural landowners v Bergrivier Municipality discussed in more detail in section 6.3.3. The problem was found to be that the farmers feel they do not benefit from their financial contributions to the municipality.

The Bergrivier Municipality, has expressed an interest in being involved in building resilience through the Integrated Development Plan (IDP) and has recognised the importance of the agricultural sector in this regard (Bergrivier Municipality, 2014b). With this in mind it is important to understand the current governance of the resource management network and the weaknesses which can be addressed currently at the local level.

The municipal IDP process is a mechanism through which a series of forums are hosted throughout the year. The municipality is required to consult the local community on its needs and development priorities in order to help shape the objectives of the IDP. It was found by Haiden (2014) that the effectiveness of these forums relies on the attendance of, as well as discussions between, multiple stakeholders. It is, therefore, unfortunate that there was limited representation of the many actors involved in supporting the environment in the 2014 Bergrivier IDP meeting. This seemed to impact on the focus of the IDP, and, as described by Hoffman:

> It was a little bit sobering that the conservation issues that I understand, didn't emerge as critical issues for the municipality. For me the environmental content was surprising as the environmental focus at the municipality level is not the veldt or conservation, it's not protected areas but is dominated primarily by land fill sites, living conditions, and about composting. For me, the environment is nature and conservation, and if there is an

> environmental sector that is what they should surround themselves with. (personal communication, IDP meeting overview, 2014)

It appears that this was a missed opportunity to demonstrate to stakeholders the concern that the municipality has for the environment, and the progress the municipality has made, especially in terms of the Environmental Base Adaptation for Climate Change. There was no representation of the farmers, or from the farming forums, to guide possible interventions, although it was noted that the relationship between the farmers and the municipality is not easily managed.

It may not be a mandate, but it is important for the municipality to increase communication, be aware of projects and learn where support is needed within the municipal boundaries. Forums offer this opportunity but from the interviews it was clear that there is little engagement from the local level forums with the municipality. Both The Verlorenvlei Estuary Management Forum and the Sandveld Bewaringskomitee Vergadering have expressed their many attempts at including the Bergrivier Municipality in local level involvement as forum representatives said that they actively try to engage the municipality, but to little effect.

> You can ask what does this committee do to involve Bergrivier Municipality, and what does the Verlorenvlei committee do to trust that they are invited to each and every meeting, they just don't show up. Each one of them are invited religiously, and quite a wide band in each municipality different kinds of people. (Group communication, Sandveld Bewaringskomitee Vergadering, February 2015)

Both forums shared the opinion that municipal engagement is "weak" and focused on the urban edge. This opinion was backed up by Sandveld Potato Growers Association (SAKO) and Right Rooibos (Haiden, 2014). Cape Nature also emphasised that "the support of the local authority is said to make it a lot easier to implement these kinds of initiatives," highlighting the importance of the municipality as a facilitator and power for decision making (Haiden, 2014).

It is of concern that there are so few links from the forums to the municipality (see Figure 7). The only links are to the IDP meeting, which has no links directly to the farmers. The link between the Bergrivier Municipality and the Berg Estuary Management Forum is in one direction as the municipality was only as a participant with limited interaction. The one link that was recognised by both farmers and the municipality was through Working on Fire (WoF), although this relationship is strained as there seem to be communication problems related to recent billing regulations. An interesting point was made in the Moutonshoek valley where farmers considered putting their own

water association in place. They believed this would “have the same power as a government institution and we are able to have the same inputs and power as the municipality” (L.Smit, Moutonshoek, personal communication, November 2014). This initiative by the farmers has the intention of bypassing the municipality and becoming a coordinated voice for the valley. To note, there was strong coordination amongst the Moutonshoek farmers. This was generated through the effective leadership of Jocubus Smit and others in the valley. Their determination is largely as a result of up to seven generations of water shortages, as well as the threat of prospecting by Bongani Minerals for Tungsten. It is interesting to note that although the Bergrivier Municipality is opposed to this mining initiative, the farmers do not feel secure enough to rely on the municipal efforts.

Figure 7 shows the poor network connections for holistic resource management between the municipality and the farmers. In terms of applying the nexus approach, this calls for governance that is reliant on an integrated approach to policy, planning, management, development and institutional capacity building(Von Bormann and Gulati, 2014). In Figure 7, it is evident that this connectivity is not strong for municipal engagement in nexus resource management. This is supported by Hoff (2011), as he acknowledges the lack of strong regional institutions for integrated management and governance across the nexus. It is important to recognise these weaknesses to progress forward, as highlighted by Ziervogel and Parnell (2014). The municipality has an important role to play in the micro scale, as well as in multi-level governance, because of their link to the local and national scale. The municipality has the opportunity to play a constructive role in holistic resource management. It is important to note that municipal scale resource management requires a major effort in collective action involving players from a range of different perspectives (Wyborn and Bixler, 2013). This project takes into consideration the contribution of the agricultural sector and the municipality, but it must be recognised that there are many actors involved in the governance of the nexus at the local level.

Chapter 6: Barriers farmers face in accessing support

The third research objective requires an examination of the barriers farmers face in accessing support for resource management from the Bergrivier Municipality. Barriers for both the farmer and the municipality will be discussed. Faysse et al.'s (2014) three characteristics of weak governance, will supply a useful analytical framework for exploring the problem of weak governance related to the role of the Bergrivier Municipality in supporting nexus thinking at the local level. Through this section, this research is contributing to the literature on social-ecological governance, because in the past research has focused on single issues or resources, rather than across the multiple resources conceptualised by the nexus (Folke et al. 2005).

6.1 Barriers for farmer engagement with Municipality

This section is about barriers farmers face when engaging with the municipality. Figure 8 shows the emerging barriers that farmers faced in interacting with the municipality. If only the strongly agreed to barriers are taken into consideration, it is evident that the farmers saw accountability and transparency as the most noteworthy barriers. A rating system is used where 3 is allocated to strongly agreed, 2 allocated to agree, and 1 is for disagree and is subtracted from the total sum of strongly agree and agree, it is evident that lacking transparency is still the strongest with a rating of 44 and the urban focus is the next significant barrier at 41. Then missing capacity at 40, lacking trust has a rating of 39, poor communication is at 36 and lacking leadership is on 35.

Barriers	Strongly agree	Agree	Disagree
Urban focus	8	9	1
Missing capacity	8	9	2
Lacking Leadership	4	12	1
Lacking Accountability	10	6	1
Lacking Trust	6	11	1
Lacking Transparency	11	6	1
Poor communication	6	10	2

Table 2: Barriers for municipal engagement with the farmer

6.2 Barriers for farmers' engagement in holistic resource management

Table 2 shows the barriers the municipality may experience when dealing with the farmers as described from a farmer's perspective. If the same rating technique is used as in 6.1 it is evident that the farmers are strongly independent from the municipality with a rating of 34. The perception that the farming community can be a difficult community to integrate into from an outside perspective was acknowledged with a rating of 25 and the perception that accepting change has been difficult for farmers was acknowledged with a rate of 18.

Barriers	Strongly agree	Agree	Disagree
Independence	7	8	3
Approachability	3	10	4
Accepting Change	4	7	8

Table 3: Barriers for farmer engagement in holistic resource management

6.3 Barriers between municipality and farmer

The Bergrivier Municipality has demonstrated itself to be a forward thinking and proactive governing body that is beginning to recognize the importance of the environment and off reserve conservation through private land owners (ICLEI, 2010). This has been seen in the Bergrivier's recognition of the importance of environmental management and the recent inclusion and provisions for this in the municipal structure. The Bergrivier has recognised that upwards of 80% of national biodiversity occurs on private property, and has highlighted the importance of including private land owners within the environmental management framework (ICLEI, 2010). It is evident that the network structure (figure 7) perceived by the farmers interviewed is not offering any link from the municipality to the farmers and thus making it difficult for the municipality to know how to support resource management through a key sector being agriculture. This section looks to address the current barriers farmers face in accessing support for resource management from Bergrivier Municipality by identifying the social-ecological systems characteristics for weak governance. The only way to enable the municipality the opportunity to be more involved in resilience building in the agricultural sector is by identifying the barriers that currently impact on this relationship.

Faysse et al. (2013) acknowledge that strong governance of social-ecological systems is essential for resource management and for building resilience. Weak interaction among actors will lead to weak governance. In line with evidence supplied by Faysse (2013), these weak relations lead to poor management of resources and are often found to stem from one or more of the following characteristics of social-ecological systems:

1) The actors' limited capacity to interact with others. This was found between farmers and the municipality, where the municipality's tendency to limit its attention to the urban areas is a contributing factor.

2a) The actors' limited interest in being involved in the management of the social-ecological systems, such as the municipality's lack of involvement in agricultural forums as well as the farmers' independence.

2b) Limited trust between the actors concerned. This was significant between the farmers and the municipality at the local level.

3) Difficult and costly implementation of direct control of natural resource use (Faysse et al., 2013). This third factor was viewed differently by the farmers and municipality, but played an important role and will be discussed further in chapter 7

Faysse et al. (2014) use these characteristics in relation to natural resource use but this project will apply them to the nexus resources and the governance between the municipality and the farmers.

6.3.1 The urban/rural divide

In the interviews the municipality was described by farmers as "not having the capacity to provide any benefits to the farmer as they are limited to the urban edge" (Coetzee, Wheat, personal communication, November 2014). This relates to the first social-ecological characteristic for weak governance in resource management, as the municipality has limited capacity to interact with others beyond the urban edge. The majority of the interviewees agreed with the finding that significant engagement from the Bergrivier Municipality stops at the urban edge, and this was supported in the follow-up survey (Figure 8). The results from the follow-up survey did acknowledge the municipality's recent attempts to move out of this urban classification. It was not explained as to how the municipality would do this.

The second characteristic of social-ecological systems – the actors' limited interest – was acknowledged in many of the interviews, but highlighted here by Jan Smit who stated that "a lot of the departments have capacity but not a lot of them find their way into the rural areas" (Smit, Department of Agriculture, personal communication, November 2014). The significance of this divide is that it impinges on the Municipality's ability to support resilience-building through resource management.

The above suggests that there is a divide in the Bergrivier Municipality between the governing of the urban and the rural areas, although there are mixed perceptions as to why this is so.

There were two explanations for the cause of inadequate attention being paid to farming communities by the municipality. The first is that this divide is as a result of a lack of capacity within the municipal support system for resource management. Similar findings are presented in Brown et al. (2012), as well in Fleeger and Becker (2008), where the municipality's capacity and human resources are stretched too far to adequately engage with resource management. A reason for this may have been the shift from Transitional Local Councils (TLCs) and Transitional Representative Councils (TRepCs) to district municipalities in 2000 (Franzsen, 2000). This expanded the metropolitan focus to include the rural as well as urban areas. The second explanation for the urban/rural divide is related to service delivery to different voting constituencies. The urban area lends itself to a higher

voter density and therefore attracts better service delivery, as found by Pasquini and Shearing (2014). Both perceptions will be discussed in depth through a and b.

a. Need for local level access

There was reference made within the interviews to the lack of support for resource management provided through national government infrastructure, with the exception of the Department of Water and Forestry (DWAF). This can be seen in Figure 7, where the arrow only points towards the DWAF. One of the main issues arising through the interviews was the need for local level support for resource management which lies as a national mandate. Smit recognises the problem as being that "there are too many bureaucrats at desks and not in the field" (Smit, Western Cape Department of Agriculture, personal communication, November 2014).This can be understood as there being not enough engagement on the local level, and this is affecting the local level coordination and integration of resource management. This opens an opportunity for the municipality, in that they could fill the gap between the national government and the farmers. The Bergrivier Municipality has recognised the importance of the agricultural sector and of generating resilience, but due to a recent introduction of an environmental management sector and an unspecified mandate, they lack the capacity through financial and human resources to adequately engage.

The interviews showed that the farmers expected more input from the local level and expected the municipality to be involved and at least attend the forums. The follow-up interviews also revealed that the Bergrivier Municipality did not engage enough with other state departments, and displayed a lack of interest in the Verlorenvlei Estuary Forum and Sandveld Bewaringskomitee Vergadering (Figure 7) (F. Steyn, Western Cape Department of Agriculture, personal communication, February 2015). As discussed in 5.2, the lack of engagement by the municipality was indicated by the group feedback from the Sandveld Bewaringskomitee Vergadering in December 2015, where (using the example of the Verlorenvlei) it was described how the Bergrivier Municipality is not present at the local level.

It is well understood that support needs to filter down within the hierarchy of government and it is essential that there is an interest to participate by the municipality, as highlighted by Faysse et al. (2013). A reason given for this lack of engagement is that municipal financial and human resources are being stretched too far. There has only recently been an appointed environmental officer in the Bergrivier Municipality, and it was said by Booyes that often he/she carries the responsibility of other departments as well (Bergrivier Municipality, personal communication, February 2015). As discussed later, municipal departments were also seen to operate like 'islands' within the municipality, as there is no adequate integration of environmental issues among departments within

the municipality, and there is little engagement with environmental issues outside of the urban edge (Wessels and Malherbe, Cape Nature, personal communication, November 2014). The municipality is showing a willingness to transform, but it is evident through the IDP meeting, as well as in other observations, that there is uncertainty and difficulty in carrying this out.

b. The municipal political system

The urban/rural divide can be seen when we examine municipal political system of voting as indicated in Figure 8. According to Cape Nature:

> "As long as the people sitting in the town are happy then their (municipality) work is done, as the voter density is so much larger within the town, even though the economic clout is happening outside of their urban boundary. It is where their focus is and they have not been able to prove themselves outside of their urban area" (Wessels and Malherbe, personal communication, November 2014).

This issue raises other themes such as trust and consistency. A lack of trust seems to be the foundation for a dysfunctional relationship between the municipality and the farmers. This was made evident in the follow-up survey (Figure 8). The lack of trust relates to political issues. The farmers see a lack of consistency, as the short term political goals of the municipality do not lend themselves to effective and efficient resource management. Mouton said that he would "rather not have the municipality involved (in resource management) as they are politicians" (Mouton, Wheat, personal communication, November 2014). Municipal officials are associated with politicians and promoting their political position rather than benefitting the people. This may be as a result of the recent 2011 shift in elected party leadership in the local government, and the need for the municipality to stabilise their position.

Consistency within the political system seems to be a significant barrier within the farmer and municipal relationship, as the "turnover is too quick and there is no continuity within the municipality that the farmers might have lost trust" (Bryant, Piket-bo-berg, personal communication, November 2014). This was further addressed by Bryant when describing how an idea may be driven forward by a particular person in the municipality but as soon as they are gone, the idea fizzles out (Bryant, Piket-bo-berg, personal communication, November 2014). Pasquini and Shearing recognised the problems of the short-term cycles of elected government due to the short time scale and the need for demonstrable results. Through this, Pasquini and Shearing (2014) found that short-term time scales are unlikely to favour the achievement of environmentally sustainable development of long term resource management.

6.3.2 Lack of leadership

Leadership is a theme which crosses vertical and horizontal scales of governance, as recognised by Eigelaar: “We are not an island, we are part of the municipality, part of the province and part of the country, and if leadership cannot get their acts together then we are at the mercy of all that” (Eigelaar, Piket-bo-berg, personal communication, November 2014). This highlights the need for interconnection and communication throughout. A feeling of a lack of leadership being displayed by the municipality was supported by the majority of responses in the follow-up survey (Figure 8).

Leadership filters into themes of accountability and trust. It was agreed that the municipality does not seem to be accountable and take responsibility. This has led to the loss of trust between Bergrivier Municipality and other actors, due to the blame getting shifted around. This was expanded on by Bryant:

> Accountability is not there, you don’t know who is accountable. It almost seems that there are so many facets within the municipality and the blame is just getting shifted around. Nobody is standing accountable. All the farmers are so independent and they have realised that they are on their own (Bryant, Piket-bo-berg, personal communication, November 2014).

Wyborn and Bixler (2013) argue that credible, stable and inclusive governance requires strong foundations of legitimacy and accountability. An important aspect was put forward by Vlok in saying that, “the thing is to lead by example, that is the only way you can change people’s mindsets, you must practice what you preach, you must show people, and show that it works” (Vlok, Moutonshoek, personal communication, November 2014). This touches on other themes such as communication, which will be discussed in the next section.

6.3.3 Lack of transparency and communication

Poor communication seems to underlie many of the barriers, and in the case of transparency, the municipality did not seem to adequately communicate what the rates and taxes are used for, and where. This was also found to be the case in gathering data for this project and establishing the rates and taxes for the Bergrivier Municipality. “It’s a long process to get through and find out where rates and taxes are going. They don’t respond at all” (Delle Roux, Small scale, personal communication, November 2014). This lack of communication has led to feelings of mistrust, as the farmers do not know or see where the funds are going. This is highlighted by the acknowledgement of farmers feeling like ‘cash cows’ for the municipality (Liebenberg, Wheat, personal communication, November 2014). Feeling like a ‘cash cow’ was common among the farmers, and was supported by

responses to the follow-up survey. As Duncan said, “the municipality is starting to charge you for a lot of things and I am sure they do good work in the background but one doesn’t always see it” (Duncan, Piket-bo-berg, personal communication, November 2014). Through the follow-up survey (Figure 8) it was agreed that transparency of the municipality is an issue, as it is unclear where rates and taxes go, and this has led to frustrations, hindering the possibilities of a trustful relationship. These are the foundations on which an integrated and coordinated relationship needs to be built on for holistic resource management.

It was evident that the issue of rates and taxes implemented after the introduction of the Land Tax of 1998, as well as the transition from Transitional Local Councils (TLCs) and Transitional Representative Councils (TRepCs) to district municipalities in 2000,has been a sensitive topic, fuelled by many emotions due to the recent court case of JJ Liebenberg. The Constitutional Court dismissed the application of JJ Liebenberg and other rural landowners who contended that certain municipal rates and levies, imposed by the Bergrivier Municipality during the period of 2001 to 2009, were unlawful (Pullen, 2013). The reason was that the implications of this court ruling were seen to possibly have far-reaching financial consequences for other municipalities. The ruling of the Constitutional Court was in favour of the imposed rates and taxes of the Local Government Transition Act for the 2006/2007 to 2008/2009 financial years, and the court found that they complied with the relevant statutory requirements (Pullen, 2013). This requires landowners to contribute the specified rates and taxes to the municipality. The problematic issue is that the farmers do not see a return of benefits for these rates and taxes. The Land Tax of 1998 was to enhance accountability and good governance at the level of local government, and to allow for revenue transfer from central government to municipalities to ensure adequate local support is achieved. Environmental management is an area where the municipality can demonstrate their support for the farmer in achieving a common goal of environmental sustainability.

The relationship between the farmers and the Bergrivier Municipality was unstable during the 2013 court case, but there has been reference to recent improved relations as stated by Devaal: “In the beginning we had a lot of problems with them as the rates we pay are very high for what we receive. It is getting better as they are starting to listen to us” (Devaal, Wheat, personal communication, November 2014). This is a step in the right direction for resource management, as it was acknowledged how important communication is to “get all these guys talking to one another, all the private and government sectors communicating. All these guys have some input. If they don’t talk to one another then the system will collapse” (Van Wyk, Marine Ranger Berg River Estuary, personal

communication, November 2014). As noted by Wyborn and Bixler (2013), successful implementation depends on local support and thus requires communication between planning and action.

6.3.4 Confusion in municipal role

Fleeger and Becker (2008) recognise the need for the municipality to assume more responsibility for resource management at the local scale but this is not possible when actors feel uncomfortable allowing the municipality greater input. This was a mutual feeling amongst the farmers:

> "We decided we don't want to get involved because they (Bergrivier Municipality) don't have a track record of managing resources effectively and then we (farmers) would have to deal with the effects. Unless they can prove that they are capable of handling it, then we are not interested." (Duncan, Piket-bo-berg, personal communication, December 2014)

This coincides with what Fleeger and Becker (2008) found where most participants expressed a very low confidence in the municipality's' ability and commitment to adequately implement, supervise, and monitor projects over time.

The municipality's role in the rural areas was met with a lot of uncertainty and it was expressed by Riette Bryant that "the community is maybe unaware of what the municipal role is" (Bryant, Piket-bo-berg, personal communication, November 2014). This was not limited to one source and extended throughout the interviews. Many of the interviewees battled to understand why the municipality would be involved in resource management. Yet in an interview with Booyes and Du Toit, they were confident that the municipality could play an important role in 'offering knowledge and opening gateways' (Booyes, Bergrivier Municipality and Du Toit, Western Cape Department of Agriculture, personal communication, November 2014). It is evident that there is a need to define and clarify what the particular role is for each party and work towards a shared vision. This involves how they intend to collaborate as well as cooperate which is necessary for a long standing resource management plan such as the nexus (Wyborn and Bixler, 2013).

6.4 Farmers' barriers for holistic and integrated resource management

This section addresses the barriers specific to the farmers' engagement with holistic and integrated resource management. It represents a self reflection of farmers as actors in the resource management network and the barriers they may face.

6.4.1 Farmers' independence

Farmers across the Bergrivier Municipality have expressed their independence and indicated that they are not interested in the municipality (Du Toit, Western Cape Department of Agriculture,

personal communication, November 2014). This independence was supported in the follow-up survey (Table 2). Independence of the farmers from the municipality opens up integration challenges for resource management at the municipal level, as there needs to be a willingness to collaborate and integrate to achieve holistic management (Ljung, 2005; Schusler et al. 2003). An imbalance is starting to emerge due to the dependence of the municipality on the agricultural community for rates and taxes. It was evident in the ruling of the Liebenberg and others v Bergrivier Municipality court case, that the municipality relies on the agricultural sector for a large portion of their rates and taxes to cover the cost of providing municipal services (Pullen, 2013). These services are focused primarily on service delivery within the urban boundary, and the imbalance is that the farmers have not found the support they feel is due to them, and are now sourcing support from the private sector. The farmers were found not to be very supportive of an increased municipal involvement in resource management as the municipality has not proven itself to the farmers in this light. As described by Duncan:

> We decided we don't want to get involved because they (municipality) don't have a track record of managing it effectively and then we would have to deal with the effects. Unless they can prove that they are capable of handling it, then we are not interested. (Piket-bo-berg, personal communication, November 2014)

However, cooperation between these two actors is important for community-led development and for national development objectives (Pasquini and Shearing, 2014).

6.4.2 Approachability and accepting change

The ability of key role players to approach one other is critical in holistic resource management, because it is about different actors engaging with one another (De Villiers et al., 2014; Ferguson et al., 2013). Although farmers call for more support for resource management, it must also be recognised that the farming community can be difficult to engage with from an outside perspective. This statement was agreed to in the follow-up questionnaire (Table 2) – not everyone "'shares the same perspectives and agendas" (Smit, Western Cape Department of Agriculture, personal communication, November 2014). In terms of approaching and connecting with the farmers, Van Wyk described it as being helpful that he is a white middle aged man, who is able to speak Afrikaans and able to integrate easier (Van Wyk, Marine Ranger, personal communication, November 2014). The Bergrivier Municipality is a region of strong family ties, as well as harsh farming conditions, which have led to tight-knit communities with a well-established method of survival. This has constructed the community in a particular way, as "you have to look after the people that you have grown up with and that live on the farm with you. New people coming into the area don't understand the old ways of doing things" (Coetzee, small scale, personal communication, December

2014). This may lead to difficulties when engaging with certain communities, but allows for good insight into history surrounding resources.

The ability of the farming community to be approached links to the concept of accepting change, and how at the beginning of the data analysis, I presumed that accepting change is difficult for farmers. This was disagreed to by the majority of the responses in the follow-up survey (Table 2). Smit acknowledged that "farmers aren't against change, it is just safer to stay with something that is working" (Smit, Moutonshoek, personal communication, December 2014). Allowing and accepting change was agreed to be more a question of how much you can afford to change, and how much change can be afforded (Smit, Western Cape Department of Agriculture, personal communication, November 2014). It was acknowledged in the interviews that there are people who are open to change, and there are people who resist change (Vlok, Moutonshoek, personal communication, November 2014). An important aspect that was put forward by Bryant is that "you can only make a change in peoples' minds if they trust you. When you come at them on an even playing field with the ability to discuss" (Bryant, Piket-bo-berg, personal communication, November 2014). This was reinforced by Delle Roux as she said

> I think the most important thing is for people to start a dialogue, a better communication and an open mindedness. There it should start to open their minds to new ideas. It has to be a holistic approach. You can't just take one resource and try and solve its problems but you need to approach it in a bigger picture. Communication and cooperation is maybe where it could start. But it is a difficult situation. (Delle Roux, Small scale, personal communication, November 2014).

This being said, in some of the interviews the farmers acknowledged that "a farmer is a difficult guy to teach if he doesn't want to learn" (Mouton, Wheat, personal communication, November 2014). Holistic resource management does not depend solely on the municipality's engagement, but requires active positive involvement of the farming community, for better integration and coordination. This may require being more open to people's positions, and a willingness to integrate with other people and their ideas.

6.4.3 Engaging with social-ecological characteristics

The findings were in line with Hoff (2011), in that there is a lack of strong regional institutions for integrated management and governance across the nexus. This is as a result of multiple characteristics of weak governance being present within the Bergriver Municipality (Faysse et al., 2013). These weak relations relate to barriers to municipal engagement for the implementation of holistic resource management. These barriers are summarised in Table 4 with regard to two of the social-ecological characteristics.

Actors	1) Actors limited capacity to interact with others	2a) The actors limited interest in being involved in the management of social-ecological systems	2b) Limited trust between the actors concerned
Bergrivier Municipality	• Limited to urban edge • Municipal resources stretched too far • No conservation appointed person • Lack of support provided through the national system	• Not willing to move out of urban edge • Limited involvement in forums • Environmental person operates like an island inside the municipality • Not engaging enough with other departments	• Lack of trust in the political system • Lack of trust leading to transparency and accountability issues • Poor leadership leading to mistrust • Poor communication leading to mistrust
Agricultural Sector	• Knowledge gaps • History of the region	• Farmers are strongly independent from the municipality and looking to keep their sovereignty • A farmer is a difficult person to teach if he is not willing to learn	• Lack of trust for the municipality

Table 4: Summary of social-ecological system characteristics leading to weak relations between actors

Chapter 7: Factors affecting farmers implementation of the nexus

External drivers (figure 1) are seen to be those macro drivers that influence how farmers respond to the nexus and manage their resources. Many of these external drivers lie outside of the control of the municipality and the farmers, yet they play a vital role in the way in which resources are managed sustainably within the municipality. These external drivers were initially identified through the semi-structured survey and validated through the follow up survey. These differ to the external drivers established by Midgley (2014) (figure 1) and focus on factors affecting farmers implementation of the nexus. The external drivers are viewed in relation to the economic, social and environmental context in which farmers operate.

Section 7.2.5 will examine how these drivers influence the third point for social-ecological characteristics for weak governance. This is important as much of the third characteristic, being difficult and costly implementation of direct control of resources is dependent on the external context, and is largely out of the actors' control.

7.1 Background to the impact of external drivers on the farmers

Table 5 presents the drivers which influence farmers' decisions in implementing resource management. Table 5 shows that there is agreement among farmers that conservation is important but economic short-term goals have taken preference. There is also agreement around the economic drivers being more important than social concerns, where the farmers and municipality are at 'loggerheads' due to the different drivers behind them. As described by Booyes "The problem with agriculture, for example, is that there is no investment in the farm labourers kids and we will always be banging heads with the farmer around these social issues" (Bergrivier Municipality, personal communication, December 2014). The farmers are largely driven by an economic frame of mind whereas the municipality prioritises social needs. This has resulted in conflicting views especially around labor issues.

According to Midgley (2014), external drivers for the nexus framework in the Berg river catchment included the global economic crisis and the volatility of the global energy and food market. These did arise in some of the interviews, as well as the role of politics in impacting on effective resource management and urbanization discussed in 6.3.1. There was little recognition of any impact of globalization and population growth among the farmers in the Bergrivier municipality but the role of conservation against development is an important driver. These will be addressed in 7.2 against the background of economic, social and environmental context.

External drivers	Strongly agree	Agree	Disagree
Conservation vs Development	4	14	0
Economic vs Social	5	9	3
Big Business vs Conservation	0	4	14

Table 5: External drivers specific to the Bergrivier farmers' understanding and implementation of the nexus framework

7.2 Impact of external drivers on the understanding and implementation of nexus thinking at the local level

This section addresses how the external drivers of the nexus framework impact on farmers' implementation of the nexus. The external drivers are discussed within this broader context as Hoff (2011) emphasises that resources do not keep within our political boundaries, and that resource management needs to take external influences into consideration.

7.2.1 Economic vs environmental

Economic resources are a key external driver in the FEWLB nexus system, and it was clear through the interviews that economics are a limiting factor for the farmers, as well as for the municipality, in terms of resource management. Conservation and development are often found to be in competition with each other, as seen in Table 3, as short term economic goals have been given priority over conservation by the farmers.

The farmers in Bergrivier are driven largely by the 'economy of scale' (Coetzee, Wheat, personal communication, November 2014). The economy of scale refers to the constant need to expand and develop in order to match the growing input costs of farming and combat the volatility of the global energy and food markets (Figure 1). The economy of scale influences the trade-offs between conservation and development at the local scale, as access to workable land is a vital resource when trying to expand expansive farming activity. This is described by Morton:

> There is a need to expand the area for more efficiency and the economy stipulates that you cannot stay small and stagnate. You have to expand your business if you want to be more cost effective. (Morton, Wheat, personal communication, November 2014).

There is a conflict between economic development and the environment, as there is a need for a farmer to make the most out of the space he has. This may conflict with a conservation need to protect the natural state of the land and restrict the breakup of more veldt. This was found to be particularly important for the expansive wheat farmers as they feel the need to expand more directly than those involved in intensive agriculture. Intensive agriculture is limited not by land

access, but by water availability, as indicated by Frans Vlok who said, 'there is no use in establishing more land because there is not enough water' (Moutonshoek, personal communication, November 2014). Shifting the conservation focus from land onto water highlights the range of resources that conservation needs to cover. This cannot be achieved through individual actors, but requires a holistic and integrated approach among actors.

7.2.2 Economic vs social

The external influence of the larger national agenda plays a role within the municipality as "it is out of their control (municipality) – they cannot control where they get the money from. Natural resources are tending to get less and less money each year and we are expected to do more" (Wessels and Malherbe, Cape Nature, personal communication, November 2014). As indicated in section 4.2, conservation is a luxury and it only starts when there are available funds. Conservation requires inputs such as funds for monitoring, the protection of land and the clearing of alien vegetation. As a result, funders hold a large amount of power as they are able to stipulate how projects are structured; and this is reflected in the national/municipal relationship. The municipality structure sits projects in accordance with the National Development Plan (NDP) to acquire more funding. Smit acknowledges that "the municipality is tied to the larger national agenda, with a large social focus" (Smit, Western Cape Department of Agriculture, personal communication, November 2014). As the farmers are driven largely by an economic frame of mind, they give priority to the economic drivers with regard to resource management (Table 3). This differs from the municipality, which needs to take the social aspect into consideration, to gain available funding from the national government. The conflict between the social and economic drivers is a source of contestation, as the farmers and municipality are often at 'loggerheads' with each another (Delle Roux, Small scale, personal communication, November 2014). Managing the nexus resources and ensuring environmental sustainability is difficult and costly to implement, especially when the environment comes second in relation to the priority given to social and economic agendas.

An example of this contestation can be seen with regard to the issue of labour. The issue of labour is large and controversial within the Bergrivier Municipality, and contributes to the contestation between the municipality and the farmers which affects the ability for the two to collaborate. The farmers feel the pressure to develop 'economy of scale' and to cut down on input costs. Cutting labour costs is a possible method for achieving this.

> Labour costs are going up and labour is becoming less needed. Mechanisation means fewer but skilled people, but it is a catch 22 because the more unemployed people there are in the

> area the greater the unrest and the crime rates. (Duncan, Piket-bo-berg, personal communication, November 2014).

Between 2000 and 2011, a total of 11277 jobs were lost in the agriculture, forestry and fishing sector which now provides jobs for only 2624 people. If the unemployment trend continues on the farms, it will cut a large portion of the cash flow coming in and "supporting the town through labour wages" (Liebenberg, Wheat, personal communication, November 2014).

7.2.3 Social vs environmental

Due to the national development goals there has been a strong social focus in the municipality agenda, where environmental aspects are often used as the foundation for a larger social agenda.

> The natural resource scope is just used as a pack animal to drive on. The environmental benefits come second to social upliftment or local economic development. The clearing of alien vegetation is just a vehicle. In that sense funders do not realise that the natural resource should be the main focus of the funding rather than job creation. We find ourselves running around trying to count how many jobs we have created instead of doing the job correctly. (Wessels and Malherbe, Cape Nature, personal communication, November 2014)

Although social and ecological drivers can go hand in hand, the municipal social driver takes priority over the environmental, as "in this country there is a need for development and unfortunately conservation and biodiversity will not win" (Smit, Western Cape Department of Agriculture, personal communication, November 2014). This is not to say that the social aspects should not be a focus, but resource management needs to be recognised as its own entity so that it can reach its full potential and benefit the social. The general opinion gathered over the course of the interviews was that the social agenda is distracting attention from the much needed conservation and ecological approach.

7.2.4 Unstable socio-political situation and uncertainty around land tenure

One external driver influencing farmers' willingness to invest in resource management on farms is the unstable socio-political situation in the country, and the uncertainty around land tenure and the draft Land Security Bill 2010, which is still in progress (Page, 2015). As described by Sholtz,

> With the political instability in the country, a farmer will think twice about doing anything that will be an investment into the farm, because the investment into your farm is money that you can use potentially and part of the nest egg that is vulnerable. It is very difficult for farmers, it is fine for multinational corporations as they can cut their losses, but us who live here is a different story (Sholtz, Wheat, personal communication, November 2014).

This illustrates the promotion of larger scale corporate farms for better security from possible changes in land tenure by the government, and a movement away from individual farming. This uncertainty was reinforced by Dewaal, who said,

> I know I have to expand to be competitive in the future, but it is crazy to expand now and with the possible expropriation of land. There is no certainty where land is going or private enterprise is going. (Devaal, Wheat, personal communication, November 2014).

It is evident that the current situation of socio-political instability within the country is influencing resource management on the local scale, against the backdrop of the re-introduction of the Expropriation Bill of 2015. This Bill will empower the state to take ownership and possession of property by notice to the owner without a prior court order confirming the validity of the expropriation (Jeffery, 2015). Expropriated owners are expected to accept whatever compensation is offered by the state. The overarching goal of this Bill is to ensure cheap and easy expropriation of farms, mines, and firms, which are often people's most important assets, and which have been built over a life time (Jeffery, 2015). This is affecting the farmers' sense of security and trust in local and national government, as seen in Moutonhoek (discussed in section 5.2.), where there is a drive for farmers to come together in an association separate from the municipality.

7.2.5 Engaging with social-ecological characteristics

Table 6 summarizes the external drivers in relation to the social-ecological characteristics which have led to weak governance of nexus resources between the agricultural sector and the municipality. What is evident is that much of the third characteristic being difficult and costly implementation of direct control of resources is dependent on the external context, and is largely out of the actors' control. This being said, enabling conscious decision-making which is collaborative and integrative can contribute to solving many of the issues of weak governance over resources.

Actors	3a)Difficult implementation of direct control of nexus resource use	3b)Costly implementation of direct control of nexus resource use
National Influence	• Larger national agenda - environment comes third against priorities of social and economic agendas • National mandate is needing to catch up with the nineteenth Strategic Integrated Plan (SIP 19)	• Conservation is a luxury
Bergrivier Municipality	• Environment comes third against priorities of social and economic agendas • The distraction of the social agenda	• Funding is not going towards natural resources yet expected to do more
Agricultural Sector	• Environment comes third against priorities of social and economic agendas • In pursuit of the economy of scale • Success of the farmer is linked to access to land and available water resources • The socio-political factor through Land Tenure Security Bill.	• Increased focus on the economic aspect impinges on the natural resources

Table 6: Summary of external social-ecological system characteristics leading to weak relations between actors

Chapter 8: Conclusion

In conclusion what is evident is that the farmers' engagement with the nexus framework system depends largely on the scale of agriculture they are undertaking, as well as whether this is intensive or extensive farming. Figures 4 and 5 show that many farmers implement nexus thinking in terms of holistic resource management, as adequate resource management influences their ability to run productive profitable farms. Water is the resource which drives many of the agricultural decisions, but there was recognition of the many important links between different resources and how these support one another. Although the farmers had no prior exposure to nexus thinking, it can be concluded that their understanding, awareness and implementation of holistic resource management is good.

Cape Nature reinforced the importance of the involvement of the local government as a facilitator, and as having power necessary for decision making. The local municipality should theoretically have access to significant technical support, as well as support from the majority of the community. This should provide an adequate basis for resource management implementation (Fleeger and Becker, 2008). Yet through figure 7 it is evident that the Bergrivier Municipality is not well situated in the actors' network for resource management and lacks engagement at the local level. The municipality was described as having weak connectivity to farmers at the local level, as well as weak links through vertical channels to other levels of government. Similar findings emerged in around the Syr Darya River, looking at nexus across transboundary river basins for agricultural production where Hoff (2011) suggests that there is a lack of strong regional institutions for integrated management and governance across the nexus. The Bergrivier municipality recognises the importance of including private land owners for effective environmental management for off reserve conservation (ICLEI, 2010). Both the Bergrivier Municipality and the farmers collectively play an important role in the management of resources within the municipal boundary. They contribute to the larger scale of the Berg and Olifants River catchments.

The municipality is faced with challenges such as an unspecified environmental mandate as well as limited allocated funds for resource management. In light of this, the Bergrivier Municipality has demonstrated itself to be forward thinking and a proactive governing body through a willingness to involve itself in resilience building and improving environmental management within the municipality. They have done this through recognising the need for a dedicated section or staff component to deal with environmental matters (ICLEI, 2010). The Bergrivier Municipality also contributes to a trans and interdisciplinary network comprising academics from the University of Cape Town, government practitioners and local community members who although focus on climate

change has allowed for a spectrum of academic projects around building resilience (Bergrivier Municipality, 2015). The municipality recognises the importance of the agricultural sector in building resilience but it is evident that there are barriers farmers face in accessing support for resource management from the Bergrivier Municipality. This study showed that better integration and coordination is needed between the municipality and the farmers. It is clear that the network structure (Figure 7), perceived by the farmers interviewed, is not offering any link from the municipality to the farmers. This makes it difficult for the municipality to know how to support resource management in collaboration with the agricultural sector. It is essential for the benefit of the municipality, and for better governance of resource management, for the municipality to find ways to integrate better in agricultural networks.

Agricultural resource management in the Bergrivier Municipality was found to have multiple characteristics of weak governance, ranging from barriers for the municipality and barriers for the farmer, as well as influences from and external drivers. The findings highlighted that the municipality might want to reconsider how they engage with the agricultural sector to achieve greater collaboration and communication. Armitage et al. (2009) recognise that successful collaboration depends on trust and tight social networks built through personal relations. From the above discussion, it is evident that the lack of trust between the agricultural sector and the municipality is a limiting factor for the Bergrivier Municipality. It is much easier to grow trust through face-to-face interaction at the local level, and the municipality needs to recognise the value of this. As stressed by Wyborn and Bixler (2013), the interaction within an extended network is foundational to successful social and ecological outcomes.

It is necessary to define and clarify the role of the municipality in supporting resource management. This is important for ensuring that the resources are managed in a more effective manner, and also for developing transparency and accountability (Fleeger and Becker, 2008). As discussed in section 6.3.3, lack of transparency and accountability is a weakness within the Bergrivier Municipality, and has led to limited trust between the actors. The importance of a transparent system was highlighted by Jordan (2008), in arguing that for credible, stable and inclusive governance there are strong requirements for sturdy foundations of legitimacy and accountability.

The governance of agricultural resource management by the municipality and the farmers was set against the backdrop of the external drivers within the nexus framework. These were found to have a large influence on the farmers' understanding and implementation of nexus thinking, in relation to municipal support for resource management. The project tried to address the external economic, social and environmental drivers, in order to capture a holistic perspective of the nexus system. It

was found that the national social mandate significantly influences the ability of the Bergrivier Municipality to provide adequate local support directly for resource management. The challenge of achieving the national mandate must be set against the influence of the external drivers, which differ from the external drivers found by Midgley (2014) at the catchment scale and focused on global drivers. It was found that the farmers were more focused on the local scale influences, which often did not exceed the national scale.

There is clearly a fragmented relationship between the municipality and the agricultural sector, which impacts on the ability to adequately plan and manage for the nexus and for the national goal of achieving a green economy. There are shared responsibilities and clear overlapping interests between the farmers and the municipality, but due to a lack of collaboration and weak governance, the relationship between the farmers and the municipality has been a source of confusion and frustration for both parties involved.

Qualitative methods were used in this study which meant the focus was on depth of individual experiences rather than trying to get a representative sample of all farmers in the municipality. The interviews with the municipality were limited by the lack of people working in the environmental sector, as well as time constraints. A positive aspect to the study is that the samples were geographically well spaced within the Bergrivier Municipality.

This research allows for a local perspective of nexus thinking. As described by Ringler, et al. (2013) comprehensive multi-level assessment of existing institutional arrangements are needed to identify common factors that enable integrated management approaches at global, regional, national, sub-national and local level. Addressing the local level is as important as addressing the global. This study only addressed a small portion of the actors involved in nexus thinking at the local scale and future research could expand the diversity of actors interviewed.

As this study has shown that there is a imbalance of resource representation as water and land are more dominant in the farmers thinking showing that the nexus is not traded off equally. There is a need to ensure a mechanism of monitoring an effective trade-off between the resources, ensuring continual sustainability. The role of policy is important as natural resources become scarcer, how land and water rights are allocated, and who will receive or be bypassed access to these rights will have social and economic affects (Ringler et al., 2013). To enable effective trade-off, it is essential that ‘silo’ thinking and vested interests are abandoned. Creating greater awareness either through research or through policy can contribute to greater collaboration among actors and ensure effective resource management.

What was evident in the study is that managing resources involves the management of people as well as ensuring the environment is taken into consideration. I recommend that the Bergrivier Municipality establish an active environmental sector with the capacity to partake in the local agricultural forums in an attempt to bridge the gap between the municipality and the farmers. Both parties can contribute to better management of resources with greater access to appropriate policy under the right governance.

References

Archer, E., Conrad, J., Munch, Z., Opperman, D., Tadross, M., and Venter, J. (2009). Climate change, groundwater and intensive commercial farming in the semi-arid northern Sandveld, South Africa. *Journal of Integrative Environmental Sciences*, *6*(2), 139–155. doi:10.1080/19438150902916589

Armitage, D.R., Plummer, R., Berkes, F., Arthur, R. I., Charles, A.T., Davidson-Hunt, I. J and Wollenberg, E. K. (2009). Adaptive co-management for social-ecological complexity. *Frontiers in Ecology and the Environment*, 7(2), 95-102. doi:10.1890/070089

Bach, H., Bird, J., Clausen, T. J., Jensen , K.M., Lange, R. B. and Taylor, R, . (2012). *Transboundary River Basin Management: Addressing Water, Energy and Food Security*. Mekong River Commission, Lao *PDR*.

Baker, I. et al., (2012). Local government response to the impacts of climate change: An evaluation of local climate adaptation plans. *Landscape and Urban Planning*, 107(2), pp.127–136. Available at: http://linkinghub.elsevier.com/retrieve/pii/S0169204612001594 [Accessed May 30, 2014].

Bergrivier Municipality. (2013). Bergrivier Local Municipality: Overview Western Cape Government. Retrieved March 12, 2015, from http://www.westerncape.gov.za/your_gov/3

Bergrivier Municipality. (2014a). Bergrivier Municipality. Retrieved March 20, 2015, from http://www.bergmun.org.za/pages/english/home.php

Bergrivier Municipality. (2014b). Bergrivier municipality: Integrated Development Plan Summary. Retrieved March 20, 2015, from http://www.bergmun.org.za/media/files/2014/STRATEGIC SERVICES/Bergrivier IDP 2nd Review 2014 -15 (27 May 2014)Summary.pdf

Bergrivier Municipality. (2015). Bergrivier Municipality Annual Report (Vol. 1). Retrieved from http://www.bergmun.org.za/media/files/2015/STRATEGIC MANAGER/Annual Report Volume 1 - 26 March 2015.pdf

Berkes, F. (2004). Rethinking community-based conservation. *Conservation Biology*, *18*(3), 621–630.

Berkes, F and Folke, C. (2000). *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience* (Vol. 2). Cambridge University Press. Retrieved from http://books.google.com/books?hl=enandlr=andid=XixuNvX2zLwCandpgis=1

Berkes, F., Colding, J,. Folke, C. (2002). *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change*. Cambridge University Press. Retrieved from http://books.google.com/books?hl=enandlr=andid=Y5FnAq9kjxgCandpgis=1

Biggs, R., and Schoon, M. L. (2014). Principles for Building Resilience. *Not Published*.

Bodin, O. and Prell, C . (2011). *Social Networks and Natural Resource Management: Uncovering the Social Fabric of Environmental Governance*. Cambridge University Press. Retrieved from http://books.google.com/books?hl=enandlr=andid=uClj6Heel5gCandpgis=1

Boyd, E. and Folke, C. (2011). *Adapting Institutions: Governance, Complexity and Social-Ecological Resilience* (p. 290). Cambridge University Press. Retrieved from http://books.google.com/books?hl=enandlr=andid=5r-r9ptA6QwCandpgis=1

Brenner, N. (2001). The limits to scale? Methodological reflections on scalar structuration. *Progress in Human Geography*, *25*(4), 591–614. doi:10.1191/030913201682688959

Brown, P. R., Nelson, R., Jacobs, B., Kokic, P., Tracey, J., Ahmed, M., and DeVoil, P. (2010). Enabling natural resource managers to self-assess their adaptive capacity. *Agricultural Systems*, *103*(8), 562–568. doi:10.1016/j.agsy.2010.06.004

Briske. D, Ash. A, and Derner. J, H.L., (2014). Commentary: A critical assessment of the policy endorsement for holistic management. Available at: http://ac.els-cdn.com/S0308521X13001480/1-s2.0-S0308521X13001480-main.pdf?_tid=cda21b94-9bea-11e4-bb77-00000aab0f26&acdnat=1421239530_a281bcc6c9e888001af6d345ba61832f [Accessed January 14, 2015].

Bulkeley, H. (2005). Reconfiguring environmental governance: towards a politics of scale and networks. *Political Geography*, *24*(August), 875–903.

Creswell, J. W. (2003). *Research design: Qualitative, quantitative and mixed methods approaches* (2nd ed.). London: SAGE Publications.

De Villiers,C. A., Esler, K. J., and Knight, A. T. (2014). Social processes promoting the adaptive capacity of rangeland managers to achieve resilience in the Karoo, South Africa. *Journal of Environmental Management*, *146*, 276–83. doi:10.1016/j.jenvman.2014.08.005

Department for Cooperative Governance and Traditional Affairs. (2009). *State of Local Government in South Africa*.

Faysse, N., Errahj, M., Imache, A., Kemmoun, H., and Labbaci, T. (2013). Paving the Way for Social Learning When Governance Is Weak: Supporting Dialogue Between Stakeholders to Face a Groundwater Crisis in Morocco. *Society and Natural Resources*, *27*(3), 249–264. doi:10.1080/08941920.2013.847998

Ferguson, B. G., Diemont, S. A. W., Alfaro-Arguello, R., Martin, J. F., Nahed-Toral, J., Álvarez-Solís, D., and Pinto-Ruíz, R. (2013). Sustainability of holistic and conventional cattle ranching in the seasonally dry tropics of Chiapas, Mexico. *Agricultural Systems*, *120*, 38–48. doi:10.1016/j.agsy.2013.05.005

Fleeger, W. E., and Becker, M. L. (2008). Creating and sustaining community capacity for ecosystem-based management: Is local government the key? *Journal of Environmental Management*, *88*(4), 1396–405. doi:10.1016/j.jenvman.2007.07.018

Folke, C., Carpenter, S. R., Walker, B., Scheffer, M., and Chapin, T. (2010). Resilience Thinking : Integrating Resilience , Adaptability and Transformability. *Ecology and Society*, *15*(4).

Folke, C., Hahn, T., Olsson, P., and Norberg, J. (2005). Adaptive Governance of Social-Ecological Systems. *Annual Review of Environment and Resources*, *30*(1), 441–473. doi:10.1146/annurev.energy.30.050504.144511

Food and Agrigultureal Organisation of the United Nations (FAO). (2010). *"Climate-Smart" Agriculture*. Rome. Retrieved from http://www.fao.org/climate-smart-agriculture/en/

Franzsen, R. C. (2000). Local Government and Property Tax Reform in South Africa. Retrieved June 30, 2015, from http://www.lincolninst.edu/pubs/299_Local-Government-and-Property-Tax-Reform-in-South-Africa

Funtowicz, S., and Ravetz, J. (1999). *Information tools for environmental policy under conditions of complexity* (pp. 1–34). Retrieved from http://www.pedz.uni-mannheim.de/daten/edz-bn/eua/00/envissue09.pdf

Galaz, V. (2014). *Global Environmental Governance, Technology and Politics: The Anthropocene Gap* (p. 208). Edward Elgar Publishing. Retrieved from http://books.google.com/books?hl=enandlr=andid=e-BnAwAAQBAJandpgis=1

Giampietro, M., Richard . J,. Aspinall, S., Diaz-Maurin, G., François, F., Alessandro Flammini, B,. Madrid,T., Cristina, G and Jesús Ramos-Martín, T. (2013). An Innovative Accounting Framework for the Food-Energy-Water Nexus. *Food and Agriculture Organization of the United Nations*, (56), 1–81.

Granit, J., Jägerskog, A., Lindström, A., Björklund, G., Bullock, A., Löfgren, R and Pettigrew, S. (2012). Regional Options for Addressing the Water, Energy and Food Nexus in Central Asia and the Aral Sea Basin. *International Journal of Water Resources Development*, *28*(3), 419–432. doi:10.1080/07900627.2012.684307

Gunderson, L. H. (2000). Ecological resilience- In theory and application. *Annual Review of Ecology and Systematics*, *31*, 425–439.

Hagmann, J., Chuma, E and Murwira, K.(2002). Success Factors in Integrated Natural Resource Management R & D : Lessons from Practice. *Conservation Biology*, 5(2), pp.1–22.

Haiden, S. (2014). *Mapping the governance landscape related to ecosystem-based adaptation in the Bergrivier Municipality , Western Cape , South Africa*. Not Published

Hancock, T. (2015). CSIR report to help guide SA's transition to an agricultural green economy. *Engineering News*. Retrieved from http://www.engineeringnews.co.za/article/csir-report-to-help-guide-sas-transition-to-an-agricultural-green-economy-2015-03-27

Hoff, H. (2011). *Understanding the Nexus. Background Paper for the Bonn2011 Conference: The water, energy and food security nexus. Stockholm Environment Institute, Stockholm* (pp. 1–12).

Holechek, J. L., Gomes, H., Molinar, F., Galt, D., and Valdez, R. (2000). Short-Duration Grazing : The facts in 1999. *Society for Range Management*, *22*(1), 18–22.

Holgate, C.(2007). Factors and Actors in Climate Change Mitigation: A Tale of Two South African Cities. *Local Environment*, 12(5), pp.471–484. Available at: http://www.tandfonline.com/doi/abs/10.1080/13549830701656994 [Accessed July 31, 2014].

Holling, C. S. (2001). Understanding the Complexity of Economic, Ecological, and Social Systems. *Ecosystems*, *4*(5), 390–405. doi:10.1007/s10021-001-0101-5

ICLEI, (2010). Bergrivier Municipality Biodiversity Report. *The Local Action for Biodiversity Programme*.

Jeffery, A. (2015). The Expropriation Bill is back — and it's still unconstitutional. *South African Institute of Race Relations: The Power of Ideas*, *17*(1), 1–12.

Jordan, A., 2008. The governance of sustainable development: taking stock and looking forwards. *Environment and Planning C: Government and Policy*, 26(1), pp.17–33. Available at: http://www.envplan.com/abstract.cgi?id=cav6 [Accessed August 1, 2014].

Källström, H. M., and Ljung, M. (2005). and Sustainability Collaborative Learning. *Royal Swedish Academy of Sciences*, *34*(4), 376–382.

KATZ Commission. (1998). *The Implications of Introducing a Land Tax in South Africa*. Retrieved from http://www.treasury.gov.za/publications/other/katz/8.pdf

Kohlbacher, F. (2006, January 31). The Use of Qualitative Content Analysis in Case Study Research. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*. Retrieved from http://www.qualitative-research.net/index.php/fqs/article/view/75/153

Lawford, R., Bogardi, J., Marx, S., Jain, S., Wostl, C. P., Knüppe, K.,and Meza, F. (2013). Basin perspectives on the Water–Energy–Food Security Nexus. *Current Opinion in Environmental Sustainability*, *5*(6), 607–616. doi:10.1016/j.cosust.2013.11.005

Methner, N. (2014). Conceptualizing horizontal cooperation in regional socio-ecological systems through actor networks and collective action: The case study of the Berg River Catchment. *Not Published*

Midgley, S. (2014). *Berg River FEWLB Nexus System Report*. ACDI.

Muro, M., and Jeffrey, P. (2012). Time to Talk ? How the Structure of Dialog Processes Shapes Stakeholder learning in Participatory water resources management. *Ecology and Society*, *17*(1).

Norberg, J. and Cumming, G. S. (2013). *Complexity Theory for a Sustainable Future* (p. 315). Columbia University Press. Retrieved from http://books.google.com/books?hl=enandlr=andid=RBBOarefKC8Candpgis=1

O'Connor, T. G., Kirkman, P., Kuyler, P., Corcoran, B. (2010). Which grazing management practices are most appropriate for maintaining biodiversity in South African grassland? Retrieved January 14, 2015, from http://www.tandfonline.com/doi/pdf/10.2989/10220119.2010.502646

Ostrom, E. (1990). Governing the commons: The Evolution of Institutions for Collective Action. *Natural Resources*, *32*, 405–417.

Ostrom, E. (2009). A general framework for analyzing sustainability of social-ecological systems. *Science*, *325*(5939), 419–22. doi:10.1126/science.1172133

Page, L. (2015). Post Land Tenure Summit 2014 plan of action | South African Government. *Government of South Africa*. Retrieved July 01, 2015, from http://www.gov.za/post-land-tenure-summit-2014-plan-action

Pasquini, L., Cowling, R. M., and Ziervogel, G. (2013). Facing the heat: Barriers to mainstreaming climate change adaptation in local government in the Western Cape Province, South Africa. *Habitat International*, *40*, 225–232. doi:10.1016/j.habitatint.2013.05.003

Pasquini, L., and Shearing, C. (2014). Municipalities, Politics, and Climate Change: An Example of the Process of Institutionalizing an Environmental Agenda Within Local Government. *The Journal of Environment and Development*, *23*(2), 271–296. doi:10.1177/1070496514525406

Plummer, R., and Armitage, D. (2007). A resilience-based framework for evaluating adaptive co-management: Linking ecology, economics and society in a complex world. *Ecological Economics*, *61*(1), 62–74. doi:10.1016/j.ecolecon.2006.09.025

Pullen, P. (2013). Ruling on Rates and Levies Imposed by Bergriver Municipality | Western Cape Government. *Western Cape Government*. Retrieved July 01, 2015, from https://www.westerncape.gov.za/news/ruling-rates-and-levies-imposed-bergriver-municipality

Republic of South Africa, 2014. South Africa's fifth annual report. In *Convention on Biological Diversity*.

Ringler, C., Bhaduri, A., and Lawford, R. (2013). The nexus across water, energy, land and food (WELF): potential for improved resource use efficiency? *Current Opinion in Environmental Sustainability*, *5*(6), 617–624. doi:10.1016/j.cosust.2013.11.002

Risser, P. G. (2014). Holistic Management Perspective. *American Institute of Biological Sciences*, *35*(7), 414–418.

Ritchey, T. (2013). Wicked Problems. *Swedish Morphological Society*, *2*(1), 1–8.

Saunders, D. a, and Briggs, S. V. (2002). Nature grows in straight lines—or does she? What are the consequences of the mismatch between human-imposed linear boundaries and ecosystem boundaries? An Australian example. *Landscape and Urban Planning*, *61*(2-4), 71–82. doi:10.1016/S0169-2046(02)00103-2

Savory, A. (1999). *Holistic Management: A New Framework for Decision Making* (p. 616). Island Press. Retrieved from http://books.google.com/books?hl=enandlr=andid=MPx0jrDqDo4Candpgis=1

Schusler, T. M., Decker, D. J., and Pfeffer, M. J. (2003). Social Learning for Collaborative Natural Resource Management. *Society and Natural Resources*, *16*(4), 309–326. doi:10.1080/08941920390178874

Schwarz, A.-M., B en e, C., Bennett, G., Boso, D., Hilly, Z., Paul, C., Posala, R., Sibiti, S., Andrew, N. (2011). Vulnerability and resilience of remote rural communities to shocks and global changes: Empirical analysis from Solomon Islands. Retrieved January 14, 2015, from http://ac.els-cdn.com.ezproxy.uct.ac.za/S0959378011000719/1-s2.0-S0959378011000719-main.pdf?_tid=1f7d8804-9be1-11e4-b93c-00000aab0f01andacdnat=1421235372_cb95cbe311c06ffa3a375af3082a70c4

Scott, J. (2012). *Social Network Analysis* (Vol. 19, p. 216). SAGE Publications. Retrieved from https://books.google.com/books?hl=enandlr=andid=MJoIGBfYDGECandpgis=1

Simonsen, R. Biggs, M. Schlüter, M. Schoon, E. Bohensky, G. Cundill, V. Dakos, T. Daw, K. Kotschy, A. Leitch, A. Quinlan, G. Peterson, F. M. (2013). *Applying resilience thinking Seven principles for building resilience in social-ecological systems Content :. Stockholm Resilience Centre* (pp. 1–20).

The Global Water System Project. (2014). International Conference:Sustainability in the water-energy-food nexus. In *Call to Action for implimenting the Water-Energy-Food nexus* (pp. 1–2).

Van Kerkhoff, L. (2014). Knowledge Governance for Sustainable Development: A Critical Analysis of an Emerging Concept. *Challenges in Sustainability*, *1*(2), 82–93. doi:10.12924/cis2013.01020082

Van Zeijl-rozema, A., and Martens, P. (2008). Governance for Sustainable Development : *Sustainable Development*, *421*(October), 410–421.

Von Bormann, T., and Gulati, M. (2014). *The food energy water nexus: Understanding South Africa ' s most urgent sustainability challenge*. *Energy Economist* (pp. 1–5). South Africa.

Waddell, S. and D. B. (1997). Fostering Intersectoral Partnering : A Guide to Promoting Cooperation Among Government , Business , and Civil Society Actors, *13*(3).

Walker, B., and Salt, D. (2012a). *Resilience Practice: Building Capacity to Absorb Disturbance and Maintain Function* (p. 240). Island Press. Retrieved from http://books.google.com/books?hl=enandlr=andid=LAEBev5Ljr8Candpgis=1

Walker, B., and Salt, D. (2012b). *Resilience Thinking: Sustaining Ecosystems and People in a Changing World* (p. 192). Island Press. Retrieved from http://books.google.com/books?hl=enandlr=andid=NFqFbXYbjLECandpgis=1

Winkler, H., Howells, M., and Baumert, K. (2007). Sustainable development policies and measures: institutional issues and electrical efficiency in South Africa. *Climate Policy*, *7*(3), 212–229. doi:10.1080/14693062.2007.9685650

World Weather. (2012). Bergrivier, South Africa Average Precipitation and Rainfall days. Retrieved June 30, 2015, from http://www.worldweatheronline.com/Bergrivier-weather-averages/Western-Cape/ZA.aspx

Wyborn, C., and Bixler, R. P. (2013). Collaboration and nested environmental governance: Scale dependency, scale framing, and cross-scale interactions in collaborative conservation. *Journal of Environmental Management*, *123*, 58–67. doi:10.1016/j.jenvman.2013.03.014

Yin, R. K. (2013). *Case Study Research: Design and Methods* (5th ed., Vol. 5). London: SAGE Publications.

Ziervogel, G. & Parnell, S., (2014). Tackling barriers to Climate Change adaptation in South African Coastal Cities. In B. C. Glavovic & G. P. Smith, eds. *Adapting to Climate Change*. Dordrecht: Springer Netherlands, pp. 57–73. Available at: http://link.springer.com/10.1007/978-94-017-8631-7 [Accessed October 10, 2014].

9. Appendices

9.1. Appendix 1: Summary of interviews

People in authority positions

Name	Organisation	Date	Length	Language	Race/Gender	Age	Degree
Ewald Van Wyk	Berg river estuary forum	27 November 2014	40 min	English	White male	50	Yes
Leandi Wessels and Danny Malherbe	Cape Nature	17 November 2014	1 hr	English	White male and female	30-40	Yes
Jan Smit	Department of Agriculture	17 November 2014	1 hr 6 min	Afrikaans/English	White male	+-50	Yes
Eric Du Toit	Department of agriculture	28 November 2014	1 hr	Afrikaans/English	Coloured male	30-40	Yes
Stanton Booyes	Bergrivier Municipality-agri dept	28 November 2014	1hr	Afrikaans/English	Coloured male	30-40	Yes

Piket-bo-berg Mountain

Name	Date	Length	language	Race/Gen	Age	Degree	No. Years on	Intensive/ extensive	Manager/o

				der			the farm	and Size of farm	wner
Dedre Eigelaar	27 November 2014	48 min	English/Afrikaans	Female/white	+-50	Yes	Family history	Intensive and 25ha	owner
Rietta Bryant	1 December 2014	52 min	English	White female	+-40	Yes	Brought kids up on the farm	Intensive and 22ha	owner
Johan Bekker	1 December 2014	1 hr	English	White male	+-30	Yes	3	Intensive and 75ha under production	manager
Rob and Mary Duncan	1 December 2014	1 hr 15 min	English	White couple	40-50	yes	11	Intensive and 182ha, 20ha proteas, 18ha fruit	owner

Moutonshoek Valley

Name	Date	Length	Language	Race/Gender	Age	Degree	No. Years on farm	Intensive/ Extensive and Size of farm	Manager/owner
Alex Romero	2 December 2014	42min	English	White male	50	Yes	3	Mix of intensive and extensive 2 farms 890ha 850ha	Manager
Low Smit	2 December 2014	47 min	Afrikaans/English	White male	27	Yes	5 generations	Mix of intensive and extensive 2000ha 3 farms	Manager
Jacobus Smit	2 December 2014	1hr 56 min	English/Afrikaans	White male	+-60	Yes	Entire life	Intensive 350ha	Owner
Bennie and Jakkie Van Der Merwe	2 December 2014	53 min	English	White couple	40-50	Yes	20	Mix of intensive and extensive 950ha	Owner as well as manager

								2 farms	
Frans Vlok	27 November 2014	1hr 4min	Afrikaans/English	White male	+-60	Yes	10	Mix of intensive and extensive 650ha	Owner

Small scale farmers

Name	Date	Length	Language	Race/Gender	Age	Degree	No.years on farm	Intensive/ Extensive and Size of farm	Manager/owner/land leased
Ian Schaffers	1 December 2014	24 min	English/ Afrikaans	Coloured male	+-30	Yes	7	Intensive and 10ha	Land leased
Kirsten Delle Roux	27 November 2014	33min	English	White couple	+-30	Yes	4	5ha	Land leased
Patrick Carter	17 November 2014	19 min	English	White male	59	Yes	5	50 ha	Manager
Johan Hanekom	17 November 2014	16 min	Afrikaans/English	White male	28	Yes	2	50 ha	Manager
Johannes Coetzee	3 December 2014	50min	Afrikaans/English	White couple	60-70	No	Entire life	50ha	Owner

Wheat fields

Name	Date	Length	Language	Race/Gender	Age	Degree	No. Years on farm	Intensive/ extensive and Size of farm	Manager/owner
Niekie Mouton	28 November 2014	48 min	Afrikaans/ English	White male	+60	Yes	30	Extensive and 4000ha 4 farms Unite of two farms in collaboration with brother	owner
Bennie Liebenberg	28 November 2014	1 hr	Afrikaans	White male	+-60	Yes		Extensive and 310ha	Owner
Hugo Devaal	28 November 2014	22min	Afrikaans/English	White male	40-50	Yes	27	Extensive and 600ha	Owner
Jurgens Coetzee	27 November 2014	37 min	Afrikaans/English	White male	60	Yes	8th generation	Extensive and 2500ha Rent 1500ha	Owner
Maret Scholts	27 November 2014	53min	English/Afrikaans	White female	20-30	Yes	Family history	Extensive and 75oha in total Two farms	Manager and owner

9.2. Appendix 2: Semi-structured Interview

Section 1

Unpacking the nexus

1. How does your agricultural business **depend** (either directly or indirectly) on natural resources within the Bergrivier Municipality?
2. Do you think a holistic way of managing resources is **important**?
3. In the box below please indicate using high/medium/low the level of **influence** you, as an agriculturalist can exert over the particular resource

	Level of control over resource	Level of engagement with resource	Level of impact on resource
1. Water			
2. Energy			
3. Food			
4. Land			
5. Biodiversity			

4. How does agriculture **impact** on FWEBL nexus resource? (i.e. are you central/peripheral to its management/ resource use)?
5. Have you **consciously/unconsciously** managed resources in a holistic manner in the past? If so, please provide an example
6. Is it in your **capacity** to incorporate all pillars of the nexus (water, energy, land, food and biodiversity) into your local scale resource management?

Section 2

1. Which government agencies, organization or industry, in your opinion, has the largest **influence** on the System in terms of resource management? In what way/s?
2. When looking at the larger scale, who does the **responsibility** for better resource management lie with?

-do you see it as an individual problem for each sector or the need for cross sector integration?

3. Have you found yourself working with **others/across boundaries/sectors** for better resource management at the local scale? (reliance of neighbours or other sectors) Please provide example
4. Do you experience any **interdependencies (or conflict)** with other sectors such as water, land, or biodiversity conservation as a result of a shared use of resources?

- Does it influence your resource management if your neighbour is a different type of agriculturalist or different business model and therefore different priorities?

5. Do you keep yourself informed about going ons in the community and region?

Section 3

1. a)What engagement do you **currently have** with the municipality that helps to manage resources

   b)What engagement is **needed** with the municipality

   -same for Province and National
2. Do you feel supported by the local government?
3. Are there any **significant policies** in place at the moment to guide resource management?
4. How would you **describe your relationship** with the municipality over resource management?
5. What are some of the **challenges** of integrated resource management, you face or may face on a local scale?
6. What hinders communication in this area?
7. Do you feel a sense of belonging in this community?

Section 4

1. Is the management of your agri resources **driven** by economic, social or economic priorities? Please describe
2. How do you think **climate, the economy and the socio political system** will effect holistic resource management over the next 30 years?
   - Which do you think will be the most influential for you?
3. With **oncoming pressures** on resources, do you see a need for improved holistic resource management?
4. In your opinion, what are the **most important** points of stress to manage now and how do you think these should be managed?
5. What other **major constraints or uncertainties** that we haven't discussed so far do you feel might limit you in what you can achieve in your current and/or future operations in the region?
6. Given the opportunity, would you like to **be more pro active** in resource management?
7. Do you feel nexus thinking (greater holistic approach) may make **a positive** contribution to better management of resources?

9.3. Appendix 3: Follow up questionnaire

These statements come from the 25 Interviews with farmers and other stakeholder in the Bergrivier Municipality during 2014/2015. The intention is to see if there is agreement to the emerging findings or differing perceptions as to these how strongly these statements hold.

Name (if happy to be named, else just state role such as small-scale farmer):

Resource	Strongly agree	Agree	Disagree	Comments
Water is the most critical resource on which farming decisions are made within the Bergrivier Municipality				
System functions				
Conservation vs development: conservation is important but economic short-term goals have taken preference				
Economic vs social : Farmers and municipality are at logger heads due to the different drivers behind them. The farmers are largely driven by an economic frame of mind whereas the municipality is largely social. This has resulted in conflicting views especially played out with labour issues.				
Big Business vs Conservation The incentives the municipality provide favour the larger farms				
Structure				
Independence: Farmers are very independent from the municipality				
Urban vs rural: Significant engagement from the Bergrivier Municipality stops at the urban edge.				
Missing links:				

There are missing links between the municipality and the rural areas, partly because the municipality do not have the enough people in the field with adequate knowledge and experience.				
Barriers				
Accountability: The municipality does not seem to stand accountable and take responsibility				
Leadership: The farmers are not seeing any leadership displayed from the municipality				
Trust: There is limited trust between the municipality and the farmers				
Transparency: It has been unclear where rates and taxes paid by farmers go and this has led to frustrations				
Engagement				
Approachability The farming community can be a difficult community to integrate from an outside perspective				
Accepting change has been difficult for farmers which often makes it difficult for them to engage with new mindsets				
Communication: The municipality has not communicated in an open manner with the farmers				

Thank you for your participation. Please contact Sarah Hulley, shulley10@gmail.com/072 2708935, if you have further questions or comment